



Interagency Collaboration on Alternatively Fueled Vehicle Infrastructure

Final Report

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December 2017

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Executive Summary

With the increased availability of and attention on alternative fuel vehicles (AFVs) in recent years, the North Jersey Transportation Planning Authority (NJTPA) is supporting regional deployment of these vehicles and related infrastructure in both the consumer and fleet markets. The NJTPA region stands to benefit greatly from all that AFVs have to offer. This includes reduced fuel costs, savings on maintenance, attractive new technology, support of domestic industries, and promotion of improved air quality and environmental sustainability.

Community readiness planning efforts are part of a broader strategy to shift away from reliance on conventional vehicles and fuels to AFVs. As such, the NJTPA partnered with three pilot municipalities – Montclair Township in Essex County, the Town of Secaucus in Hudson County, and Woodbridge Township in Middlesex County – to develop local readiness plans that identify barriers and provide recommendations to support widespread adoption of AFVs. The effort also included a literature review, targeted stakeholder outreach, and the development of an AFV readiness guidebook for all municipalities in the NJTPA region.

This report provides an overview of each project task (literature review, stakeholder engagement, readiness plans, and guidebook), including the approach, key findings or results, challenges, and opportunities. The final versions of each project deliverable are included in the appendices.

Several reoccurring themes emerged and are highlighted in the deliverables, including the demonstrated value of local readiness planning, the importance of active stakeholder engagement, the significant opportunity for AFV deployment in the NJTPA region in the near term future, the unique considerations for each fuel type (e.g., the consumer focus for PEVs and fleet focus for NGVs), and the challenge of maintaining momentum around AFV readiness planning.

The products of this study are:

- A literature review on AFV readiness from across the United States and internationally;
- AFV readiness plans for Montclair Township, the Town of Secaucus, and Woodbridge Township;
- A guidebook to help any municipality develop an AFV readiness plan; and
- A final report, summarizing all work conducted.

Key Findings

Major conclusions, findings, and lessons from this study are as follows:

- **Stakeholder engagement and partnerships are critical to effective AFV infrastructure planning and implementation.** Deploying AFVs is a complex process involving a variety of stakeholders. Stakeholders include individuals and organizations that will be involved in implementing readiness actions, as well as those that can provide perspective. Gathering input from stakeholders and building partnerships are important steps toward effective goal setting,

Fuels of Focus

To align with the New Jersey Energy Master Plan, the municipal readiness planning efforts, including the literature review, focused on plug-in electric vehicles (PEVs) and natural gas vehicles (NGVs). Note that both plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) make up the broader PEV category. For the guidebook, the NJTPA and the project team also considered propane, hydrogen, and biofuels.

comprehensive readiness planning, and successful implementation. It is necessary to engage stakeholders early and on an ongoing basis.

- **Readiness planning should focus on local needs, priorities, and challenges.** Effective readiness planning includes identifying specific barriers and challenges to local AFV use. Much of the readiness planning work done nationwide has had a state or regional focus, with very few truly local plans. While it is important to consider and apply lessons learned from early AFV readiness planning efforts in California and other areas, the most relevant and impactful recommendations are rooted in an understanding of the local conditions and opportunities.
- **Municipalities should prioritize efforts to support infrastructure development based on demand.** Demand analyses can provide municipalities with a better understanding of how much demand exists for PEV charging infrastructure in residential (single-family and multi-family), workplace, and public settings. While residential demand is primarily driven by market dynamics, municipalities can have a greater impact on increasing and meeting workplace and public charging demand through targeted education, outreach, and partnerships.
- **Multi-unit dwellings (MUDs) present significant challenges and opportunities for widespread PEV use.** An MUD resident typically does not have access to their own charging station given the lack of a dedicated garage or parking space. Interest in providing charging stations at MUDs is largely driven by tenant demand. Enabling PEV charging for MUD residents could be a significant opportunity to increase PEV use given that parts of the NJTPA region are densely populated urban areas. Effectively addressing the issue requires coordination with MUD developers, managers, home owners associations, and residents.
- **Municipal policy changes are among critical implementation activities leading to increased AFV use.** Municipalities must be willing to consider and eventually execute changes to ordinances, codes, and internal practices in order to address regulatory and other barriers. Activities could include the following:
 - Include PEV charging stations as a permitted accessory use in specified zoning districts.
 - Encourage or require that new developments include PEV charging stations or the electrical wiring to install them later.
 - Assess the municipal fleet and develop a fleet management plan that includes AFVs.
- **PEV charging infrastructure will be the focus of increased investment in the near-term.** Building on financial incentives available from New Jersey state agencies, funding from private entities such as Electrify America, as well as utilities, will result in more charging stations in the NJTPA region. Most infrastructure will be intended for public charging, with higher powered chargers placed along long-distance travel corridors and a mix of charging levels in metropolitan areas. There are also efforts underway to incorporate PEVs into rideshare programs and other fleets, meaning more people will be exposed to the technology.

Literature Review

The project team conducted a literature review of AFV readiness from across the United States and internationally. The literature review was intended to inform the municipal readiness planning activities by identifying case studies, lessons learned, best practices, and information gaps relevant to AFV infrastructure planning in the existing literature.

Approach

The project team initially compiled a list of documents to include in the review based on a library of readiness planning documentation from previous efforts, internet searches, and input from local stakeholders. The project team identified and reviewed 81 documents related to PEV and NGV readiness and implementation.

The project team prioritized documents that:

- **Were recently published.** All publications included were released after 2009, and approximately half were published since 2014.
- **Were locally relevant.** Over a quarter of publications included focused on the Mid-Atlantic or Northeast regions.
- **Summarized previous efforts and provided lessons learned.**
- **Focused on PEVs and NGVs.**

The project team categorized each of the documents and then developed an Excel spreadsheet to guide the review, including a document overview as well as a summary of how (if at all) the document addressed each of these items:

- **Key challenges and benefits evaluation**, including environmental, economic, and energy security.
- **Techniques for market assessment**, including niche applications and infrastructure siting visions and goals.
- **Regulatory frameworks**, including zoning, parking codes, permitting, building codes, incentives, and utility considerations.
- **Strategies for advancement**, including key partnerships, corridor planning, procurement practices, education and training, and other strategies.

Key Findings

The literature review, provided in Appendix B, includes readiness planning best practices for PEVs and NGVs, as well as key findings for AFV readiness planning in the NJTPA region overall. The most salient takeaways focus on the value of addressing the following topics:

- **Regulatory elements, including codes, standards, permitting, and parking.** The literature encourages municipalities to examine their building, electrical, and zoning codes for opportunities to standardize definitions related to AFVs, encourage PEV charging infrastructure in new construction, add charging infrastructure as a permitted use in various zones, require charging infrastructure for specific land use developments, and adopt infrastructure design standards. The permitting process should be clear, streamlined, and accessible. Lastly, parking rules should specify design criteria for PEV parking spaces and establish associated regulations and enforcement policies that are clear and consistent.

- **Incentives, financial and otherwise.** Municipalities may be able to leverage utility, state, and federal incentives and programs for AFV infrastructure development. In addition, municipalities can consider providing their own incentives, such as grants for vehicles or equipment, high-occupancy vehicle lane and time-of-day driving restrictions, parking fee exemptions, or “head of the line” incentive programs.
- **Purposeful and inclusive infrastructure planning.** One of the central challenges of AFV deployment is the accessibility of adequate fueling infrastructure to support vehicles, particularly for PEVs. PEV readiness planning should involve an analytical exercise to identify charging demand in residential, multi-family, workplace, and public settings. This analysis should take into account the logistics of infrastructure installation (e.g., proximity to electrical service) and impacts on the grid. Natural gas infrastructure siting should focus on fleet deployment interest and fuel supply.
- **Clarity, collaboration, and consistency in communication.** The literature identifies several opportunities for municipal partnerships, including with utilities, other jurisdictions, and dealerships. For example, municipalities should collaborate to ensure AFV signage is consistent.
- **Opportunities for training and education, including municipal and fleet decision-makers and first responders.** Audience-specific training and outreach is a critical component of increased AFV deployment, and ensuring safety once the vehicles are on the road. For example, consumer education around PEVs may ease concerns about charging station availability. Similar educational opportunities may exist with fleets considering AFVs. Additionally, electrician and inspector training will ensure low stress and consistently high-quality charging station installations. Lastly, first responders, drivers, and fleet managers may benefit from safety training.

The project team identified the following overarching lessons learned, based on the existing body of literature:

- **Stakeholder engagement and partnerships are critical.** Deploying PEVs and NGVs is a complex process involving a variety of players, including, but not limited to, permitting authorities, transportation planners, parking authorities, business owners, fleet managers, consumers, and local nonprofits. It is critical to engage these groups early to gather input into the readiness planning effort, and to follow up with any outcomes and to address any education and training needs. The literature includes a variety of methodologies for stakeholder engagement, including interviews, focus groups, and surveys.
- **The literature lacks NGV readiness planning guidance.** For NGV planning, local governments rely on industry documents rather than actual municipal planning documentation. The focus of NGV readiness planning is on fleets, which includes infrastructure planning, education and outreach, and other efforts, but does not typically involve as many stakeholders. This differs from a consumer focus for PEVs, which makes them more mainstream. As a result, PEV readiness planning has more widespread impacts on a variety of stakeholders (e.g., employers, residential landlords) not typically involved in fleet vehicle deployment and infrastructure development.

- **Readiness planning should focus on local challenges for PEV and NGV deployment.** While the national, and even broad regional, literature is robust – particularly for PEV readiness – effective planning should focus on identifying specific barriers and challenges to adoption in the applicable locality for it to be most impactful. For example, in cold weather climates, PEV charger location siting needs to account for snow removal, which is not relevant for warmer climates. At the time of the literature review, all of the publicly-available readiness plans were conducted at the state or regional level. Therefore, the NJTPA’s commitment to engaging with local municipalities is particularly innovative.
- **The literature lacks evidence-based approaches.** While research suggests readiness planning is effective (see below), a closer look at the literature shows that there are few best practices in this area. There are certainly examples and case studies available for review; however, there is little quantifiable evidence or metric tracking around specific approaches.
- **Stakeholders would benefit from living documents and resources.** The AFV industry, consumer and fleet markets, and political climate are always changing. Municipal planners and other stakeholders would benefit from a living central resource allowing them to share the most recent techniques, methodologies, and templates within the region. Interactive toolkits and social media tools, such as blogs with guest contributors, can also be a creative way to ensure active engagement.
- **Readiness planning is important for increasing vehicle and infrastructure use.** The success of short- and long-term transportation goals (e.g., emissions and petroleum reduction, public health improvements) will depend on the near-term deployment of AFVs and fueling infrastructure, and the associated planning required by stakeholders. Researchers have demonstrated a correlation between higher PEV deployments and infrastructure utilization and areas that undertook readiness planning efforts.

Stakeholder Engagement

Stakeholders include individuals and organizations that will be involved in implementing readiness actions, as well as those that can provide perspective based on experience, area of expertise, and complimentary efforts. Stakeholder feedback was a critical component of the entire project. Municipal stakeholder input helped to ensure each readiness plan was developed in a way that was tailored to the particular goals, interests, and concerns of the community. The project team also actively engaged stakeholders and sought input by providing progress updates and educating stakeholders on AFVs, infrastructure, and relevant topics. The project team received comments and feedback throughout the project timeframe, though the most substantive input was provided at Stakeholder Advisory Committee (SAC) meetings.

Municipal Stakeholder Advisory Committees (SACs)

In coordination with the NJTPA, the project team facilitated SACs within each of the three pilot communities. Engaging stakeholders was important to gain an improved understanding of the local demand and barriers for PEVs and NGVs, to identify potential high opportunity charging infrastructure locations, and generally to foster a sense of ownership of implementation activities. The project team worked with the municipal stakeholders to both educate them regarding the advancement of AFV technology as well as solicit guidance for the development of the local municipal readiness plans.

The project team and the NJTPA provided high level guidance and encouragement to the local municipalities so that the municipalities could identify and invite stakeholders to be part of the SACs. See Appendix A for the list of participants, though attendance at each meeting varied.

The project team held three meetings of each of the three municipal SACs during the project's timeline.

- **SAC Meeting 1, September 2016.** Following a presentation on the basics of PEVs and NGVs, as well as the various elements of the project, the goal of the initial SAC meetings was to gather input on stakeholder perception of the municipality's state of readiness, barriers (real and perceived), opportunities, and potential solutions. Discussion included ideas for increasing the level of participation and reach of the SACs.
- **SAC Meeting 2, March 2017.** The focus of the second round of SAC meetings was interactive discussion with stakeholders to draw input on a series of strategies that could be included in the readiness plan as well as help determine priority areas. The priorities, opportunities, and challenges identified and discussed during these meetings helped to determine the recommendations presented in the readiness plans.
- **SAC Meeting 3, September 2017.** During the third round of SAC meetings, the project team presented findings that were included in the draft readiness plans and received feedback from the participants on specific aspects, including high opportunity zones. The project team also presented an outline of the guidebook.

Technical Advisory Committee (TAC)

The project team helped to coordinate and facilitate three meetings of a broad-based TAC, which the NJTPA established with input from the project team. See Appendix A for a full list of TAC members. TAC meetings provided a forum for exchange of ideas related to the municipal readiness plans, the AFV guidebook, and other related information. Agenda items included guidance on the project, coordination and input on stakeholder engagement, and high-level review and input on draft deliverables. The project team prepared the TAC meeting agendas, notes, and presentation materials, and distributed them to participants in coordination with the NJTPA.

A summary of each TAC meeting is as follows:

- **TAC Meeting 1, November 1, 2016.** The project team introduced TAC members to the project, discussed the goals of the project and of the committee, and established a dialogue to inform the project. TAC participants provided brief overviews of the relevant activities they are involved in. It was immediately clear there are several complementary efforts related to AFVs and AFV infrastructure underway or in the works across the state. Challenges and barriers discussed included the following:
 - There is a lack of actual data around the business case for PEV chargers
 - The cost effectiveness, or return on investment, for installation of workplace chargers and public chargers is not well understood.
 - Gas quality can be an inhibiting factor for fleet use of natural gas within the PSE&G territory due to cold weather peak injection of propane into the natural gas distribution system.
 - The high number of multi-unit dwellings (MUDs) throughout the region will create challenges for residential charging at these developments.
- **TAC Meeting 2, May 11, 2017.** The project team briefed TAC members on the status of the readiness planning effort, the results of the interactive SAC meetings, plans for the guidebook, and other project activities. TAC members exchanged information on several relevant issues including the following:
 - There are notable challenges involved in providing PEV charging station access at MUDs.
 - The Transportation Management Associations (TMAs) need to be involved in outreach efforts, leveraging relationships with employers/workplaces.
 - Education and outreach messages should be crafted with the target audience in mind.. For example, elected officials and policy makers will want to see the value proposition for infrastructure development.
- **TAC Meeting 3, October 17, 2017.** The project team opened the meeting by highlighting the continued growth of the AFV market in New Jersey, particularly for PEVs. Since the TAC first met in November 2016, the number of PEVs registered in the state increased by one-third. The project team summarized the municipal readiness plans and focused on an overview of the guidebook. As became typical of TAC meetings, participants also shared updates on relevant activities, especially those involving PEVs and charging infrastructure.

The project team held several additional follow-up conversations with various individual members of the TAC regarding specific issues related to their organization or areas of expertise over the course of the study. Periodic discussions involved the following individuals and topics:

- **Kenny Esser, Jr., PSE&G**
 - PSE&G’s workplace charging program. PSE&G provided free charging stations at customer locations across their service territory.
 - PSE&G’s employee workplace charging program. PSE&G is providing charging stations at several PSE&G locations across the state for employee use.
 - The progress PSE&G is making in incorporating PEVs into their own fleet of vehicles.
 - The rate filing that PSE&G was in the process of developing for PEVs and potentially NGVs for submittal to the New Jersey Board of Public Utilities (NJBPU).
- **Peg Hanna, New Jersey Department of Environmental Protection (NJDEP)**
 - Progress made on the joint NJDEP and NJBPU “It Pays to Charge” program. The NJDEP is providing rebates to workplaces for charging station installation.
 - AFV registration data. The NJDEP provided updated vehicle registration data, including PEVs, NGVs, and hybrid vehicles, throughout the study period.
 - Development of the state’s mitigation plan under the Volkswagen Settlement Environmental Mitigation Trust.
- **Mike Hornsby and Mike Winka, New Jersey Board of Public Utilities (NJBPU)**
 - Discussions regarding a pending NJBPU rebate program for NGVs.
 - Progress made on the joint NJDEP and NJBPU “It Pays to Charge” program.
- **Mark Warner and Pam Frank, ChargeVC**
 - The roadmap that ChargeVC is developing for moving the state toward increased transportation electrification.
 - The detailed study that ChargeVC is conducting regarding the costs and benefits of PEVs and their potential impact on electricity rates and on the distribution system.

Additional Stakeholder Collaboration

In addition to the TAC and SAC meetings, the project team and the NJTPA participated in a number of other outreach activities. These activities aimed to solicit input from individuals or groups that had information, expertise, or direct experience in dealing with the issues relating to installing PEV charging infrastructure at MUDs. Sources of specific suggestions included SAC members, TAC members, and the project team’s research and networks.

The project team held several calls with representatives of the **New Jersey Apartment Association (NJAA)**. The NJAA is a nonprofit association representing owners, builders, developers and managers of over 200,000 apartment homes across the state. With this unique perspective, the project team was able to gain valuable insight regarding installation and use of PEV charging stations as MUDs. In addition to information exchanged during telephone conversations, the project team prepared a brief survey,

which the NJAA distributed to its members. While the response rate was relatively low, the feedback was useful in informing the project team's efforts and confirmed that MUD interest in PEV charging is driven by tenant demand.

Other outreach involved representatives of individual MUD developers and property managers, including the Pinnacle Group, Hartz Mountain, and Atlantic Realty. These discussions primarily confirmed the results of the NJAA survey, that interest in providing charging stations at MUDs is largely driven by tenant demand. At luxury buildings and higher end developments, the demographics are such that the developers are seeing interest and are seeking to facilitate residents' PEV use. In other areas, particularly MUDs serving lower income or elderly populations, there is not as much interest, therefore building managers are not taking steps to explore and incorporate PEV charging infrastructure.

The project team incorporated the MUD stakeholder discussions and conclusions summarized above into the readiness plans as well as the guidebook. Enabling PEV charging for MUD residents is a key challenge that is not unique to New Jersey, but could be a significant opportunity to increase PEV use given that parts of the NJTPA region are densely populated urban areas. Stakeholders and municipalities should continue to monitor MUD charging work being done in the San Diego area, Minnesota, and others, and make resources available to MUD developers, managers, boards, and residents.

The **New Jersey Clean Cities Coalition** (NJCCC) participated in the project as a stakeholder and a technical resource. As a coalition formally designated by the U.S. Department of Energy, the NJCCC is a source of nonbiased information about a variety of alternative fuels and advanced vehicle technologies. The NJCCC consists of numerous public and private stakeholders from across the state whose relationships and varying perspectives regarding PEVs, NGVs, and other fuels were informative to this study and its results. The NJCCC will also serve as a technical assistance resource for pilot municipalities and other New Jersey municipalities as they pursue and implement AFV readiness plans.

Readiness Plans

Building upon and informed by the literature review, and with input from the stakeholder engagement process, the three municipal readiness plans were drafted. The objective of the readiness plan development was to identify, prioritize, and guide the execution of actions within the next 10 years in order to unlock the potential of transportation electrification and NGV deployment as a sustainability initiative. More specifically, the AFV readiness plans lay out the path to make each community “AFV ready” by identifying the barriers to widespread deployment of infrastructure and vehicles, and outlining recommended actions that will reduce and resolve these barriers. The majority of readiness planning efforts to date have focused at the regional or state level, not the municipal level.

Approach

While there is some redundancy, each of the three readiness plans focuses on the individual municipality, taking into account the unique attributes that influence AFV adoption in that community and provides customized insights and recommendations. The plans were designed to help decision-makers identify and prioritize the most effective ways to catalyze AFV deployment, specifically for PEVs and NGVs.

The project team approached the readiness planning process through the following key activities:

- **Stakeholder engagement:** Gathering input from stakeholders and building partnerships are important steps toward effective goal setting, comprehensive readiness planning, and successful implementation. Municipal staff provided valuable background data and critical review throughout the project. SAC meetings helped to articulate each municipality’s vision for AFV readiness and gather input about the challenges, barriers, and opportunities related to AFV readiness. See the Stakeholder Engagement section for more information.
- **Regulatory review:** The project team, with input and information from municipal staff, researched and reviewed existing municipal plans as they relate to facilitating AFV infrastructure. The team also reviewed local zoning regulations and assessed their potential to impact installation of PEV charging infrastructure; regulations addressed include those relating to parking, site plans and site development; and environmental performance standards (noise, air quality, etc.). Finally, the team compiled a summary of financial incentives and funding sources for PEVs, NGVs, and their fueling infrastructure.
- **Data collection and analysis:** The project team collected and compiled numerous datasets at the municipal and regional level to inform the analysis and recommendations. The analyses focused on the following:
 - PEV ownership forecasts over a planning horizon from 2016-2030. Projections were developed based on varying assumptions around three PEV adoption scenarios – low, high, and greenhouse gas (GHG) stretch. The GHG stretch scenario assumes that PEV adoption rates will be slightly lower than the NJTPA Regional GHG Mitigation Plan, with a 50 percent market share by 2040
 - Charging infrastructure demand analysis, which was conducted to broadly identify the areas within each community that are most likely to see demand for charging infrastructure. It complemented the vehicle adoption forecasting, and introduced an important geographic component to guide municipal policy and investments to meet

the increased demand for charging infrastructure. Four separate analyses and resulting maps were included in the plans to correlate with the different charging types: residential, MUD, workplace, and opportunity.

- **Recommendation development:** The three steps above helped to shape the recommendations for PEV and NGV readiness in each plan.

Key Findings and Results

Readiness plans for all three municipalities are provided in Appendix C. Each readiness plan includes an executive summary, overview of the municipality, and a statement of goals for that particular readiness effort. Section 1 and Section 2 focus on PEVs and NGVs, respectively. These sections address the vehicle markets, current infrastructure development, key barriers to increased adoption, the regulatory framework, and available incentives. Section 3 of each plan lays out the roadmap and recommended actions to achieve the community's AFV readiness goals. Recommendations are presented in a way that aligns with the types of infrastructure demand. Each recommendation also references an entity or entities best suited to take responsibility for leading implementation.

All three municipalities have different characteristics in terms of population, area, demographics, land use, and other aspects, yet there are similarities between the three readiness plans. For example, many of the recommendations appear in all of the plans, framed in a way that responds to or reflects local conditions.

Commonalities among all three local readiness plans include:

- **A focus on actions to support PEVs and charging infrastructure.** While NGVs and fueling infrastructure are addressed in the plans to some extent, most recommendations will result in actions that increase awareness and usage of PEVs.
- **An emphasis on targeted initiatives to maximize the impact of municipal actions.** Each municipality participates in Sustainable Jersey and other environmentally-focused efforts, many of which result in widespread community awareness of sustainability topics and activities. The plans recommend targeted initiatives, such as outreach to specific high-priority businesses and employers to increase PEV charging infrastructure, which will complement ongoing efforts.
- **Opportunities to engage a variety of stakeholders and partners.** Collaborations involving utilities, TMAs, local businesses, and other partners will be critical to ensuring forward progress toward existing goals and goals set during the readiness planning process.

Some of the notable differences for each municipality include:

- **Montclair Township**
 - Montclair Township is the only municipality of the three that has taken steps to require PEV charging as part of redevelopment plans. While a requirement is not yet codified, multiple redevelopment plans include PEV charging spaces.
 - Montclair has a number promising public charging infrastructure development opportunities, leveraging what the township has learned from their existing chargers as well as those hosted by local businesses. Montclair Center Corporation, the business improvement district, was represented on the SAC. Montclair Center Corporation is in a

position to help coordinate meetings with businesses and assist with outreach to these stakeholders.

- The proximity of Montclair State University and existing partnership between the township and the university is another opportunity for both public and workplace charging.
- In general, SAC members expressed a genuine commitment to support implementation.
- **Town of Secaucus**
 - Secaucus has notably high demand for workplace charging throughout the municipality.
 - Secaucus is also home to several large MUDs, including those under development, presenting an opportunity for additional MUD charging infrastructure. Town staff suggested that one or more public parking lots could make an ideal location for charging stations intended for MUD residents without access to charging.
- **Woodridge Township**
 - Woodbridge Township is committed to sustainability and was named the 2016 Sustainable Jersey Silver-Level Champion. This spotlight will help demonstrate to other municipalities the importance of AFV readiness planning.
 - Woodbridge Center is an ideal location for PEV charging infrastructure because of high public and workplace charging demand. The property management company responsible for the popular retail and entertainment destination was represented on the SAC and confirmed interest in pursuing opportunities.

Challenges

In the process of developing the municipal readiness plans, the project team encountered the following challenges:

- **Accounting for variable levels of stakeholder engagement.** Just as the existing conditions for AFVs varied across the three municipalities, so did the involvement of and feedback from stakeholders. Based on the project team's previous experience with readiness planning this was expected, but it was even more evident with three separate municipalities. As noted in the Stakeholder Engagement section, the mix of stakeholders was different for each SAC. Several SAC members provided information outside of SAC meetings, such as confirming details for the Bayshore Recycling workplace charging station, but active engagement was generally limited to the SAC meetings. While municipal staff from Secaucus and Woodbridge Township sent suggestions and edits to the draft readiness plans, with the exception of comments and questions during the final SAC meetings, the project team received no feedback from individual stakeholders. This emphasizes the important role municipal staff, in particular, must play to ensure the plan is shared, used, and updated.
- **Applying the readiness planning framework to both PEVs and NGVs.** The readiness plans focus primarily on recommended actions intended to support the increased adoption of PEVs and the development of charging infrastructure. This reflects the large body of PEV readiness plans developed to date, as well as interest from the pilot municipalities to focus planning efforts on PEVs, rather than NGVs. The majority of PEVs purchased in the NJTPA region will be driven by the average consumer, each with different motivations, income levels, housing situations, and other variables. NGVs, on the other hand, are almost exclusively used in fleets, particularly medium- and heavy-duty applications. Fleet managers typically make vehicle purchase and

conversion decisions based on a combination of business-related factors, such as organization mandates or targets, return on investment, and vehicle availability. The fueling infrastructure is part of that decision-making process. Generally speaking, there are few things a municipality can do to influence a fleet's decision to use AFVs. As the project team learned from the literature review, local governments rely on industry documents for NGV infrastructure planning, rather than actual municipal planning documentation that can be used as examples.

- **Prioritizing recommended readiness actions.** The number of recommended actions can be overwhelming, as there are numerous ways to address barriers to AFV infrastructure development. Realistically, most municipalities will not pursue all recommended actions, but a municipality can prioritize implementation activities based on feasibility, community interest, resource availability, and other considerations.

Recommendations are organized to correlate with the demand for charging or fueling infrastructure. In the case of PEVs, recommendations are distinguished by their role in residential charging, MUD charging, workplace charging, and public charging. Several recommendations appear multiple times, though with different steps to implementation depending on the infrastructure to target. These recommendations include the identification of grants and other funding opportunities, and conducting targeted outreach to install charging infrastructure at high-priority locations.

Ultimately, each municipality and relevant stakeholders will need to determine which actions should be priorities. But the resulting presentation may help the municipalities develop a more strategic approach to addressing the various infrastructure types.

Follow-up Activities

The readiness plans will serve as roadmaps to increased AFV infrastructure, as long as the pilot municipalities incorporate the recommended actions into their practices, plans, and policies. All three municipalities indicated they intend to implement recommended actions and their participation in Sustainable Jersey will complement these efforts.

More specifically, the pilot municipalities expressed interest in the following priority actions:

- **Montclair Township** – explore options to require PEV charging infrastructure in all future redevelopment plans, potentially as a zoning code amendment. Also develop a comprehensive fleet management plan for all vehicles under the Township's control.
- **Town of Secaucus** – complete the pending grant-funded PEV charger installations and track usage data to understand demand. Also make resources available to MUD residents, boards, and managers to increase awareness of PEV charging infrastructure development processes and opportunities.
- **Woodridge Township** – continue to highlight the community's "AFV friendliness" through sustainability activities, education, and outreach. Serve as a resource for businesses, employers, and other potential charging infrastructure site hosts.
- **All three municipalities** – partner with local stakeholders to pursue grant funding for PEV charging infrastructure, leveraging the demand analyses from the readiness plans.

As a first step, each pilot municipalities should increase awareness of the plan and recommendations through outreach and education. Municipal staff, elected officials, and relevant local organizations will be interested in the results as well as how they can help with implementation. The executive summary provides a concise overview of the key findings and takeaways, which can be used as an overview document or content for presentations to boards and committees. Pilot municipalities should also look to the AFV readiness guidebook as a key resource, as it was informed by their plans.

As the AFV industry continues to develop, municipalities may be able to take advantage of funding sources, partnerships, additional pilot projects, and other opportunities to increase AFV and infrastructure use. Anticipated developments include (but are not limited to) technology advancements, such as faster/higher powered charging infrastructure and increased use of renewable natural gas, as well as national infrastructure development efforts, like Electrify America. Each municipality will be responsible for being aware of these opportunities, with assistance from the NJTPA, Sustainable Jersey, and other organizations to track and determine how best to leverage each.

Alternative Fuel Vehicle (AFV) Readiness Guidebook

The NJTPA and FHWA could not possibly fund the extensive readiness planning efforts the project team performed in the three pilot municipalities in every North Jersey municipality. The goal of the guidebook was to allow other municipalities in the NJTPA region to follow the same process in their own communities. While the project team came to the table with significant background knowledge on AFV readiness planning, as well as the local AFV climate, the pilot municipalities were a proving ground for the readiness planning process in the NJTPA region.

Incorporating lessons learned from the individual readiness plans, the project team developed the municipal guidebook for all municipalities in the NJTPA region to design and conduct AFV readiness planning efforts in their own communities. Recognizing that each municipality is unique, and will be starting from a different place with varying needs and priorities, the guidebook is general enough to assist any community on this spectrum, while also offering suggestions and recommendations specific enough for individual municipalities to put into practice.

Approach

Based on the information needs identified in the literature review and through stakeholder outreach, the project team designed the guidebook to be a toolkit for municipalities considering or committed to AFV deployment in their communities. Since a comprehensive approach to readiness planning is preferable, the guidebook is designed as a complete tool. It also provides direction on how municipalities can prioritize actions to identify and tackle the easier or more feasible projects and address the most pressing issues, first. From there, municipalities can use individual guidebook sections for implementation.

The project team relied heavily on the methodologies used to develop the pilot municipality readiness plans (e.g., analysis and forecasting of the PEV market), and included example figures and results from those documents as case studies and to identify lessons learned. The guidebook also touched on topics not covered as comprehensively in the readiness plans, including additional alternative fuel types (i.e., propane, hydrogen, biofuels).

While AFV planning may happen at a geographically broader level, the guidebook was written primarily with municipal policy makers and staff in mind, including councils, planning and zoning staff and boards, parking authorities, municipal utilities, environmental commissions, and business improvement districts. A larger audience could benefit from the concepts and information, including county and regional government agencies, fleet operators, local fueling station operators, and other private stakeholders.

Other Educational Materials

In addition to the guidebook, the project team updated text for the NJTPA's electronic **brochure** on AFVs. The brochure includes a general overview of each fuel, as well as a summary of related efforts in the region. See Appendix E for the final draft, which includes suggested revisions.

In coordination with the NJTPA, the project team developed a **one-pager** providing a summary of the study for outreach and education purposes. See Appendix E for the final draft.

The project team prepared a **summary presentation** for the study, calling out key takeaways. See Appendix E.

Finally, one of the guidebook appendices is a compilation of **MUD charging resources**, targeting MUD residents, boards, and managers. See Appendix D.

Results

The project team sought to answer three key questions with the guidebook, which served as the overarching sections in the document:

- **Why Take Action?** This section provided a framework by introducing the benefits of being AFV ready, as well as the state and federal actions that support AFV readiness in New Jersey. Using this background information, municipalities can build off of what is already being done.
- **What are AFVs and What do they Require?** This section summarized each alternative fuel type, vehicles, fueling infrastructure, and other considerations. The data and resources in this section provide a complete picture for municipalities deciding which fuels makes the most sense for their community.
- **What Does it Take to Become AFV Ready?** As the focal point of the document, this section focused on the steps to develop a readiness plan, including key recommendations.

Understanding that each fuel and infrastructure type is different, the guidebook, provided in Appendix D, includes fuel-specific icons to identify recommendations and activities for each fuel type.

Key Findings and Opportunities

In the process of developing the guidebook, the project team identified numerous key findings and opportunities:

- **A comprehensive approach to readiness planning is more effective than a piecemeal approach.** Ideally, a municipality will follow a thorough methodology covering all recommendations in the guidebook. Recognizing that many communities will not have the resources (i.e., staff, data) to conduct a complete AFV readiness analysis and implementation, the project team designed the guidebook to allow municipalities to prioritize and address the more easily attainable projects. Similarly, given its length and density, the guidebook could seem unwieldy to some municipalities just embarking on their AFV readiness planning efforts. The project team wanted to be sure the reader had all of the relevant tools and resources. However, where possible, the project team pointed towards existing resources (e.g., Sustainable Jersey). In addition, the guidebook includes icons, text boxes, and other formatting solutions to ensure that the document is readable and allows for quick reference.
- **Readiness planning guidance needs to remain relevant beyond the initial publication.** The alternative fuels industry is rapidly changing, meaning that the guidebook may soon become outdated. For example, New Jersey state-level efforts and focus areas could shift dramatically with each new executive administration. To ensure that the guidebook has a long shelf life, the project team attempted to include all relevant background information, while making the recommendations and guidance general enough to be useful in coming years. For instance, rather than including extensive data on current AFV registrations in the state, the guidebook points the reader to resources for the most up-to-date information.
- **Readiness planning should consider all fuel types but efforts will target specific fuels, technologies, and sectors.** Certain fuels are more suitable for different areas of the country and in different applications. In addition, state-level policy may dictate a preference for one or more fuels. The guidebook was intended to cover all alternative fuels (biodiesel, electricity, ethanol, hydrogen, natural gas, and propane) identified in the federal Energy Policy Act whereas the

literature review, pilot municipality readiness plans, and other local readiness activities align more closely with priorities identified in the New Jersey Energy Master Plan. As a result, the guidebook focuses more heavily on PEVs and NGVs and has less information on the other fuels. PEVs are typically seen as a consumer solution, where the other AFV types are more common in fleet settings. The analysis and activities necessary to prepare for PEVs is very different from the other vehicles. In the guidebook, the project team used the icons described above to differentiate and allow the reader to focus on recommendations that are relevant to their preferred fuel type(s).

- **National recommended practices can be applied in a way that maintains a local focus.** Each region and state (and even municipality) has a unique set of challenges and opportunities related to AFVs. While it is important to apply the lessons learned from early AFV readiness planning efforts, which were largely conducted in California, the project team worked to ensure that the guidebook did not lose the local focus. As a result, the document includes detailed information on topics that may not be relevant elsewhere (e.g., PEV charging at MUDs, natural gas quality).
- **Metropolitan Planning Organizations (MPOs) and Transportation Management Associations (TMAs) should be involved with readiness planning and implementation efforts.** Staff at regional MPOs and TMAs have the data and skills necessary to conduct readiness planning efforts and support municipalities, though funding and staff availability are limited. For example, TMAs may not be able to assist with targeted outreach to employers and businesses, as recommended in the guidebook. The guidebook includes a few instances where TMAs and MPOs might be able to contribute to municipal efforts, but also provides enough background for communities to work independently.
- **The NJTPA's study will help connect municipalities within the NJTPA region and serve as a resource to those nationwide.** The guidebook itself, if appropriately marketed, provides an opportunity to connect with other municipalities in the region and provide assistance, where appropriate. The guidebook will be posted online and can be circulated broadly to demonstrate the NJTPA's leadership in the area of AFV readiness planning and provide direction to MPOs in other parts of the country. It should also be shared with all stakeholders involved in the project as a resource for those organizations.

Appendix A: Stakeholders

Municipal SAC Members

Montclair Township

Councilor Bob Russo

Keith Brodock, Montclair Township Planning Board & Environmental Commission

James Sherman, Montclair Township Environmental Commission

Tina Iordamlis, Montclair Township (Parking Utility)

Graham Petto, Montclair Township (Department of Planning & Community Development)

Gray Russell, Montclair Township (Department of Environmental Affairs)

Janice Talley, Montclair Township (Department of Planning & Community Development)

David Antonio, Essex County

Krishna Murthy, EZ Ride

Israel Cronk, Montclair Center BID

Tom Mologhney, Nauna's Bella Casa

Town of Secaucus

Foula Ballas, Town of Secaucus (Construction and Zoning Department)

Captain Carlos Goyenechea, Town of Secaucus (Police Department)

Lynn Kramer, Town of Secaucus (Environmental Department)

Jennifer Modi, Town of Secaucus (Engineering Department)

Amanda Nesheiwat, Town of Secaucus (Environmental Department)

Megan Massey, Hudson County

Luis Delgado, Hudson TMA

Anthony Vairieri, Hudson TMA

Ron Mroz, Secaucus Middle School

John Elissa, Harmon Cove Towers Board Member

Carol Ellison, Harmon Cove

Don Evanson, Harmon Cove Towers Resident

Daniel Rozenbaum, Harmon Cove Towers Board Member

Tommy Schwartz, Harmon Cove

Woodbridge Township

Nancy Drumm, Woodbridge Town Council and Metro Chamber of Commerce

Thomas Flynn, Woodbridge Township (Office of the Mayor)

Mike Gelin, Woodbridge Township (Engineering)

Eric Griffith, Woodbridge Township (Planning & Development)

Dennis Henry, Woodbridge Township (Department of Public Works)

Chris Kesici, Woodbridge Township (Planning & Development)

Marta Lefsky, Woodbridge Township (Planning & Development)

Jeffrey Mayerowitz, Woodbridge Township (Office of Sustainability)

Tony Gambilonghi, Middlesex County

Morteza Ansari, Keep Middlesex Moving

Bill Neary, Keep Middlesex Moving

Amy Bellisano, Woodbridge Center/GGP
Allison Cartin, The Crossings/Fieldstone Properties
John Davies, Bayshore Recycling
Ted Schlemovitz, Wakefern Food Corporation
Gary Sondermeyer, Bayshore Recycling
Jamie Straub, Atlantic Realty/Middlesex Management

TAC Members

Nathaly Agosto Fillion, City of Newark
Rob Thomas, City of Newark
David Antonio, Essex County
Jim Appleton, New Jersey Coalition of Auto Retailers (NJ CAR)
Charlene Burke, Hudson County
Megan Massey, Hudson County
Ashley-Lynn Chrzaszcz, ChargEVC
Mark Warner, ChargEVC
Tim Croushore, FirstEnergy
Eva Gardow, FirstEnergy
Luis Delgado, Hudson TMA
Jay DiDominico, Hudson TMA
Kenny Esser, Jr., PSE&G
Rob Graff, Delaware Valley Regional Planning Commission (DVRPC)
Eric Griffith, Woodbridge Township
Peg Hanna, New Jersey Department of Environmental Protection (NJDEP)
Mike Hornsby, New Jersey Board of Public Utilities (NJBPU)
Roberta Karpinecz, Keep Middlesex Moving
Bill Neary, Keep Middlesex Moving
Bruce McCracken, Middlesex County
Tom Moloughney, Private Citizen
Chris Moog, NJ TRANSIT
Krishna Murthy, EZ Ride
Ellie Ferrer, EZ Ride
Kinga Skora, EZ Ride
Amanda Nesheiwat, Town of Secaucus
Graham Petto, Montclair Township
Nancy Quirk, Sustainable Jersey
Linda Weber, Sustainable Jersey

Appendix B: Literature Review



Interagency Collaboration on Alternatively Fueled Infrastructure: Literature Review

January 2017

Prepared for:

North Jersey Transportation Planning Authority
One Newark Center, 17th Floor
Newark, NJ 07120

Prepared by:

The ICF Team
1725 Eye Street, NW
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Appendix A: Literature Review Summary

Appendix B: Literature Review Detail

Executive Summary

In recent years, alternative fuel vehicles have gained traction in the both the national and New Jersey markets. There are environmental, public health, economic, energy security, and resiliency benefits for the fleet and consumer markets and for all vehicle types and applications. Plug-in electric vehicle (PEVs) and natural gas vehicles (NGVs) are drawing particular attention in New Jersey, due to state and regional goals and planning efforts.

Since 2011, when manufacturers released the first modern PEVs, the national PEV market has expanded in scale, geography, offerings, and technology. Driven by incentives, mandates, investment from industry, and enthusiasm from early adopters, total new PEV sales numbers went from approximately 10,000 in 2011 to nearly 115,000 in 2015.¹ Over that same period, charging infrastructure increased nearly ten times.² While California has historically led in PEV adoption, the Northeast and Mid-Atlantic region is quickly becoming a primary market for PEVs, due to its geographical and demographic characteristics. However, PEVs still account for less than 1% of the total light-duty vehicle market nationwide.

While PEVs primarily serve the light-duty consumer market, the NGV industry is currently targeting the medium- and heavy-duty fleet sector. Following an initial surge in NGV interest in the mid- to late-1990s, natural gas fueling infrastructure increased steadily from approximately 750 stations in 2007 to over 1,800 in 2016.³ The use of natural gas as a vehicle fuel has grown by 75% in that same period.⁴ Once again, incentives and investment from industry have been important drivers for this growth. Currently, natural gas only accounts for 3% of fuel (based on energy content) used in the transportation sector.⁵ Additional development of this market is focused on strategic deployment of NGVs in appropriate fleets. For example, nationwide, compressed natural gas (CNG) vehicles currently account for 35% and 55% of the transit bus and refuse truck markets, respectively.^{6,7}

Research suggests that municipalities and regions engaged in alternative fuel vehicle (AFV) readiness planning activities observe higher rates of AFV adoption and infrastructure utilization. As part of a North Jersey Transportation Planning Authority (NJTPA) funded study on interagency collaboration and readiness for AFV infrastructure, the project team conducted this literature review of AFV readiness guidance documents and other resources. The goal was to identify case studies, lessons learned, best practices, and information gaps relevant to AFV infrastructure planning, and to provide the NJTPA with a review of applicability to the study region.

The project team identified and reviewed more than 80 documents related to PEV and NGV readiness and implementation from across the United States and internationally. The full review is available in Appendix B. This literature review provides a summary of the key findings for PEVs and NGV readiness, specifically benefits and challenges, techniques for market analysis, regulatory and policy frameworks, and strategies for advancement. The literature review also

¹ U.S. Department of Energy (DOE), U.S. PEV Sales by Model, <http://www.afdc.energy.gov/data/10567>. January 2016.

² U.S. DOE, U.S. Alternative Fueling Stations by Fuel Type, <http://www.afdc.energy.gov/data/10332>, September 2016.

³ *ibid*

⁴ U.S. Energy Information Administration (EIA), U.S. Natural Gas Vehicle Fuel Consumption, <https://www.eia.gov/dnav/ng/hist/n3025us2m.htm>. Accessed November 7, 2016.

⁵ U.S. EIA, Energy Use in Transportation, http://www.eia.gov/energyexplained/?page=us_energy_transportation. Accessed November 7, 2016.

⁶ NGVAmerica, Transit, <http://www.ngvamerica.org/vehicles/for-fleets/transit/>. Accessed November 8, 2016.

⁷ NGVAmerica, Refuse, <http://www.ngvamerica.org/vehicles/for-fleets/refuse/>. Accessed November 8, 2016.

begins to compare the body of literature with the PEV and NGV activities in North Jersey to date and appetite for future work in this area. Further analysis will be completed as part of future work on the study.

Key findings from the literature review include:

- Readiness planning, such as the development of supportive policies and incentive programs, is tied to AFV market growth, yet quantitative analysis is necessary to demonstrate the effectiveness of readiness planning as currently it is only backed by anecdotal evidence.
- Stakeholder engagement and partnerships, with municipalities at the epicenter, are the key to readiness planning and successful deployment. Stakeholders include utilities, policy makers, regulatory agencies, educational institutions, nonprofits, and business partners. In addition, consumer engagement is paramount for PEV readiness, while fleet outreach is important for NGV deployment.
- There is no “one size fits all” for AFV readiness and deployment. While it can be assumed that deployment challenges and opportunities are somewhat universal, interviews, surveys, and regulatory analyses can be used to understand regional and local dynamics. The project team will need to assess the North Jersey region using existing market assessments and policy analysis techniques (e.g., understand how the PEV purchaser segments overlaps with North Jersey demographics) and address areas that are not as well understood (e.g., spatial analyses of land use to identify land parcels for infrastructure and prioritize locations). Readiness cannot be a static process; stakeholders will benefit from “living” resources and continuous engagement.
- The NGV literature is not as robust as PEV literature, in part because the industry has recently been focused on fleet applications, rather than the consumer market. The project team will need to rely heavily on stakeholder input to understand the regional NGV market, challenges, and opportunities.

Introduction

With the increased availability of and attention on AFVs in recent years, the NJTPA is invested in supporting regional deployment of these vehicles and related infrastructure in both the consumer and fleet markets. The North Jersey region stands to benefit greatly from all that AFVs have to offer. This includes reduced fuel costs, savings on maintenance, attractive new technology, support of domestic industries, and promotion of environmental sustainability.

Community readiness planning efforts are one way to accelerate the shift away from reliance on conventional vehicles to AFVs. As such, the NJTPA is partnering with three pilot municipalities, Montclair Township in Essex County, the Town of Secaucus in Hudson County, and Woodbridge Township in Middlesex County, to develop local readiness plans that encourage the widespread adoption of AFVs, particularly PEVs and NGVs. Note that both plug-in hybrid electric vehicles (PHEVs) and all-electric vehicles (EVs) make up the broader PEV category.

The plans will consider how municipal regulations and infrastructure can be improved to advance the use of AFVs, including a review of local zoning and land use ordinances, permitting requirements, and potential locations for infrastructure. Based on input from a variety of resources and stakeholders, the project team will develop a cohesive set of strategies and recommendations for each community to become PEV- and NGV-ready. From there, a guidebook will be developed for municipalities in the NJTPA region to plan for and develop AFV readiness plans in their own communities. Lastly, a final report will review the project outcomes and AFV readiness for the entire North Jersey region.

As a first step in this effort, the project team conducted a literature review of readiness guidance documents and other resources from across the United States and internationally. The literature review is intended to inform the other project activities outlined above by identifying case studies, lessons learned, and best practices relevant to AFV infrastructure planning in the existing literature. Specifically, it includes a review of the technology and applications, market assessment techniques, policy and regulatory frameworks, and advancement strategies currently pursued at the state, regional, and local levels. As such, the project team also identifies and discusses the key unaddressed issues and topics related to PEV and NGV readiness.

While this summary aims to make connections between the established literature, draw conclusions, and identify gaps and trends, it is limited to published literature. The goal is not to conduct any new analysis, only to establish a baseline for additional work to be completed by the project team as part of the overarching study.

Literature Review Methodology

To begin the literature review process, the project team compiled a list of documents for inclusion in the review. The list was compiled based on a library of readiness planning documentation from previous efforts, Internet searches, and input from local stakeholders. Specifically, each of the pilot municipalities, the New Jersey Department of Environmental Protection (NJDEP), and the NJTPA provided input on documents for inclusion.

Priority was placed on recently published documents, as well as those from the Northeast and Mid-Atlantic regions. All publications were released after 2009, and approximately half were published since 2014. Over a quarter of publications the project team reviewed focus on the Mid-Atlantic or Northeast regions.

Where possible, the project team focused attention on documents that summarize previous efforts and provide lessons learned. For instance, in 2011, the U.S. DOE's Clean Cities program funded the development of 16 PEV readiness plans around the country. The readiness planning projects ran for 18 months, through the spring of 2013. Because many of the plans are now somewhat outdated, the project team reviewed U.S. DOE's summary document, *A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects*, rather than each individual readiness plan.

While the guidebook to be prepared under the present project will include additional alternative fuels (e.g., ethanol, biodiesel, hydrogen, propane), the municipal readiness plans and this literature review focus on PEVs and NGVs, in order to align with the New Jersey Energy Master Plan (see below).

As a result, the project team collected 81 documents, each of which falls into one or more of the following categories:

1. [Model Municipal PEV Planning Documents and Guidance](#) (19 total)
2. [Model Regional PEV Planning Documents and Guidance](#) (13 total)
3. [Model State PEV Planning Documents and Guidance](#) (5 total)
4. [Model International PEV Planning Documents and Guidance](#) (6 total)
5. [Consumer and Fleet PEV Guidance](#) (9 total)
6. [PEV Charging Station Host Guidance and Analysis](#) (7 total)
7. [Other PEV Resources, Studies, and Analysis](#) (11 total)
8. [Model NGV Planning Documents and Guidance](#) (8 total)
9. [Other NGV Resources, Studies, and Analysis](#) (8 total)

Note that some documents are counted in two categories because they cover both PEVs and NGVs.

The project team then developed an Excel spreadsheet to guide the review of each of the 81 documents. The original spreadsheet was comprised of 30 columns, including a document overview (title, author organization, web link, geographic area covered, date of publication, general overview, summary of usefulness and relevance to North Jersey municipalities, and methodology) as well as a summary of how (if at all) the document addressed each of these items:

- **Key challenges and benefits evaluation**, including environmental, economic, and energy security.
- **Techniques for market assessment**, including niche applications and siting visions and goals.
- **Regulatory frameworks**, including zoning, parking codes, permitting, building codes, incentives, and utility considerations.
- **Strategies for advancement**, including key partnerships, corridor planning, procurement practices, education and training, and other strategies.

The project team has summarized the information from the original review spreadsheet into a more succinct format in Appendix A. Appendix B provides a complete summary of each of the documents with additional detail.

The following sections will review the findings of the literature review. Throughout the document, key findings are called out in dark blue text boxes. In addition, the Electric Vehicle and Natural Gas Vehicle Readiness Planning sections conclude with a set of best practices for readiness planning for PEVs and NGVs, respectively. The document concludes with a general summary of key findings, including lessons learned and gaps identified.

Electric Vehicle Readiness Planning

There is a breadth of literature available on PEV readiness, from the local to the regional, national, and international levels. The project team identified 57 studies focused solely on PEV readiness and a dozen more that include PEV readiness among other topics.

Most studies address the benefits posed by PEVs, as well as the challenges of deploying them. Many studies also analyze the market status of PEVs and best practices to develop a regulatory framework that promotes widespread PEV adoption and the infrastructure necessary to support it. This section provides a more specific look at the literature available and gaps to be aware of as the NJTPA undertakes its own readiness planning effort.

Key Challenges and Benefits Evaluation

Nearly all of the PEV readiness plans and studies in the literature review address the benefits of increasing the number of PEVs on the road, as well as the key challenges to widespread PEV and charging infrastructure deployment.

Benefits

There are many potential benefits associated with an increase in PEVs on the road, including lower operating and maintenance costs. Most studies in the literature categorize the other primary benefits into three areas: air quality and emissions, energy usage, and economic growth.

Air Quality and Emissions

Transportation is the largest single source of air pollution in the United States, specifically in the form of particulate matter, carbon monoxide, and pollutants associated with smog formation. Most of these pollutants are emitted from car tailpipes and result in local air quality degradation. Additionally, the significant greenhouse gas (GHG) emissions from the petroleum fuel life cycle contributes to climate impacts at a broader scale. Because EVs and PHEVs operating on electricity do not have any tailpipe emissions, they produce less localized pollution. And even when charged with electricity produced from the dirtiest of fuel sources, PEVs are cleaner on a life cycle GHG emissions basis. According to the U.S. DOE, an average EV produces 2,529

Key Finding for the NJTPA Study**

While there is significant information available on the benefits and challenges of PEVs, there is little specific to North Jersey, particularly as it relates to the challenges of PEV and charging infrastructure deployment. This is an area where the project team will invest efforts, particularly through stakeholder and consumer engagement. The literature suggests that interviews, surveys, and regulatory analyses are appropriate methodologies to collect this information.

** Also applies to NGV readiness.

Key Finding for the NJTPA Study

Georgetown Climate Center's *Assessment of Current Electric Vehicle Supply Equipment (EVSE) and EV Deployment* points out that PEV driving moves pollution to the point of electricity generation, introducing other categories of pollutants to certain communities. However, because the Northeast and Mid-Atlantic regions rely on relatively clean energy, conventional vehicles would need to achieve at least 50 miles per gallon (MPG) to result in a GHG emission level equivalent to that of a PEV.¹

¹ Georgetown Climate Center, *Assessment of Current EVSE and EV Deployment*, http://www.transportationandclimate.org/sites/default/files/Assessment_of_EVSE_and_EV_Deployment.pdf, December 2012.

pounds of carbon dioxide emissions on a life cycle basis, compared to 4,895 pounds for a PHEV, 6,258 pounds for an HEV, and 11,435 pounds for a gasoline vehicle.⁸

The NJDEP's It Pay\$ to Plug In program website points out that the smooth operation of the transportation system relies upon a secure supply of oil – approximately 90% of fuel used in the U.S transportation sector is derived from oil.^{9,10} But the continued security of oil supplies is far from certain, which leads to macroeconomic losses, and political and security problems. Because PEVs can run on electricity generated by domestic resources – some of which are renewable – they can offer a highly promising solution for daily travel routes in Northeast and Mid-Atlantic cities. Ultimately, electric drive could be part of a mixture of fuels and modes used to address transportation and energy security issues.

Economic Growth

The New York State Energy Research and Development Authority (NYSERDA) assessed the impacts associated with large-scale use of PEVs in New York State. Under one study's scenario in which PEVs achieve about 40% of new car sales by 2025, New York's economic benefits overall would be \$4.45 billion to \$10.75 billion per year, with net job creation numbers between 19,800 and 59,800. While this finding is based on an aggressive PEV sales assumption compared to others, it no doubt contributes to Georgetown Climate Center's conclusion that PEV deployment can be economically beneficial from both a micro and macroeconomic perspective.¹¹ Along the lines of economic growth, PEVs also present consumers with a transportation option that provides lower operating and maintenance costs.

Challenges

While PEVs present many potential benefits, there are also challenges to widespread PEV adoption in the United States and, more specifically, in the Northeast and Mid-Atlantic region. Georgetown Climate Center's *PEV Deployment in the Northeast: A Market Overview & Literature Review* divides these barriers to adoption into three categories:¹²

Vehicle Cost

Upfront vehicle cost is likely one of the largest barriers to widespread PEV adoption. Battery costs comprise the largest percentage of a PEV's price. However, that cost has been decreasing per unit of energy and will continue to do so as manufacturers achieve additional technological breakthroughs and economies of scale in the coming decade.

⁸ U.S. DOE, Alternative Fuels Data Center, Emissions from Hybrid and Plug-In Electric Vehicles, http://www.afdc.energy.gov/vehicles/electric_emissions.php. Accessed September 7, 2016.

⁹ NJDEP, It Pay\$ to Plug In, <http://www.drivegreen.nj.gov/programs.html>. Accessed August 31, 2016.

¹⁰ U.S. EIA, Use of Energy in the United States Explained, Energy Use for Transportation, http://www.eia.gov/Energyexplained/?page=us_energy_transportation. Accessed September 8, 2016.

¹¹ Georgetown Climate Center, *PEV Deployment in the Northeast: A Market Overview & Literature Review*, <http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/PEV-Deployment-in-the-Northeast.pdf>. September 2012.

¹² Ibid

Charging Station Build-out and Range Anxiety

EV drivers, and PHEV drivers wishing to operate on electricity, must have at least one charging unit available to them. While public charging station network development will help with this, the current perceived lack of charging infrastructure accessibility has led to consumer “range anxiety,” the fear that a vehicle may leave a driver stranded because it runs out of charge before reaching the intended destination.

Several barriers embedded in this challenge are long permitting and inspection processes, and faulty charger installations resulting from untrained electricians. These issues are addressed below.

Figure 1 shows the build-out of public charging infrastructure in New Jersey as of January 2017, which includes 199 charging locations (15 Level 1, 166 Level 2, 41 DC fast charge; note that some locations have more than one charger type) and 442 charging outlets. Level 1 is a standard 110-volt outlet, which takes approximately 12 hours to fully charge a battery, depending on the vehicle type and other factors. Level 1 is most commonly found in residential applications but could be suitable for some fleets and at the workplace. Level 2 is a 220 or 240-volt outlet, charges a battery in about three to four hours depending on the vehicle type and other factors. Level 2 can also be used at the home and workplace. DC fast charge is more in line with the gas station model, and provides a charge in about 30 minutes. Not all PEVs currently available can use these chargers.

Figure 2 breaks down the number of stations in the NJTPA region by county and charger type.

Key Finding for the NJTPA Study

Range anxiety is heightened in the Northeast because of cold weather conditions, hilly terrain, and stop-and-go traffic, all of which bring down vehicle range and result in added uncertainty. Only a few resources provide specific research on the impact of these factors on range, so this is an area the NJTPA will want to focus on in stakeholder interviews as this study contributes to the development of a charging station network in the North Jersey region.

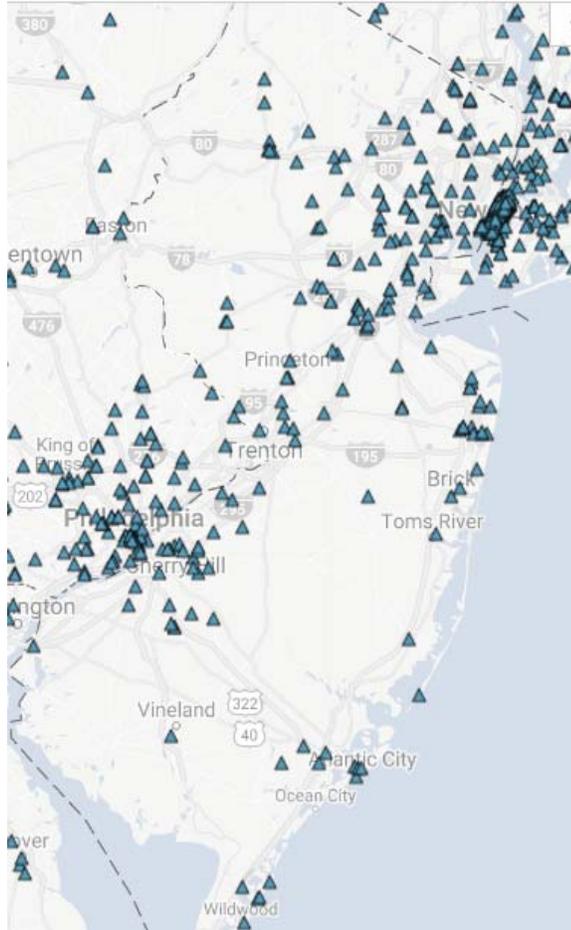


Figure 1. Publicly Accessible Charging Stations in New Jersey, January 2017¹³

County	Level 1	Level 2	DC Fast
Bergen	1	17	10
Essex	3	17	4
Hudson	2	9	2
Hunterdon	0	4	0
Middlesex	2	12	8
Monmouth	1	17	3
Morris	0	13	1
Ocean	1	5	0
Passaic	0	4	0
Somerset	0	6	2
Sussex	0	3	0
Union	0	12	0
Warren	0	0	0
Total	10	119	30

Figure 2. Publicly Accessible Charging Stations in the NJTPA Region by County and Level, January 2017¹⁴

¹³ U.S. DOE, Alternative Fuels Data Center, Station Locator, <http://www.afdc.energy.gov/locator/stations/>. Accessed January 17, 2017.

¹⁴ U.S. DOE, Alternative Fuels Data Center, Station Locator, <http://www.afdc.energy.gov/locator/stations/>. Accessed January 17, 2017.

Impacts on Electrical Grid

Given projected PEV penetration rates, regional impacts on the electrical grid will likely be negligible for many years. However, unmanaged charging station installations and increasing PEV penetrations in specific areas could negatively affect local distribution systems. The Hydrogen Energy Center's report, *Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England*, addresses state-level public utility rules and policies and how they tie into PEV infrastructure development. The Delaware Valley Regional Planning Commission (DVRPC)¹⁵ and Georgetown Climate Center¹⁶ also discuss grid integration issues, including analyses of potential grid impacts, and provide recommendations to manage potential impacts. One simple, but not always utilized, solution to this potential challenge is for utilities to establish a clear notification protocol. Pacific Gas & Electric in California is an example of a utility that has taken a leadership role establishing a notification protocol and communicating the importance of it to local and regional stakeholders.¹⁷

Techniques for Market Assessment

Among the literature reviewed in this study, over half the reports include a specific analysis of the PEV and charging infrastructure markets. Most studies provide an overview of the PEV models and types of charging infrastructure available, as well as an analysis of current PEV ownership. Approximately one quarter of these studies develop quantitative PEV ownership projections. A handful provide attitudinal segmentation in order to understand who the PEV consumer is and their decision making process in buying a new car.

Market Status Evaluation

It is critical to understand who is buying PEVs, the current market status, and the projected growth in order to plan accordingly. As mentioned above, since modern-day PEVs were introduced to the U.S. market in 2010, over half of PEV-related studies have sought to evaluate the overall PEV market and understand the PEV consumer.

Most studies use the number of vehicle models available and the number purchased, as well as sales growth rates, in order to project PEV ownership and charging infrastructure needs in a given area. At the national level, long-term PEV market projections typically incorporate a variety of other factors, including the continued presence of financial incentives (e.g., the federal PEV tax credit of up to \$7,500), as well as non-financial incentives like high occupancy vehicle (HOV) lane access for qualified PEVs. That being said, even

Key Finding for the NJTPA Study

Although the magnitude of PEV growth is uncertain, the region is likely to become a primary market for PEVs. According to TCI, PEV numbers could double every three or four years nationwide.¹ The Northeast and Mid-Atlantic is likely to be a key contributor to this growth because of the geographical and demographic characteristics, which are especially conducive to PEV deployment.

¹ Georgetown Climate Center, *PEV Deployment in the Northeast: A Market Overview & Literature Review*, <http://www.nyscrda.ny.gov/-/media/Files/Programs/ChargeNY/PEV-Deployment-in-the-Northeast.pdf>. September 2012.

¹⁵ DVRPC, *Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action Plan*, <http://www.dvrpc.org/reports/12055B.pdf>. June 2013. (Note: ICF prepared this document for DVRPC)

¹⁶ Georgetown Climate Center, *PEV Deployment in the Northeast: A Market Overview & Literature Review*, <http://www.nyscrda.ny.gov/-/media/Files/Programs/ChargeNY/PEV-Deployment-in-the-Northeast.pdf>. September 2012.

¹⁷ Bay Area Air Quality Management District, *PEV Readiness Plan*, <http://www.baaqmd.gov/-/media/files/strategic-incentives/ev-ready/bay-area-pev-readiness-plan-background-and-analysis-web-pdf.pdf?la=en>. December 2013. (Note: ICF prepared this document for DVRPC)

optimistic PEV forecasts predict that sales will remain low compared to the size of the overall U.S. vehicle fleet. For example, the U.S EIA predicts that PEVs will be 8% of the vehicle stock by 2040.¹⁸

Some studies look at PEV growth on the local level, specifically in California communities, where PEV sales have been concentrated. A few studies look at PEV growth projections in the Northeast region. For example, Georgetown Climate Center’s research on sales growth projections and stakeholder interviews indicates that the Northeast and Mid-Atlantic have a potential market that matches – or even surpasses – that of any other region or state in the United States because of its high density, urbanization, short commute distances, and relatively high incomes. The report looks at HEV market penetration between 2007 and 2009 by state as an indicator for future PEV sales. For total sales, New Jersey ranks 10th, and for market penetration per capita, it ranks 18th (26.8 HEVs per 10,000 people).¹⁹ As demonstrated in Figure 3, the Northeast and Mid-Atlantic markets had already begun to pick up as of 2014.

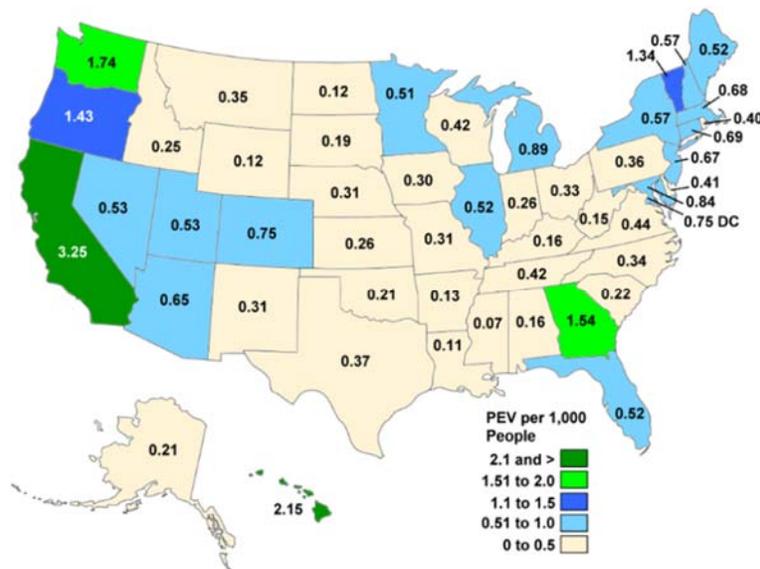


Figure 3. PEV Registrations per Thousand People by State, 2014.²⁰

As a final example of market status evaluation, DVRPC’s PEV readiness plan, *Ready to Roll!*,²¹ uses household income, HEV ownership, home ownership, dwelling type, and education at the census block group level to project the distribution of PEV ownership in southeastern Pennsylvania from 2011 through 2020. The results of this analysis are displayed in Figure 4.

¹⁸ U.S. EIA, Annual Energy Outlook 2016, Table: Light-Duty Vehicle Stock by Technology Type, Reference Case, https://www.eia.gov/forecasts/aeo/data/browser/#/?id=49-AEO2016&cases=ref2016-ref_no_cpp&sourcekey=0. Accessed September 7, 2016.

¹⁹ Georgetown Climate Center, *PEV Deployment in the Northeast: A Market Overview & Literature Review*, <http://www.nyscrda.ny.gov/-/media/Files/Programs/ChargeNY/PEV-Deployment-in-the-Northeast.pdf>. September 2012.

²⁰ U.S. DOE, Fact #876: June 8, 2015 PEV Vehicle Penetration by State, 2014. <http://energy.gov/eere/vehicles/fact-876-june-8-2015-plug-electric-vehicle-penetration-state-2014>. Accessed September 8, 2016.

²¹ DVRPC, *Ready to Roll! Southeastern Pennsylvania’s Regional Electric Vehicle Action Plan*, <http://www.dvrpc.org/reports/12055B.pdf>. June 2013.

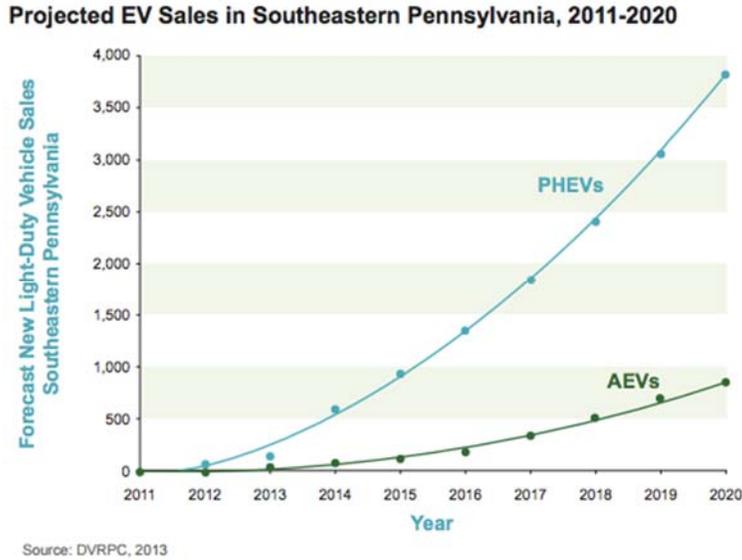


Figure 4. Projected PEV Sales in Southeastern Pennsylvania, 2011-2020²²

Figure 5 shows PEV counts in New Jersey as of 2015. While this map will become outdated, it serves as a baseline for NJTPA and its pilot municipalities as they develop and implement PEV readiness plans.

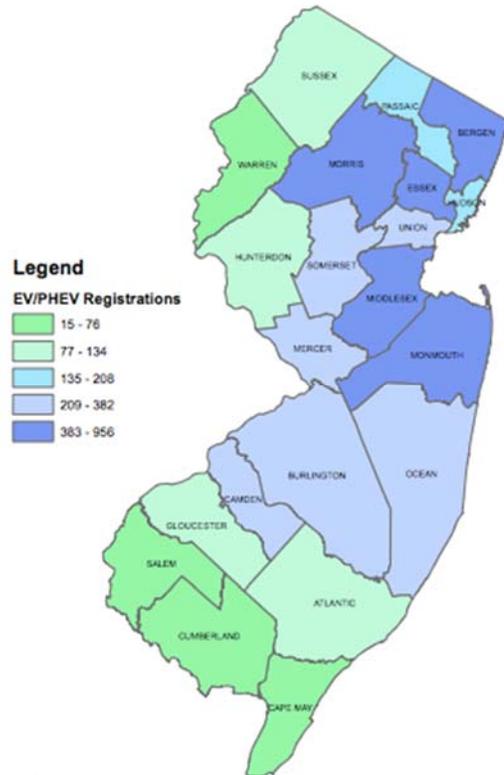


Figure 5. New Jersey PEV Registrations by County, 2015²³

²² Ibid

²³ NJDEP, *Clean Vehicles*, <http://www.nj.gov/dep/cleanvehicles/Alt%20Fuel%20Vehicles%20Total%20Electric.pdf>. November 2015.

Niche Application Assessment

In order to develop a comprehensive PEV readiness plan, it is critical to understand the various applications for PEVs, from private consumers to fleets, both public and private. While there is more information and research done on consumer adoption of PEVs than fleet adoption, the U.S. DOE has several guides relevant to fleet managers preparing for PEVs and many resources include case studies of fleets that have successfully deployed PEVs. This section summarizes those resources and identifies gaps as they relate to relevant information for the NJTPA as it develops its PEV readiness plan.

Consumer Market

About one quarter of the market analyses incorporate consumer surveys, as well as input from PEV automakers, to understand which segments of the consumer market tend to be interested in purchasing PEVs.

Fleet Applications

Some PEV resources in the literature review include case studies of fleets that have deployed PEVs. The literature generally agrees that urban fleets with recurring routes and return-to-base operations stand to benefit from implementing PEVs. This model allows for frequent, reliable charging using the same charging stations.

Local government fleets, while the lowest hanging fruit for municipal planning efforts, may not be the most practical application because of their relatively low mileage and unique needs (e.g., towing capabilities). Some public fleets in the Northeast have, however, been successful in deploying PEVs. For example, New York City has the nation's largest HEV fleet and is working to build its PEV fleet in departments ranging from the Police Department to the Department of Corrections. The city is also working to accelerate PEV penetration in its taxi fleet – it provided six Nissan Leafs in spring of 2013 and is supporting charging station installation for a pilot program in preparation for widespread deployment of EV taxis.²⁴

PEV technology has historically been used in light-duty fleet applications, such as those mentioned above, but has begun to break into the transit and school bus, delivery truck, and other medium- and heavy-duty markets.

Key Finding for the NJTPA Study

To date, key components of market analysis include the availability of financial and non-financial incentives, urban density, commute distances, household income and other socioeconomic indicators, and HEV ownership. However, beyond early adopters, limited information is available about the PEV consumer market. Also, further work is necessary to understand how the PEV purchaser segments overlap with North Jersey demographics.

Key Finding for the NJTPA Study

PEVs may not be a good fit for all fleets. There is little information available specific to North Jersey's communities and the fleets operating in this region. Interviews with fleet managers either using PEVs or considering PEVs for their fleets, as well as case studies to identify area-specific considerations, will be highly beneficial for the NJTPA as it lays the foundation for PEV adoption in the region. Outreach with local fleets will be necessary to understand the demand in the region.

²⁴ DVRPC, *Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action Plan*, <http://www.dvrpc.org/reports/12055B.pdf>. June 2013.

The California PEV Collaborative report, *Taking Charge: Establishing California Leadership in the Plug-in Electric Vehicle Marketplace*,²⁵ and the Bay Area Air Quality Management District's *PEV Readiness Plan*,²⁶ provide specific analysis of the benefits and challenges of PEVs in a fleet setting, as well as case studies and recommendations to encourage PEV deployment in public and private fleets. Example suggested actions include educating and informing fleet operators and organization decision makers, developing targeted policies for fleets that focus on purchase criteria other than vehicle price, and leveraging fleet purchasing power through purchase cooperatives.

Infrastructure Siting Analyses

One of the central challenges with PEV deployment is accessibility of adequate charging infrastructure to support vehicles. Many studies therefore include charging infrastructure demand forecasting and siting analyses.

Several studies include an analysis of where PEV owners will look to charge their vehicles. For example, Georgetown Climate Center's *EVSE Cluster Analysis: EVSE Support Study* provides qualitative research on potential charging station clusters and prioritizes high-potential locations along the Eastern Seaboard.²⁷ The study identified nine deployment cluster types, including downtown, retail, workplace, higher education, fleet and freight, leisure destination, regional transit, medical campus, and multi-unit dwelling clusters. However, researchers concluded that the PEV charging market is largely reactive and chargers largely have not been deployed according to these clusters.

The Drive Green New Jersey website²⁸ and U.S. DOE Alternative Fuels Data Center²⁹ provide baseline data on the current charging infrastructure availability in North Jersey, which can be used to identify gaps.

Once it is known where drivers are likely to need charging accessibility (e.g., at home, at work, at shopping locations), the next step is to assess locations that can physically support charging infrastructure. The *Western Riverside PEV Deployment Plan* is an example of a region that conducted spatial analyses of the area through inventories of land use at the sub-regional and municipal level to identify land parcels for PEV charging and prioritize charging infrastructure development throughout the region.³⁰

After identifying the highest potential charging infrastructure sites, it is important to consider – at the site planning level – about the logistics of installing charging infrastructure and ensuring that they are easy to find and easy for drivers to use. There is a breadth of

Key Finding for the NJTPA Study

There is robust information in the literature about how to assess charging needs in a community (e.g., consumer surveys, automobile dealer interviews, parking analysis), but few studies conduct a spatial analyses of land use to identify land parcels for PEV charging and prioritize locations. This analysis will be critical for the NJTPA region.

²⁵ California PEV Collaborative, *Taking Charge: Establishing California Leadership in the Plug-In Electric Vehicle Marketplace*, http://www.pevcollaborative.org/sites/all/themes/pev/files/docs/Taking_Charge_final2.pdf. December 2010.

²⁶ Bay Area Air Quality Management District, *PEV Readiness Plan*, <http://www.baaqmd.gov/~media/files/strategic-incentives/ev-ready/bay-area-pev-readiness-plan-background-and-analysis-web-pdf.pdf?la=en>. December 2013.

²⁷ Georgetown Climate Center, *EVSE Cluster Analysis: EVSE Support Study*, <http://www.nyscrda.ny.gov/~media/Files/Programs/ChargeNY/EVSE-Cluster-Analysis.pdf>. December 2012.

²⁸ NJDEP, Drive Green New Jersey, <http://www.drivegreen.nj.gov/index.html>. Accessed September 1, 2013.

²⁹ U.S. DOE, Alternative Fueling Station Locator, <http://www.afdc.energy.gov/locator/stations/>. Accessed September 1, 2016.

³⁰ Luskin Center at University of California – Los Angeles, *Western Riverside PEV Deployment Plan*, <http://innovation.luskin.ucla.edu/content/western-riverside-plug-electric-vehicle-deployment-plan>. July 2013.

information on siting best practices, including NYSERDA's guidebook, *Site Design for EV Charging Stations*,³¹

Finally, it is critical to understand the load that these additional charging stations will place on the local electrical grid. While almost every study mentions this, only a few look closely at projected loads from PEV charging, specifically the DVRPC and Bay Area Air Quality Management District PEV readiness plans. The DVRPC plan recommends dynamic pricing strategies and smart grid technologies as potential ways to level out the additional peak load associated with PEV charging.

Regulatory and Policy Frameworks

Regulatory and policy frameworks at the municipal, state, and federal levels can play a role in facilitating PEV adoption. Furthermore, to the extent that the global market for PEVs matures at the same pace as the United States, a look at international efforts sheds light on the issues that may not have been previously considered.

The key components of an effective municipal regulatory framework are building, electrical, and zoning codes; parking rules; permitting processes; and incentives. State and federal laws and incentives and utility programs can also contribute to PEV deployment.

Municipal

At the municipal level, two types of codes that can influence charging infrastructure deployment (and, by extension, PEV adoption) are building and electrical codes: collections of rules that govern infrastructure development and are developed by experts to ensure public health and safety. In New Jersey, the Department of Community Affairs has adopted statewide building and electrical codes, though local inspectors are responsible for enforcement.³²

Most existing readiness plans recommend that municipalities adopt provisions for their codes from the International Code Council. In municipalities that are limited in their capacity to amend codes, it is also possible to encourage voluntary pre-wiring or installation of electrical conduit to prepare for potential future charging infrastructure. Los Angeles is considered a good case study of PEV-ready building requirements (see box).

Zoning codes identify the allowable types of development and use of property within a jurisdiction. By addressing charging infrastructure explicitly in zoning codes, municipalities can help developers understand their options with respect to PEV and charging

Key Finding for the NJTPA Study

Consistency and standardization across municipalities for zoning codes, permitting and inspection, and parking regulations reduce confusion for the municipal staff and consumers. New Jersey municipalities engaged with the Sustainable Jersey program (see the Alternative Fuel Vehicle Readiness Planning in the North Jersey Region section) are already exposed to many of these best practices. For instance, to earn points for the Make Your Town Electric Vehicle Friendly action,¹ municipalities must update zoning and parking policies to encourage PEV deployment. Municipalities can choose from a list of other activities, including pre-wiring ordinances.

¹ Sustainable Jersey, Make Your Town Electric Vehicle Friendly, http://www.sustainablejersey.com/actions-certification/actions/?type=1336777436&tx_sicert_action%5BactionObject%5D=520&tx_sicert_action%5Baction%5D=getPDF&tx_sicert_action%5Bcontroller%5D=Action&cHash=38e44e6f3893e6fef20fca68f3539fd. October 2014.

³¹ NYSERDA, *Site Design for EV Charging Stations*, <http://www.nyserdera.ny.gov/-/media/Files/Programs/ChargeNY/Site-Design-for-EV-Charging-Stations.pdf>. July 2012.

³² New Jersey Department of Community Affairs, Codes and Regulations, <http://www.state.nj.us/dca/divisions/codes/codreg/>. Accessed September 8, 2016.

infrastructure deployment. There are numerous resources to identify sample zoning ordinance language for jurisdictions. DVRPC's *Ready to Roll!* provides sample zoning language and a list of other community zoning ordinance templates for reference.³³

Municipalities typically control their own permitting and inspection processes. Differences from town to town can cause confusion for electricians and charging station installers. Standardizing these processes will help prevent inconsistencies. The U.S. DOE developed a permitting template for residential charging infrastructure installations in an effort to encourage PEV readiness.³⁴ The U.S. DOE also provides diagrams of the streamlined permitting processes implemented in three cities that have been leaders in this area: Houston, Texas,³⁵ Los Angeles, California,³⁶ and Raleigh, North Carolina.³⁷

Parking rules specify the requirements for location, accessibility, use, design, and fees of public parking spaces. Many communities develop rules specific to parking spaces with charging infrastructure. The Des Moines Area Metropolitan Planning Organization provides guidance regarding site design and parking ordinances, as well as sample

Case Study: Raleigh, North Carolina

Raleigh, North Carolina was an early mover in PEV readiness. The city's efforts began in 2009, when the Research Triangle Region joined Project Get Ready, an initiative to help U.S. cities prepare for PEVs. The city created an interdepartmental team that included representatives from the city's departments of transportation, sustainability, development services, permitting, administration, and public affairs, as well as from the Triangle Clean Cities coalition, Duke Energy, and Advanced Energy, which served as an energy advisor.

This team developed and implemented expedited charging infrastructure permitting and installation processes, which has since been used by many other municipalities as a model. With these processes, the entire assessment, permitting, installation, and inspection process for a basic residential charging infrastructure project can be completed in as few as two days. The team reached out to municipalities in the surrounding area to work toward building consistent permitting and installation processes, as well.

The PEV readiness team also accomplished the following steps:

- Developed the *Greater Triangle PEV Readiness Plan* and the *PEV Roadmap for North Carolina*²;
- Addressed charging infrastructure barriers related to building codes, electrical codes, and city ordinances;
- Installed the city's first combination solar photovoltaic charging station and energy storage demonstration site in partnership with Duke Energy;
- Provided educational forums to highlight PEV technology and charging infrastructure; and
- Prepared guides and resources for consumers, electrical contractors and inspectors, and other stakeholders.

These efforts have encouraged PEV sales in the region – according to the North Carolina Division of Motor Vehicles, PEV registrations in Wake County more than tripled between August 2012 and June 2014. Cities seeking PEV readiness continue to use Raleigh as a model and learn from the city's experiences.³

¹ Advanced Energy, *Greater Triangle PEV Readiness Plan*, <http://www.advancedenergy.org/portal/ncpev/docs/GreaterTrianglePEVReadinessPlan-Version1.1-February2013.pdf>. February 2013.

² Advanced Energy, *PEV Roadmap for North Carolina*, http://www.advancedenergy.org/portal/ncpev/readiness_plans.php#state. Accessed September 1, 2016.

³ U.S. Department of Energy, *Raleigh, North Carolina, Paves the Way for PEV Success*, <http://www.afdc.energy.gov/case/1001>. September 2014.

³³ DVRPC, *Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action Plan*, <http://www.dvrpc.org/reports/12055B.pdf>. June 2013.

³⁴ M. Simpson, *EVSE Residential Permit Template*, http://www1.eere.energy.gov/cleancities/toolbox/pdfs/residential_permit_template.pdf. June 2013. For template, see: http://www.afdc.energy.gov/pdfs/EV_charging_template.pdf.

³⁵ U.S. DOE, *Houston Energizes Deployment of PEVs*, <http://www.afdc.energy.gov/case/1003>. September 2014.

³⁶ U.S. DOE, *Los Angeles Sets the Stage for PEVs*, <http://www.afdc.energy.gov/case/1002>. October 2014.

³⁷ U.S. DOE, *Raleigh, North Carolina, Paves the Way for PEVs Success*, <http://www.afdc.energy.gov/case/1001>. September 2014.

parking code language in its report, *Electric Vehicle Readiness: Energy Efficiency through Regional Planning*.³⁸

Lastly, municipalities can provide incentives, such as grants for vehicles or equipment, HOV lane and time-of-day and day-of-week driving restrictions, parking fee exemptions, or “head of the line” incentive programs, such as that at the Dallas Love Field airport.³⁹

State and Federal

State and federal laws and incentives have and will continue to play a large role in the mainstream adoption of PEVs. The U.S. DOE *Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects*⁴⁰ provides an overview of the most effective state incentives, and the U.S. DOE’s Alternative Fuels Data Center (AFDC) maintains an up-to-date, comprehensive database of all state and federal laws and incentives.⁴¹ The most common are:

- **Laws & Regulations**
 - Fuel use requirements (for public and private fleets)
 - Alternative fuels taxes
 - PEV parking space regulations
 - Charging infrastructure building standards and policies for multi-unit dwellings
 - PEV registration laws
- **Incentives**
 - PEV and charging infrastructure rebates
 - PEV and charging infrastructure tax credits
 - Exemptions (e.g., emissions testing, HOV lanes)

The federal government provides one of the largest currently available PEV financial incentives in the form of its federal tax credit of up to \$7,500 for qualified PEVs and its alternative fuel infrastructure tax credit. In addition, some federal agencies award grant funds that can be used for PEVs and charging infrastructure. For instance, the 2012 Moving Ahead for Progress in the 21st Century transportation explicitly states that U.S. Department of Transportation programs, such as the Congestion Mitigation and Air Quality (CMAQ) Improvement program, allow the use of funds for PEV and NGV fueling infrastructure. One example of a CMAQ-funded program is Charge Ahead Colorado⁴², which provides financial support for fleets for PEVs and charging infrastructure.

In addition to discussing state laws and incentives, U.S. DOE’s *Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects* also discusses the impact that tax credits and other federal laws and incentives are playing in the widespread adoption of PEVs.⁴³

³⁸ Des Moines Area Metropolitan Planning Organization, *Electric Vehicle Readiness: Energy Efficiency through Regional Planning*, <https://dmampodemo.files.wordpress.com/2014/12/electric-vehicle-report1.pdf>. August 2014.

³⁹ City of Dallas, Texas, Ordinance No. 27831, <http://www.greendallas.net/pdfs/TaxisOrdinance.pdf>. Accessed August 30, 2016.

⁴⁰ U.S. DOE, *A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects*, http://www.afdc.energy.gov/uploads/publication/guide_ev_projects.pdf. January 2014.

⁴¹ U.S. DOE, Alternative Fuels Data Center, Laws and Incentives Database, <http://www.afdc.energy.gov/laws>. Accessed August 30, 2016.

⁴² <http://cleanairfleets.org/programs/charge-ahead-colorado>

⁴³ U.S. DOE, *A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects*, http://www.afdc.energy.gov/uploads/publication/guide_ev_projects.pdf. January 2014.

PEV Market: Spotlight on California

With about 12% of the U.S. population, California accounted for over 50% of PEV sales in 2015.¹ While there are many regulatory and market drivers at play, some of the most notable are summarized below.

The primary regulatory mechanism for support of PEVs comes from California's progressive Zero Emission Vehicle (ZEV) Program, which requires automobile manufacturers to offer an increasingly large percentage of ZEVs for sale through Model Year 2025. In advance of the regulation becoming more stringent in 2018, many vehicle manufacturers have positioned themselves by pushing PEVs, General Motors and Nissan most prominently. In an effort to move cars in a competitive marketplace and bring in customers that might be hesitant about a new technology, manufacturers have offered attractive dealer price reductions and lease financing, all in addition to an existing state vehicle rebate and federal tax incentives.

While California is consistently ahead of the rest of the country, the market is not uniform. In Southern California, where traffic congestion is the worst in the country, drivers are motivated by access to high occupancy vehicle lanes through Clean Air Vehicle decals. Studies and anecdotal evidence have placed a value of up to \$5,000 on these stickers in areas with particularly high commute times.² On the other hand, Northern California, with its high income population, many of whom are in the technology sector, was ground zero for Tesla's significant Model S sales volumes.³

Even with state-level incentives, HOV lane access, and attractive and aggressive dealer pricing, PEVs are only about 3% of new vehicle sales in California.⁴ However, there is reason for optimism, particularly for states that are looking to seed the market early and dial back policy interventions sooner. In addition, new programs and incentives in the state promise more growth in the future. For example, California's investor-owned utilities, are about to make major investments in charging infrastructure.

¹ Hybridcars.com, California Plug-in Sales Led The US Last Year With Nearly Five-Times Greater Market Share, <http://www.hybridcars.com/california-plug-in-sales-led-us-last-year-with-nearly-five-times-greater-market-share/>. February 2016.

² Green Car Reports, California HOV-Lane Stickers For Hybrids: Worth \$1,200 To \$1,500, http://www.greencarreports.com/news/1021405_california-hov-lane-stickers-for-hybrids-worth-1200-to-1500. June 2009.

³ Argonne National Laboratory, Light Duty Electric Drive Vehicles Monthly Sales Updates, <https://www.anl.gov/energy-systems/project/light-duty-electric-drive-vehicles-monthly-sales-updates>. Accessed November 8, 2016.

⁴ Hybridcars.com, California Plug-in Sales Led The US Last Year With Nearly Five-Times Greater Market Share, <http://www.hybridcars.com/california-plug-in-sales-led-us-last-year-with-nearly-five-times-greater-market-share/>. February 2016.

International

Outside of the United States, several major cities around the world are addressing the same issues. Based on the literature reviewed from the United Kingdom and Canada, many of the challenges and opportunities for PEV and charging infrastructure are the same, even in a different regulatory environment.

However, these publications provide a different perspective on issues that may not have been thoroughly addressed in the United States. For example, the *Canadian EV Infrastructure Deployment Guidelines 2014* includes a specific discussion of charging infrastructure installations in flood zones and snow zones, which is relevant to the North Jersey region and a topic not discussed by many other resources.⁴⁴

⁴⁴ CEATI International, Inc., Natural Resources Canada and BC Hydro, Electric Transportation Engineering Corporation; *Canadian Electric Vehicle Infrastructure Deployment Guidelines 2014*; http://pluginbc.ca/wp/wp-content/uploads/2014/07/DC14-071-Canadian-EV-Infrastructure-Deployment-Guidelines-2014_web.pdf. March 2014.

Electric Vehicles in Urban Europe's *London Local Action Plan* provides an Electric Vehicle Readiness Index,⁴⁵ which is an interesting complement to the U.S. DOE's PEV Readiness Scorecard and similar resources used in California.⁴⁶

Utilities

While the government plays a large role in developing a system that incentivizes PEV adoption and lays the groundwork for safe, consistent charging accessibility, utilities are also key players in the process. The U.S. DOE's AFDC Laws and Incentives database⁴⁷ includes utility programs and incentives related to PEVs. Example utility incentives and programs include incentives for dealerships to sell PEVs, reduced time-of-use electricity

Key Finding for the NJTPA Study

Collaboration with local utilities is important to successfully PEV deployment. While the concern of grid overload may not be a threat in the immediate future, as PEVs and charging infrastructure become more prevalent, it will be critical that utilities manage their local distribution assets effectively. The *Electric Vehicle Readiness Plan for Ventura, Santa Barbara, and San Luis Obispo Counties (Central Coast)*¹ provides information and resources for utility programs, as well as a detailed analysis of potential grid integration issues and plans to minimize effects of charging on the electric grid.

¹ California Energy Commission, *Electric Vehicle Readiness Plan for Ventura, Santa Barbara, and San Luis Obispo Counties (Central Coast)*, http://www.vcapcd.org/pubs/Rules/homepage/PlugInCentralCoastEVReadinessPlan_201400715.pdf. July 2014.

Case Study: Los Angeles, California

Los Angeles, California is one of the largest vehicle markets in the United States, with 4 million residents and one of the nation's highest per-capita vehicle ownership rates. Los Angeles' municipal utility is leading Los Angeles' PEV efforts and is a great example of the prominent role utilities play in PEV readiness. As part of its Electric Vehicle Program, Los Angeles Department of Water and Power (LADWP) upgraded over 250 publicly accessible charging stations and provided rebates for nearly 1,000 residential and commercial charging stations through 2013. It funded an additional 2,000 charging stations for residential and commercial customers through mid-2015. In parallel to these incentives, LADWP has been promoting off-peak residential charging by offering discounted electric rates and working with charging infrastructure providers to evaluate the interaction of charging infrastructure with utility meters to enable effective time-of-use pricing. Additionally, the utility incorporated both light- and heavy-duty PEVs into its fleet.

LADWP's efforts have not stopped at the city's borders – it initiated the Southern California Regional PEV Plan (SoCal EV) to foster collaboration among southern California utilities, governments, automakers, businesses, and other stakeholders in support of PEV and charging infrastructure deployment. This plan has also sought to educate stakeholders about the benefits of PEVs, streamline the charging infrastructure permitting and installations processes, adopt local codes and standards to encourage PEV deployment, and develop a customer service process that can support large-scale PEV deployment. As a result of these efforts, there were over 500 charging stations in the Los Angeles metropolitan region at nearly 140 publicly-accessible locations as of August 2014, including the Los Angeles International Airport and Los Angeles World Airports.

¹ U.S. DOE, Los Angeles Sets the Stage for PEVs, <http://www.afdc.energy.gov/case/1002>. October 2014.

⁴⁵ Electric Vehicles in Urban Europe, *London Local Action Plan*, http://urbact.eu/sites/default/files/import/Projects/EVUE/outputs_media/London_Action_Plan.pdf. August 2012.

⁴⁶ Governor's Office of Planning and Research, State of California, *Zero-Emission Vehicles (ZEVs) in California: Community Readiness Guidebook*, https://www.opr.ca.gov/docs/ZEV_Guidebook.pdf. 2013.

⁴⁷ U.S. DOE, Alternative Fuels Data Center, Laws & Incentives Database, <http://www.afdc.energy.gov/laws>. Accessed September 6, 2016.

rates for PEV owners, rebates for PEVs and charging infrastructure, free charging stations (see discussion of Public Service Electric & Gas, PSE&G's, program in the Alternative Fuel Vehicle Readiness Planning in the North Jersey Region section), and educational events.⁴⁸

Strategies for Advancement

Outside of regulations and incentives, the four predominant components of PEV advancement include strategic partnerships, charging corridor planning, targeted procurement practices, and stakeholder training and education.

Partnerships

Most PEV-related literature and readiness plans are the result of multi-lateral partnerships. PEV coordinating councils and stakeholder working groups have come together around the United States to facilitate PEV adoption and charging infrastructure deployment at the municipal, regional, state, and national levels.

Readiness planning groups typically include representatives from city and county governments, regional and state government agencies, utilities, educational institutions, nonprofits, and business partners. One example is the North Coast Plug-in Electric Vehicle Coordinating Council (California), which was formed to maintain clear and consistent communication amongst local stakeholders throughout the North Coast PEV Readiness Planning Project. Members of the council can seek input from within their organization on key issues and they can also participate in working groups throughout the project.⁴⁹

Another example closer to home is the DVRPC, the metropolitan planning organization for southeastern Pennsylvania. The DVRPC partnered with the City of Philadelphia, PECO Energy Company, and Greater Philadelphia Clean Cities to develop the region's PEV readiness plan. It continues to coordinate with these groups to further the recommendations that resulted from the plan.

Corridor Planning

A commonly discussed strategy for PEV advancement is the development of "charging corridors" to ensure PEV drivers have access to charging stations for long-distance trips. This is a concept that could be highly effective along the Eastern Seaboard (e.g., along I-95).

One such corridor that has received significant attention is the West Coast EV Highway along I-5 (see box), which is discussed in *The Upstate PEV Readiness Plan* and the Federal Highway Administration's (FHWA) *Feasibility and Implications of Electric Vehicle (EV) Deployment and Infrastructure Development*.⁵⁰

Key Finding for the NJTPA Study**

With the increased attention on the I-95 and I-80 corridors following their designation by the FHWA, the charging infrastructure in the surrounding communities will be an important focus area for readiness planning.

** Also applies to NGV readiness.

⁴⁸ U.S. DOE, Utility Initiatives Foster Plug-In Electric Vehicle Charging at Home and Work, http://www.afdc.energy.gov/bulletins/technology_bulletin_2015_12_08.html. January 2016.

⁴⁹ Redwood Coast Energy Authority, *North Coast Plug-in Electric Vehicle Readiness Plan*, <http://www.redwoodenergy.org/images/Files/EV/FINAL%20North-Coast-EV-Readiness-Plan.pdf>. July 2014.

⁵⁰ FHWA, *Feasibility and Implications of Electric Vehicle (EV) Deployment and Infrastructure Development*, https://www.fhwa.dot.gov/environment/climate_change/mitigation/publications/ev_deployment/page11.cfm. Accessed August 30, 2016.

Case Study: West Coast EV Highway

The West Coast EV Highway is one example of a robust PEV charging corridor. Numerous partners participated in a \$230M U.S. DOE corridor project grant, including ECOTality (now Blink, owned by CarCharging). This corridor is comprised of charging infrastructure located at strategic points along I-5, which runs from Vancouver, British Columbia to Baja, Mexico.

To determine the number of chargers necessary in this corridor, the EV Highway team built a PEV deployment simulation model and projected the impact of infrastructure on PEV drivers' experiences. On a macro level, the team found that relatively few chargers are needed to support a large number of PEV drivers, but the order in which charging infrastructure are sited is meaningful. Level 2 chargers are important early on, with DC fast chargers only becoming necessary in high penetration areas.

The project team used these macro conclusions to create a micrositing rubric tool that ranked 99 candidate charging infrastructure sites based on criteria, such as proximity to suitable electrical connection; minimal trenching required through paved areas; public visibility; and proximity to basic services. After ranking these sites, the team used owner consultations at the top 29 sites to develop a list of the nine top sites.

The project has resulted in a cohesive set of charging infrastructure that enable PEV drivers to comfortably travel the length of the Pacific Coast without "range anxiety." It resulted in many lessons learned that apply to any corridor on the East Coast, including the need to prepare for weather conditions (e.g., radiant-heated concrete pads, a snowplow plan), to provide multiple charging connectors, and to work closely with electric utilities to plan for grid demands and future expansion (e.g., utility upgrades).²

¹ Siskiyou County Economic Development Council, *Upstate PEV Readiness Plan*, <https://static1.squarespace.com/static/53764d9fe4b0cb63d6f97b20/t/546bbf05e4b02cdf60e99f49/1416347462203/Readiness+Plan>. Accessed August 29, 2016.

² Washington State Department of Transportation, West Coast Electric Highway DC Fast Charging Network: Best Practices in Fast Charging Corridors, <http://evroadmapconference.com/program/presentations15/ToniaBuell.pdf>. July 2015.

The FHWA recognizes the importance of this strategy in order to achieve widespread AFV adoption. As such, the agency recently accepted nominations from state and local officials to designate charging and other alternative fuel corridors.⁵¹ New Jersey supported two regional applications to nominate the I-80 and the I-95 corridors to be designated as part of this effort. On November 3, 2016, the FHWA and the White House announced both signage-ready corridors (i.e., routes where alternative fuel is already available and are now eligible to feature the associated signage) and signage-pending corridors (i.e., routes that will need additional build-out of infrastructure to be considered signage-ready). Specifically, the FHWA designated the following EV corridors, which run through New Jersey:

- **Signage-ready**
 - I-95: From Augusta, Maine, to the Washington, DC/Virginia border.
 - EV: I-80: From Manhattan, New York, to Budd Lake, New Jersey.

⁵¹ FHWA, Federal Register Notice – Fixing America's Surface Transportation Act-Designation of Alternative Fuel Corridors, <https://www.federalregister.gov/articles/2016/07/22/2016-17132/fixing-americas-surface-transportation-act-designation-of-alternative-fuel-corridors>. Accessed September 6, 2016.

- **Signage-pending**
 - EV: I-80: From Budd Lake, New Jersey, to Streetsboro, Ohio.⁵²

Procurement Practices

Procurement policies establish the process and requirements that organizations – both public and private – must follow when acquiring goods and services. Both government and private fleet procurement policies can influence broader PEV and charging infrastructure deployment. The DVRPC's *Ready to Roll!* includes a list of steps that governments can take to stimulate PEV and charging infrastructure deployment through their procurement practices.⁵³ For example, governments can include PEV models on local purchasing lists and adopt procurement policies that prioritize or align with PEV advantages.

Education and Training

As the U.S. DOE asserts, education and training are critical components of increased PEV deployment.⁵⁴ For example, consumer education may ease concerns about charging station availability and whether PEVs can fit into their current lifestyle. Additionally, electrician and inspector training will ensure efficient and consistently high quality charging station installations. Dealership training results in a more educated vehicle salesforce, more likely to accurately and effectively promote the vehicles and the associated benefits. If PEV owners have a positive experience, it will assist in the continued spread of PEV adoption. Lastly, a few publications in the literature address the need for safety training for first responders, drivers, and fleet managers.

Key Finding for the NJTPA Study**

Readiness planning efforts should include training considerations for consumers, electricians, inspectors, dealerships, first responders, and fleet managers.

*** Also applies to NGV readiness.*

⁵² FHWA, Alternative Fuel Corridors, http://www.fhwa.dot.gov/environment/alternative_fuel_corridors/. Accessed November 3, 2016.

⁵³ DVRPC, *Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action Plan*, <http://www.dvrpc.org/reports/12055B.pdf>. June 2013.

⁵⁴ U.S. DOE, *A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects*, http://www.afdc.energy.gov/uploads/publication/guide_ev_projects.pdf. January 2014.

Best Practices

The DVRPC's *Ready to Roll!*, U.S. DOE's *Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects*, and Georgetown Climate Center's *Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools* are three key resources that provide a comprehensive set of relevant lessons learned and recommendations for a PEV readiness plan in North Jersey. These best practices span regulatory elements, utility and grid considerations, incentives, training/education, and include:

- Implement or revise existing building and electrical codes to encourage charging infrastructure in new construction;
- Revise zoning codes to add charging infrastructure as a permitted use, include consistent PEV-related definitions, and require charging infrastructure for specific land use development;
- Adopt charging infrastructure design standards in zoning codes;
- Provide a database of local licensed electricians and a permit application checklist to assist PEV owners in preparing a charging infrastructure installation and permit application;
- Make permits available over-the-counter or online;
- Adapt parking rules to specify design criteria for PEV parking spaces and establish clear regulations and enforcement policies for PEV parking spaces;
- Collaborate with neighboring jurisdictions to develop signage that is consistent with the FHWA Manual on Uniform Traffic Control Devices and also consistent from community to community;
- Conduct audience-specific outreach and training using local partnerships and a variety of media; and
- Map potential charging infrastructure demand to identify areas in need of infrastructure upgrades and consider alternative rate structures to incentivize off-peak electricity use patterns.

Natural Gas Vehicle Readiness Planning

The project team reviewed 16 documents that considered NGVs. While the scope of the literature offered a thorough and informative picture of the NGV market and implementation planning process, the relatively small number of resources prevented as broad of an assessment as the PEV market assessment. The lack of available NGV literature is reflective of the fact that the focus is on fleets. This differs from a consumer focus for PEVs, which makes them more mainstream. While NGV deployment involves the same level of infrastructure planning, education and outreach, and other efforts, it does not typically involve as many stakeholders.

Although over three quarters of the reports touched on some aspects of market conditions, only a handful actually analyze the vehicle market and provide quantitative metrics. Few of the sources offered a robust discussion of the regulatory framework surrounding NGV implementation. Even fewer offered insight into zoning and permitting. Approximately half addressed building codes and utility concerns, and most reports did elaborate on incentive options.

Most sources also described considerations related to infrastructure, including selecting the appropriate technology and accounting for factors such as frequency of usage, size of fleet, and weather. Partnerships were also discussed in nearly all of the reports.

Regardless of any gaps in information, the literature reviewed covers a variety of important topics that are valuable in the NGV planning assessment process.

Challenges and Benefits Evaluation

Of the literature that focused on NGVs, the majority covered the challenges and benefits associated with implementation and market penetration. The depth of evaluation varied between reports.

Benefits

NGVs offer a variety of benefits for vehicle owners and their communities, including economic advantages, particularly when gasoline prices are high. A few resources mentioned the domestic availability of natural gas and the associated energy independence as driving factors in the decision to convert to NGVs. The other primary benefits described cover environmental and economic benefits.

Environmental

Most of the reports describe emissions reductions and enhanced air quality as key benefits associated with NGV use. A report from America's Natural Gas Alliance presents the experiences of numerous fleets around the country that have successfully reduced air pollution through the adoption of NGVs.⁵⁵ New Jersey cities, for example, expect a 75% to 95% reduction in NO_x emissions from natural gas use, compared to diesel and gasoline vehicles. The Weld County (Colorado) Natural Gas Coalition cites

Key Finding for the NJTPA Study

Without established best practices in the areas of quantitative market analysis, regulatory frameworks, zoning, permitting, and building codes, the project team will need to focus further attention in these areas, soliciting input from a variety of stakeholders, including utilities and local fleets.

⁵⁵ America's Natural Gas Alliance, *Natural Gas Works for Cities: Ideas for Mayors*, http://www.angas.us/media/blog/CE74DE44-938B-DF68-DD25B58FF7FFCCE1/files/angas_mayorfs_finalaa.pdf, June 2010.

their location in an 8-Hour Ozone Non-Attainment Area as a factor in the county’s investment in CNG.⁵⁶ NGVs result in fewer emissions than conventional gasoline or diesel vehicles, thus contributing to the achievement of regional emissions reduction goals. For example, the Weld County report states that a typical NGV can reduce carbon monoxide emissions by approximately 70% over a gasoline vehicle.

Economic

Nearly all of the literature mentions economic benefits in the form of cost savings, job creation, and investments in long-term investments, such as public fueling stations. While the financial benefit of NGVs may have decreased in recent years as oil prices have come down, the payback period becomes more favorable if prices increase again to levels similar to the late 2000s.

Weld County’s report includes a table from an economic impact analysis describing the job creation, labor income, and gross domestic product (GDP) benefits associated with the natural gas industry.⁵⁷ The National Renewable Energy Laboratory (NREL) authored a study describing the factors affecting project profitability in different scenarios.⁵⁸ The report describes considerations affecting rate of return, net present value, and payback period to assist fleets in the decision making process. The NREL report provides the graph in Figure 6, which details the relationship between fleet size, fleet type, and payback period.

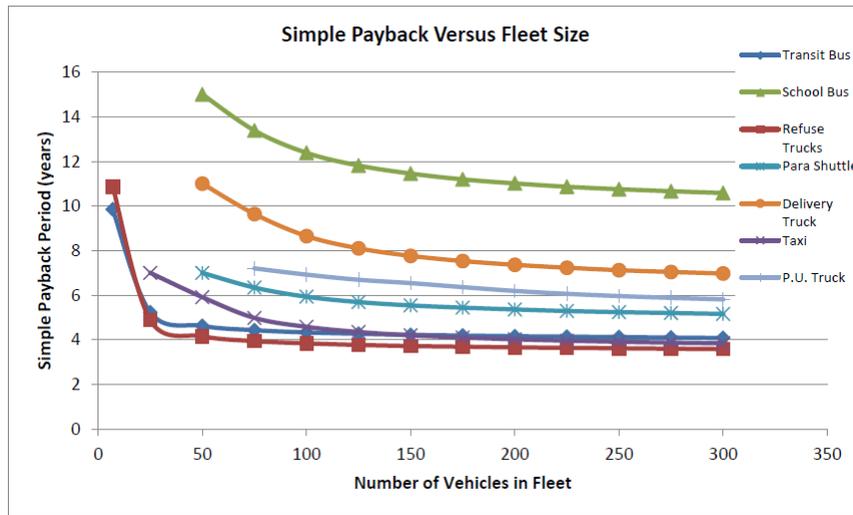


Figure 6. Simple Payback versus Fleet Application and Size⁵⁹

Overall, the literature’s assessment of benefits not only gives prospective fleets a sense of the positive effects of implementing NGVs, it also helps communities determine whether their own fleets might be able to realize similar benefits based on a variety of factors, including project type (vehicle acquisitions only, or vehicles and fueling infrastructure), investment type

⁵⁶ Weld County Natural Gas Coalition, *Alternative Fuel Corridor Plan*, <http://www.weldsmartenergy.org/assets/805Bc45794c8C9B25272.pdf>. Accessed September 7, 2016.

⁵⁷ Ibid

⁵⁸ NREL, *Building a Business Case for CNG in Fleet Applications*, http://www.afdc.energy.gov/uploads/publication/business_case_cng_fleets.pdf, March 2015.

⁵⁹ Ibid

(infrastructure investment locked to vehicle acquisitions, or not), vehicle type, average vehicle miles traveled, average vehicle life, expected fuel economy, and availability of incentives.

Challenges

Challenges addressed in the literature ranged from technological barriers and policy obstacles to public reluctance and cost issues. A handful of reports identified specific challenges faced by regions or municipalities when working to construct a new natural gas station or to deploy the fuel in a new fleet. The Colorado Energy Office describes the challenges experienced by local fleets.⁶⁰ For example, NGV fleet use in the City of Grand Junction eventually resulted in significant fuel cost savings and reduced vehicle emissions, but the project faced some initial challenges in terms of funding and infrastructure requirements.

Environmental

Although burning natural gas produces fewer carbon dioxide emissions than other fossil fuels, it is not devoid of environmental challenges.⁶¹ Natural gas consumption emits methane, a long-lasting GHG that is significantly more potent than carbon dioxide and a major contributor to climate change.

In addition, systems producing and distributing natural gas are the primary contributors to methane emissions in the United States.⁶² Leaks from distribution sources or transmission pipelines are among the top pathways for natural gas to enter the environment, and because of methane's potency, even just a small percentage of leaking infrastructure can have significant emissions implications. Any municipality intending to deploy NGVs or the associated infrastructure should be aware of the environmental tradeoffs of this fuel, and should encourage environmentally-safe practices.

There is also widespread concern about the environmental and public health impacts (e.g., on water resources) of hydraulic fracturing, the process by which natural gas and petroleum are extracted from shale formations in the United States. The U.S. Environmental Protection Agency (EPA) is currently evaluating these concerns, working with states, and assessing the need for additional regulatory protections.⁶³ While not widely discussed in the literature, more recently introduced renewable natural gas⁶⁴ results in far fewer GHG emissions and avoids conventional natural gas production concerns.

Economic

The report by the California Statewide Alternative Fuel and Fleets Project and Clean Fuel Connection goes into detail about the cost-related challenges that fleets may encounter during the NGV implementation process.⁶⁵ The report suggests methods and resources for determining the financial feasibility of a project, including a number of

⁶⁰ Colorado Energy Office, *Experiences with Compressed Natural Gas (CNG) in Colorado Vehicle Fleets*, <https://www.colorado.gov/pacific/sites/default/files/atoms/files/CNG%20Case%20Studies.pdf>. August 2012.

⁶¹ U.S. EIA, Frequently Asked Questions, <https://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11>. Accessed October 23, 2016.

⁶² U.S. EPA, Overview of Greenhouse Gases—Methane, <https://www.epa.gov/ghgemissions/overview-greenhouse-gases#CO2lifetime>. Accessed October 23, 2016.

⁶³ U.S. EPA, Natural Gas Extraction - Hydraulic Fracturing, <https://www.epa.gov/hydraulicfracturing>. Accessed October 27, 2016.

⁶⁴ Pipeline-quality natural gas produced from feedstocks such as landfill, livestock, and wastewater treatment biogas.

⁶⁵ California Statewide Alternative Fuel and Fleets Project, Clean Fuel Connection, Inc., *Permitting CNG and LNG Stations: Best Practices Guide for Host Sites and Local Permitting Authorities*, <http://www.baaqmd.gov/~media/files/strategic-incentives/alt-fuels/cng-and-lng-best-practices-9-30-14-final.pdf>. September 2014.

ownership models and their associated return on investment scenarios. Cost information about station operation is also included. NREL's *Building a Business Case for CNG in Fleet Applications* also goes into detail on project financing.

Infrastructure

Many case studies and examples in the literature emphasized the importance of a reliable infrastructure system on the overall success of fleet deployment. Over half of the reports reviewed discussed infrastructure-related challenges to some extent. These include siting issues, design considerations, safety and code compliance, and ensuring station access and availability.

A report from the Hydrogen Energy Center lists regulatory and permitting challenges that impede the development of NGV infrastructure in the Northeast, including technology, design, and financing challenges.⁶⁶

Technical issues are among the most commonly discussed. Most of the literature recommends that fleet planners consider the technical feasibility of natural gas access at the proposed station site, as some locations are unable to receive adequate natural gas supply due to capacity constraints, safety considerations, or remote locations.⁶⁷

Reports also take into account the differences between configurations of station infrastructure. A presentation by the Clean Cities Coalitions of Northern New England describes the differences between the four most common systems (cascade fast-fill, buffer fast-fill, time-fill, and combination-fill), and offers suggestions for how to determine the appropriate system for a fleet.⁶⁸

Throughout the infrastructure design and construction process, planning and compliance can be challenging but is necessary to ensure the final station is safe, financially-sound, and beneficial for the fleet.

Figure 7 shows the build-out of public CNG fueling infrastructure in New Jersey as of January 2017, which includes 13 stations. Three of these stations also have private (i.e., fleet only) fueling. There are an additional 12 private fueling stations in New Jersey. Figure 8 breaks down the number of stations in the NJTPA region by county and access.

Key Finding for the NJTPA Study

NGVAmerica urges fleets in the planning phases of a project to consider whether construction of a new station is necessary, stating that new construction may not be the most practical option when CNG or LNG stations already exist in the area.¹ This is especially applicable to smaller fleets or fleets undergoing a pilot test before committing to a longer-term, larger investment. These fleets may be able to use existing infrastructure or partner with others in the investment. Of course, natural gas infrastructure is not ubiquitous. It is crucial to first determine whether or not sufficient infrastructure exists in the area.

¹ NGVAmerica, *Transit*, <http://www.ngvamerica.org/vehicles-for-fleets/transit/>, Page Accessed August 19, 2016.

⁶⁶ Hydrogen Energy Center, *Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England*, <http://www.gpcog.org/wp-content/uploads/2015/03/Final-HEC-report.pdf>, January 2015.

⁶⁷ NGVAmerica, *Transit*, <http://www.ngvamerica.org/vehicles-for-fleets/transit/>, Accessed August 19, 2016.

⁶⁸ Clean Cities Coalitions of Northern New England, *NGVs - The Here and Now Technology: A Workshop for New England*, http://web.uri.edu/ceoc/files/CNG_Workshop_GPCOG_for_USDOE_RI_11202014.pdf, November 2014.

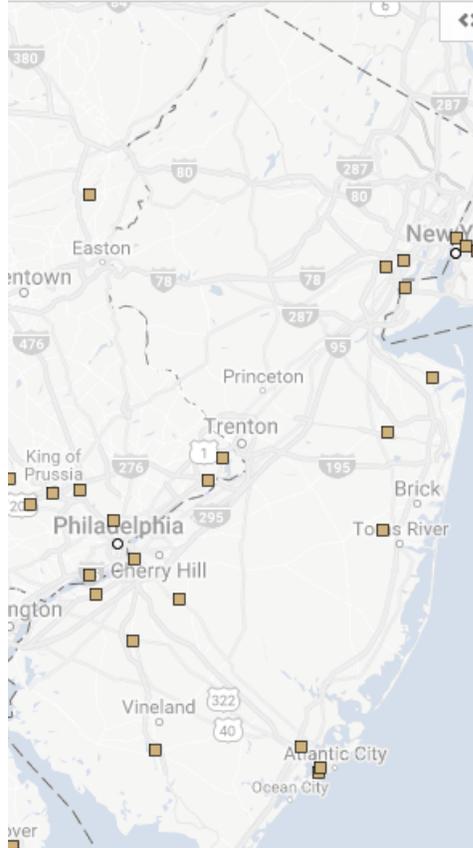


Figure 7. Publicly Accessible CNG Stations in New Jersey, January 2017⁶⁹

County	Public Only	Public/Private	Private Only
Bergen	0	0	1
Essex	1	0	2
Hudson	0	0	2
Hunterdon	0	0	0
Middlesex	0	0	0
Monmouth	1	1	1
Morris	0	0	1
Ocean	0	1	1
Passaic	0	0	0
Somerset	0	0	0
Sussex	0	0	0
Union	1	0	0
Warren	0	0	0
Total	3	2	8

Figure 8. Private and Publicly Accessible CNG Stations in the NJTPA Region by County and Level, January 2017⁷⁰

⁶⁹ U.S. DOE, Alternative Fuels Data Center, Station Locator, <http://www.afdc.energy.gov/locator/stations/>. Accessed January 17, 2017.

⁷⁰ U.S. DOE, Alternative Fuels Data Center, Station Locator, <http://www.afdc.energy.gov/locator/stations/>. Accessed January 17, 2017.

Techniques for Market Assessment

Almost all of the literature reviewed mentions the NGV market at least briefly, although few provide a thorough evaluation of the market status. A number of the reports provide some discussion of available vehicles and infrastructure technologies, fuel prices, and life cycle cost advantages.

Four of the reports stand out in terms of their effort to conduct a meaningful, thorough evaluation of the NGV market. The first, a market analysis conducted by TIAX and the American Gas Association, takes the most rigorous approach, relying on economics, analysis of multiple scenarios, and analysis of technologies.⁷¹ The second, a report by the California Statewide Alternative Fuel and Fleets Project and Clean Fuel Connection, includes actual cost broken down by vehicle application, and compares market trends across time and geographies, but is not as reliant on a quantitative methodology.⁷² The Colorado Energy Office conducted a separate market analysis that quantifies the benefits of the NGVs in the state in terms of jobs, labor income, average wages, and state revenue.⁷³ Finally, a presentation by the Clean Cities Coalitions of Northern New England takes a more instructive approach, displaying facts and figures that paint a comprehensive picture of the market but does not follow any particular methodology.⁷⁴

Market Status Evaluation

A report by the North Carolina State University Clean Energy Technology Center mentions the U.S. DOE Alternative Fuel Station Locator as a tool to help planners determine whether or not additional station development is worth the investment.⁷⁵ The report by TIAX and the American Gas Association separates CNG and liquefied natural gas (LNG) applications and presents the findings of an NGV market analysis that assesses challenges, decision factors, opportunities for growth, and market development scenarios. This market analysis looks at various vehicle segments and technologies, as well as market drivers, development activities, scenarios, and opportunities. Costs and return on investment values for a sample CNG station are also included.⁷⁶

Key Finding for the NJTPA Study

Techniques for NGV market assessment differ significantly from PEV analyses. They are much more focused on economic assessments by fleet and application type, as well as station siting analysis. This research and data collection will be critical to the NJTPA study.

In addition, some of the literature provides comparisons of the specific manufacturers and models of vehicles on the market so that planners can determine which vehicles best suit the needs of their fleet or their community.

⁷¹ TIAX, *Natural Gas Vehicle Market Analysis*, <https://www.aga.org/tiax-natural-gas-vehicle-market-analysis>. Accessed September 7, 2016.

⁷² California Statewide Alternative Fuel and Fleets Project, Clean Fuel Connection, Inc., *Permitting CNG and LNG Stations: Best Practices Guide for Host Sites and Local Permitting Authorities*. <http://www.baaqmd.gov/~media/files/strategic-incentives/alt-fuels/cng-and-lng-best-practices-9-30-14-final.pdf>. September 2014.

⁷³ Colorado Energy Office, *NGV Implementation Plan Presentation*, <https://www.codot.gov/programs/planning/documents/stac-archives/2013-stac/june-2013/ngv-implementation-plan-pres>. June 2013.

⁷⁴ Clean Cities Coalitions of Northern New England, *NGVs - The Here and Now Technology: A Workshop for New England*, http://web.uri.edu/ceoc/files/CNG_Workshop_GPCOG_for_USDOE_RI_11202014.pdf. November 2014.

⁷⁵ North Carolina State University Clean Energy Technology Center, *Planning and Installation Guide: North Carolina Compressed Natural Gas Fueling Stations*, <https://nccleantech.ncsu.edu/wp-content/uploads/CNG-Station-Installation-Guide.pdf>. Accessed September 7, 2016.

⁷⁶ TIAX, *Natural Gas Vehicle Market Analysis*, <https://www.aga.org/tiax-natural-gas-vehicle-market-analysis>. Accessed September 7, 2016.

Niche Application Assessment

In contrast to the PEV literature, the NGV literature does not address the consumer market. There is a relatively small number of consumer-owned NGVs on the road, and original equipment manufacturers and others have moved away from this market. A handful of reports offer insight as to which types of fleets are best suited for NGVs, based on factors such as life cycle cost savings, payback periods, and fuel use. The Clean Cities Coalitions of Northern New England presentation compares CNG economics for long haul (Class 8) trucks, refuse trucks, delivery step vans, delivery vans, and cargo vans, showing a range of between 1 and 3.5 years for payback based on mileage and fuel use.⁷⁷ LNG is also seen as a viable option in long haul trucks, as it offers greater range. The NREL report describes the relationship between fleet size and vehicle type (transit bus, school bus, refuse trucks, para shuttles, delivery trucks, taxis, and pick-up trucks) for a number of economic factors including return on investment and payback period. Understanding the differences in project economics for fleets of different sizes and types can help planners determine the feasibility of their plans.⁷⁸ Similar to PEVs, fleets with recurring routes and return-to-base operations are most ideal for NGV deployment.

Infrastructure Siting Analyses

Less than half of the natural gas-focused literature reviewed contained information specific to infrastructure siting; however, the reports that did cover this information included a variety of angles and options for communities to consider during their planning process. Some reports include a map of existing stations in the region, emphasizing that any siting of new infrastructure should consider how the new station will increase accessibility and

Case Study: Lower Merion School District

America's Natural Gas Alliance profiles the successes and challenges faced by a number of NGV fleets across the United States, including a case study highlighting Ardmore, Pennsylvania's successful CNG bus fleet. At the time of the report's publication, the Lower Merion School District had over 70 CNG school buses in operation. The CNG fleet got its start in 1996, and the school district has pursued updated vehicle models since that time. Over time, the fleet has displaced over 1 million gallons of diesel fuel, associated with a carbon monoxide emissions reduction of between 70% and 90% (over diesel emissions). Two CNG fueling stations are active in the area.

¹ America's Natural Gas Alliance, *Natural Gas Works for Cities: Ideas for Mayors*, http://www.anga.us/media/blog/CE74DE44-938B-DF68-DD25B58FF7FFCCE1/files/anga_mayorfs_finalaa.pdf, June 2010.

Key Finding for the NJTPA Study

A best practices guidance by the California Statewide Alternative Fuel and Fleets Project and Clean Fuel Connection provides questions for planners and fleet managers to consider as they engage in siting decisions.¹ The guidance includes information about the distribution of CNG versus LNG stations for public and private use, which can help planners determine where siting a new station would provide the most additional value to NGV users in the area. This guidance can be used by the project team in discussions with fleets in the North Jersey region.

¹ California Statewide Alternative Fuel and Fleets Project, Clean Fuel Connection, Inc., *Permitting CNG and LNG Stations: Best Practices Guide for Host Sites and Local Permitting Authorities*, <http://www.baaqmd.gov/~media/files/strategic-incentives/alt-fuels/cng-and-Ing-best-practices-9-30-14-final.pdf>, September 2014.

⁷⁷ Clean Cities Coalitions of Northern New England, *NGVs - The Here and Now Technology: A Workshop for New England*, http://web.uri.edu/ceoc/files/CNG_Workshop_GPCOG_for_USDOE_RI_11202014.pdf, November 2014.

⁷⁸ NREL, *Building a Business Case for CNG in Fleet Applications*, http://www.afdc.energy.gov/uploads/publication/business_case_cng_fleets.pdf, March 2015.

prevalence of natural gas technology. This should be considered a best practice for the North Jersey readiness planning efforts.

The TIAX and American Gas Association market analysis explores the relationship between natural gas infrastructure supply and demand for NGVs.⁷⁹ The analysis also presents a map of predicted major road usage in the future, offering planners a glimpse of where the most Class 8 truck traffic will be traveling and therefore where natural gas infrastructure will have the highest impact.

Regulatory and Policy Frameworks

An array of municipal, state, and federal policy approaches and concerns are addressed in the available literature on NGV implementation.

Municipal

At the municipal level, planning for vehicle and infrastructure deployment should address any necessary adjustments in zoning in order to efficiently and consistently implement the new technology. Local governments and planners can proactively revise their codes and bylaws so that the transition to natural gas is as seamless as possible. For example, although most new infrastructure will be located in areas zoned for commercial or industrial use, the guidance from the California Statewide Alternative Fuel and Fleets Project provides an example of how cities can include residential requirements in preparation for potential at-home NGV fueling infrastructure.⁸⁰ This would be most applicable if the consumer NGV market takes hold. It is also important for planners to ensure consistent compliance with existing statewide codes and regulations and to engage city officials in the preliminary stages of the project, especially as natural gas technologies may not have been considered when developing codes.⁸¹

Fleets and others need to take local zoning requirements into account, not only in terms of land use considerations, but also for safety regulations relating to the use of fuel, including maintenance facility upgrades. Natural gas use requires adherence with fire codes and environmental considerations. A report from the Hydrogen Energy Center

Key Finding for the NJTPA Study

A planning checklist from North Carolina State University outlines preliminary considerations for the permitting process, including initiating communication with residents and stakeholders, and determining which offices of the local permitting authority will be overseeing the process.¹ Other documents advise planners on the design and structural aspects of station permitting, and identify areas for improvement in current permitting processes. These documents will be valuable in planning efforts in North Jersey.

¹ North Carolina State University Clean Energy Technology Center, *Planning and Installation Guide: North Carolina Compressed Natural Gas Fueling Stations*, <https://nccleantech.ncsu.edu/wp-content/uploads/CNG-Station-Installation-Guide.pdf>. Accessed September 7, 2016.

Key Finding for the NJTPA Study

According to the Hydrogen Energy Center report, a challenge faced by infrastructure developers is that building code requirements are sometimes invoked for fueling systems that do not have a building component. The authors recommend the development of model permit terms and standards for municipalities so that the process for developing, permitting, and managing non-building fueling infrastructure is more predictable across towns and cities.¹

¹ Hydrogen Energy Center, *Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England*, <http://www.qpcog.org/wp-content/uploads/2015/03/Final-HEC-report.pdf>. January 2015.

⁷⁹ TIAX, *Natural Gas Vehicle Market Analysis*, <https://www.aga.org/tiax-natural-gas-vehicle-market-analysis>. Accessed September 7, 2016.

⁸⁰ TIAX, *Natural Gas Vehicle Market Analysis*, <https://www.aga.org/tiax-natural-gas-vehicle-market-analysis>. Accessed September 7, 2016.

⁸¹ Ibid

emphasizes the need for sufficient training of local zoning officials so that approval and enforcement are consistent, and so that decision-makers have the required information even if they are unfamiliar with a new technology.⁸²

Case Study: Grand Junction, Colorado

The City of Grand Junction, Colorado began using CNG in its municipal fleet in 2011. At the time of a 2012 report by the Colorado Energy Office, the city had seven NGVs in operation and planned to increase the number of NGVs in the fleet by over 40% that calendar year. In 2012, the fleet was composed of five refuse trucks, one street sweeper, and one dump truck. These vehicles utilized a fast-fill public access fueling station, as well as a time-fill station for city vehicles and transit fleet partners.

While the city’s 2012 fleet was composed of only a small number of NGVs, their planning process, challenges, and results provide helpful information for other municipalities. A public/private partnership between the city and a local infrastructure provider sparked implementation and catalyzed the installation of sufficient infrastructure. Through grant funding, partnerships, and careful planning, the city realized economic benefits not common among fleets of this size. The City of Grand Junction found that some initial costs were higher than anticipated, but through consultation with the local utility and other stakeholders, managed to find cost-effective alternatives.

In making the decision to pursue NGV deployment, the city considered its role in enhancing the connectivity of the I-70 corridor and narrowing the accessibility gap between consumers and vehicles and infrastructure. To get the project off the ground, planners from multiple municipal departments collaborated to complete paperwork and grant applications, to promote the effort, and to conduct feasibility studies and cost estimates. In convincing the city council to approve investments in NGVs, the fleet planners showed how NGV deployment fit into the larger sustainability goals of the city. Figure 9 below shows the benefits reported by the City of Grand Junction.

Metric	Description
Annual petroleum offset (DGE)	34,150 DGE (12 month period from May 2011 – April 2012)
Refueling system cost	\$1,358,458 (\$240,457, or 18% paid for by City of Grand Junction)
Total cost of CNG vehicles	\$1,072,620 for four refuse trucks
Incremental capital cost of CNG vehicles	\$167,187 for four CNG refuse trucks
Annual fuel purchase savings	\$40,000 for four CNG refuse trucks
Simple payback period	10 years, based on incremental vehicle cost plus City of Grand Junction investment in refueling system
Vehicle performance	Reduced vehicle emissions, noise, and odor Perceived minor power loss on steep hills
Maintenance impacts	Marginal increase in truck maintenance costs Fueling system limits ability to measure vehicle fuel efficiency
Economic development	Public fast-fill refueling station boosts interest in CNG vehicles Partnership with Grand Valley Transit to use time-fill station to fuel two new CNG buses increases utilization of time-fill station

Figure 9. Grand Junction Project Accomplishments and Metrics

¹ Colorado Energy Office, *Experiences with Compressed Natural Gas (CNG) in Colorado Vehicle Fleets*, <https://www.colorado.gov/pacific/sites/default/files/atoms/files/CNG%20Case%20Studies.pdf>. August 2012.

⁸² Hydrogen Energy Center, *Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England*, <http://www.gpcog.org/wp-content/uploads/2015/03/Final-HEC-report.pdf>. January 2015.

While parking codes for NGVs were not addressed in any of the reviewed resources, building code frameworks are more thoroughly developed and discussed. At the local level, building codes are a critical component of the permitting and design phase, and many reports cover codes relating to fire safety, building construction, and maintenance.

Much of the literature agrees that as NGV technology becomes more prevalent, municipal codes and standards need to be revised accordingly within an appropriate time frame.

State and Federal

Although discussion of regulatory efforts at the state and federal level was limited, a number of national codes and standards applicable to station design and maintenance facilities are included in the reports reviewed here, including the National Fire Protection Association standards and the Uniform Building Code.⁸³ The TIAX market analysis lists the major organizations that administer national codes relevant for natural gas infrastructure, including the Society of Automotive Engineers, the American National Standards Institute (ANSI), and the National Institute of Standards and Technology.⁸⁴ The list also includes brief descriptions of each of these organizations' primary purposes. ANSI, in particular, has a series of codes directly applicable to components of natural gas fueling infrastructure, such as codes for manually operated valves, hoses, and compressors.⁸⁵

The literature includes example incentive structures at all levels of government, and many sources offered recommendations for implementing successful incentive programs. A workshop presented by the Clean Cities Coalitions of Northern New England gives an overview of the federal policy developments that have occurred in the past few years, including a proposed Federal Energy Security Trust which would fund the development of alternative fuel vehicle technologies, including natural gas.⁸⁶ Other sources identify the Congestion Mitigation and Air Quality Improvement Program (CMAQ) grants, administered through the FHWA, as a potential opportunity for alternative fuel project funding.⁸⁷ A couple of sources mentioned the U.S. EPA's Diesel Emission Reduction Act program, state incentives, funding through local Clean Cities coalitions,⁸⁸ and incentive programs offered by local utilities. Examples of state incentives in place throughout the country include AFV and infrastructure tax exemptions, rebates, and refunds, as well as loans for eligible fleets.⁸⁹

International

In many areas of the world, including the Middle East and South America, NGV market penetration is much higher than the United States. For example, according to NGV Global, over 77% of the vehicles in Armenia run on natural gas.⁹⁰ While there is literature and are likely

⁸³ California Statewide Alternative Fuel and Fleets Project, Clean Fuel Connection, Inc., *Permitting CNG and LNG Stations: Best Practices Guide for Host Sites and Local Permitting Authorities*. <http://www.baaqmd.gov/~media/files/strategic-incentives/alt-fuels/cng-and-lng-best-practices-9-30-14-final.pdf>. September 2014.

⁸⁴ TIAX, *Natural Gas Vehicle Market Analysis*, <https://www.aga.org/tiax-natural-gas-vehicle-market-analysis>. Accessed September 7, 2016.

⁸⁵ Clean Cities Coalitions of Northern New England, *NGVs - The Here and Now Technology: A Workshop for New England*, http://web.uri.edu/ceoc/files/CNG_Workshop_GPCOG_for_USDOE_RI_11202014.pdf. November 2014.

⁸⁶ Ibid

⁸⁷ Weld County Natural Gas Coalition, *Alternative Fuel Corridor Plan*, <http://www.weldsmartenergy.org/assets/805Bc45794c8C9B25272.pdf>.

⁸⁸ Clean Cities Coalitions of Northern New England, *NGVs - The Here and Now Technology: A Workshop for New England*, http://web.uri.edu/ceoc/files/CNG_Workshop_GPCOG_for_USDOE_RI_11202014.pdf. November 2014.

⁸⁹ U.S. DOE, Alternative Fuels Data Center, Laws and Incentives, <http://www.afdc.energy.gov/laws/search>. Accessed September 7, 2016.

⁹⁰ NGV Global, Current NGV Statistics, <http://www.iangv.org/current-ngv-stats/>. Accessed November 1, 2016.

lessons learned from across the globe, the fuel is well-established in these countries and the readiness practices are likely not geographically relevant or timely.

Utilities

Like with PEVs, utilities play an important role in NGV deployment. The resources reviewed here identify utilities as key stakeholders throughout the development process.

The Hydrogen Energy Center identifies regulatory challenges involving utilities, including a perceived lack of quality control for natural gas used for vehicles.⁹¹ For example, the gas quality in the PSE&G service territory, which covers a broad area of the NJTPA region, has for a variety of reasons not been suitable to support heavy-duty natural gas engines. This issue is being addressed, but it is valuable for municipalities to be aware of such challenges as they work to implement new technologies.

Key Finding for the NJTPA Study

Involving utilities in the infrastructure site selection process can help alleviate any unknowns or concerns surrounding gas pressure, distance from gas distribution infrastructure, and sufficient supply of both natural gas and electricity to power the equipment.¹ Utilities can provide up-to-date information about existing natural gas infrastructure in the region as well as the feasibility of a given location.

¹ NGVAmerica, CNG Station Construction and Economics, <http://www.ngvamerica.org/stations/cng-station-construction-and-economics/>. Accessed August 20, 2016.

Strategies for Advancement

While other strategies were discussed—such as corridor planning, education and training programs, or vehicle conversion pilot programs—the common theme across resources was that strong and diverse partnerships can facilitate NGV ownership and deployment.

Worth noting is the FHWA's national designation of alternative fuel corridors. As discussed previously, corridors designated in New Jersey will have an impact on planning activities.⁹² Specifically, the FHWA designated I-80 from Teaneck, New Jersey, to DuBois, Pennsylvania, as a signage-pending CNG corridor.⁹³

A recurring theme in the literature is the importance of fleets in the overall advancement of NGV implementation. The Colorado Energy Office identifies medium- and heavy-duty fleets as among the best sources for NGV demand, and thus key players in the creation of a sustainable market.⁹⁴ Investing in fleets and infrastructure, and working together with other local players to strengthen partnerships, will expedite the process.

Key Finding for the NJTPA Study

Collaboration with local fleets is integral to NGV readiness planning. Because the individual consumer has extremely limited access to natural gas passenger vehicle models, fleets are at the forefront of development and are providing real-world examples of how natural gas can be used effectively on a long-term, large-scale basis. As part of readiness planning efforts, the project team should collect input from local fleets, specifically high-mileage medium- and heavy-duty fleets.

⁹¹ Hydrogen Energy Center, *Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England*, <http://www.gpcog.org/wp-content/uploads/2015/03/Final-HEC-report.pdf>. January 2015.

⁹² FHWA, Federal Register Notice – Fixing America's Surface Transportation Act-Designation of Alternative Fuel Corridors, <https://www.federalregister.gov/articles/2016/07/22/2016-17132/fixing-americas-surface-transportation-act-designation-of-alternative-fuel-corridors>, July 22, 2016. Accessed September 6, 2016.

⁹³ FHWA, Alternative Fuel Corridors, http://www.fhwa.dot.gov/environment/alternative_fuel_corridors/. Accessed November 3, 2016.

⁹⁴ Colorado Energy Office, *NGV Implementation Plan Presentation*, <https://www.codot.gov/programs/planning/documents/stac-archives/2013-stac/june-2013/ngv-implementation-plan-pres>. June 2013.

Some sources listed the major players in the natural gas market and stressed the importance of positive stakeholder relationships, while others described ownership models that municipalities might choose to pursue in order to make infrastructure ownership more financially feasible. For example, NGVAmerica lists three possible business models that are common in the industry: fleet or end-user ownership, local natural gas distribution company ownership, and third-party or commercial ownership.⁹⁵ The decision about which ownership model to pursue will depend on factors such as station accessibility and technology type, but the major differences between the ownership models are primarily related to how the natural gas is supplied and which entity owns the actual station.

The City of Grand Junction, Colorado, engaged in a public-private partnership with a local clean fuel distributor, which facilitated public access to their stations. In turn, the public's interest in the technology has grown and has allowed for increased NGV usage in the region.⁹⁶

Procurement practices were discussed in a few of the reports. Some went into detail about the types and brands of vehicles available and how to select between options. Others, such as the Colorado case study report, detail the selection process used by each fleet. One market analysis includes a flow chart showing the fueling infrastructure procurement process and how it can differ depending on the first point of contact (e.g., construction company versus CNG retailer).⁹⁷

⁹⁵ NGVAmerica, CNG Station Business Models, <http://www.ngvamerica.org/stations/cng-station-business-models/>. Accessed August 20, 2016.

⁹⁶ Colorado Energy Office, *Experiences with Compressed Natural Gas (CNG) in Colorado Vehicle Fleets*, <https://www.colorado.gov/pacific/sites/default/files/atoms/files/CNG%20Case%20Studies.pdf>. August 2012.

⁹⁷ TIAX, *Natural Gas Vehicle Market Analysis*, <https://www.aga.org/tiax-natural-gas-vehicle-market-analysis>. Accessed September 8, 2016.

Best Practices

A mix of best practices and lessons learned emerge from across the literature, although the most salient takeaways are summarized in the following documents: Hydrogen Energy Center's *Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England* and TIAA/America's Natural Gas Alliance's *U.S. and Canadian Natural Gas Vehicle Market Analysis*. These best practices range from regulatory elements and incentive structures to technical/design elements. Many of these best practices apply to fleet implementation, but are still applicable here, since fleet NGV deployment is a goal in North Jersey:

- Revise local ordinances and codes to allow for more streamlined NGV implementation and clarity for local officials and stakeholders;
- Assess the long-term costs associated with fleet ownership based on expected use. This information can help planners determine which type of fleet will best meet their needs;
- Implement a training program for any decision-makers and staff who will be handling NGVs frequently, as well as first responders, to ensure consistent information about local regulations, safety, and goals;
- Work to educate the public about the benefits and safety of natural gas, as public perception may be mixed on this technology;
- Remove regulatory barriers preventing retailers from dispensing alternative fuels, including natural gas;
- Determine if new infrastructure is needed for fleets, or if existing infrastructure will be sufficient;
- Assess the unique capacity needs of planned stations and work with utilities and engineers to ensure that stations will have reliable access to high-quality natural gas;
- Explore ownership models and partnerships to make fleet implementation of NGVs more financially feasible; and
- Research available incentives or promote the creation of new incentives designed to facilitate NGV deployment.

Alternative Fuel Vehicle Readiness Planning in the North Jersey Region

The remaining tasks and activities under this study will apply the key findings and best practices identified in this literature review. This section takes a high-level look at current activities in New Jersey, and the NJTPA region in general, in order to establish a baseline for additional analyses and recommendations.

State of New Jersey Efforts

At the state level, New Jersey has engaged in activities to encourage the deployment and use of AFVs.

Legislative and Regulatory Actions

As discussed above, regulatory and policy frameworks are incredibly important to the advancement of AFVs. While the focus of this readiness planning effort is municipalities, it is important to understand the state-level climate for these vehicles. The New Jersey State Legislature and governing agencies have implemented policies and incentives to encourage the use of PEVs and NGVs, as well as the deployment of the corresponding fueling infrastructure. The table below was compiled based on the U.S. DOE's Alternative Fuels Data Center Laws and Incentives page.⁹⁸

Title	Summary	Reference
Zero Emissions Vehicle (ZEV) Tax Exemption	ZEVs sold, rented, or leased in New Jersey are exempt from state sales and use tax. This exemption is not applicable to partial ZEVs, including hybrid electric vehicles (HEVs). ZEVs are defined as vehicles that meet California Air Resources Board zero emissions standards for that model year.	New Jersey Statutes 54:32B-8.55
Workplace Charging Station Grants	The NJDEP and New Jersey Board of Public Utilities (NJBPU) provide grants through the It Pay\$ to Plug In: NJ's Electric Vehicle Workplace Charging Grant Program to support PEV and charging infrastructure adoption. Reimbursement grants are offered on a first-come, first-served basis for the cost and installation of eligible charging stations at workplaces, government and educational facilities, nonprofits, and parking facilities. Funding up to \$250 is available for each Level 1 charging stations installed and up to \$5,000 for each Level 2 charging stations installed. As of January 2017, the current funding for the program has been allocated and interested parties may be put on a waitlist.	Drive Green NJ Website ⁹⁹ The program is part of New Jersey's Energy Master Plan.
High Occupancy Vehicle (HOV) Lane Exemption and Discount	The New Jersey Turnpike Authority (Authority) allows qualified HEVs to travel in the HOV lanes located between Interchange 11 and Interchange 14 on the New Jersey Turnpike. This exemption expires September 30, 2019. The Authority also offers a 10% discount on off-peak New Jersey Turnpike and Garden State Parkway toll rates through NJ EZ-Pass for drivers of vehicles that have a fuel economy of 45 miles per gallon or higher and meet the California Super Ultra Low Emission Vehicle standard, including PEVs. The discount expires November 30, 2018.	New Jersey Administrative Code 19:9-1.24

⁹⁸ U.S. DOE, Alternative Fuels Data Center, Laws and Incentives Database, <http://www.afdc.energy.gov/laws>. Accessed November 1, 2017.

⁹⁹ NJDEP, Bureau of Mobile Sources, Programs, <http://www.drivegreen.nj.gov/programs.html>. Accessed January 19, 2017.

Title	Summary	Reference
Low Emission Vehicle (LEV) Standards	New Jersey has adopted California motor vehicle emissions standards as set forth in Title 13 of the California Code of Regulations, meaning that all passenger cars and light-duty trucks must be certified by the California Air Resources Board. In addition, manufacturers must meet a minimum requirement for the percentage of ZEVs made available for sale in the state. Under the program, the NJDEP allows manufacturers who sell or lease qualified ZEVs to earn and bank vehicle equivalent credits that can be sold to other manufacturers.	New Jersey Administrative Code 7:27-29.1 through 7:27-29.14
ZEV Sales Regulations	A motor vehicle franchisor that exclusively manufacturers ZEVs and is licensed by the New Jersey Motor Vehicle Commission prior to January 1, 2014, can buy from and sell vehicles to a consumer. The franchisor can own or operate up to four sales locations in the state and must have at least one retail facility for servicing ZEVs sold, offered for sale, or otherwise distributed in the state. The franchisor will not be required to establish or operate a sales location at a ZEV service facility. Annually, by March 1, all motor vehicle franchises must report the number of ZEVs sold in the state within the prior calendar year to the New Jersey Division of Taxation.	New Jersey Statutes C.56:10-27.1 and C.54:32B-8.55a

While these policies and incentives are a good starting point, other states are far more progressive. For instance, states in the region, such as Connecticut, Massachusetts, Delaware, New York, and Rhode Island offer rebates for AFV purchases.¹⁰⁰

Procurement Practices

The Electric Vehicle and Natural Gas Vehicle Readiness Planning sections above discuss the importance of favorable procurement practices, which often starts with the state fleet. As of January 2017, the New Jersey State Motor Vehicles Purchasing Contract does not include PEVs or NGVs. At one point, it did include the Chevrolet Volt, Nissan Leaf, and Ford Focus EV, but the vehicles have since been removed.¹⁰¹

Key Finding for the NJTPA Study

Placement of PEVs on New Jersey's State Motor Vehicles Purchasing Contract would be a significant step in bringing more of these vehicles to government fleets in the state. Municipalities ordering off of this contract could benefit greatly as well.

Agency Actions

New Jersey state agencies have begun to develop the strategic partnerships and education efforts necessary for AFV advancement. For example, working with the NJTPA and other New Jersey stakeholders, the NJDEP also incorporated the topic of AFVs into the mission of their Sustainable Business Initiative. This program raises awareness, educates, and motivates companies to pursue sustainability as a competitive business strategy and a shared community responsibility. In partnership with the New Jersey Clean Air Council and the New Jersey Clean Cities Coalition, the program hosted a stakeholder meeting in November 2014 focused on

¹⁰⁰ U.S. DOE, AFDC Laws and Incentives Database, <http://www.afdc.energy.gov/laws>. Accessed November 3, 2016.

¹⁰¹ New Jersey Department of Treasury, Division of Purchase and Property, State Contracts by Type, http://www.state.nj.us/treasury/purchase/contract_types.shtml. Accessed November 1, 2016.

expanding workplace charging and supporting employer and employee incentives for the adoption of AFVs.¹⁰²

Goals and Planning

Deploying PEVs and NGVs and the associated infrastructure is also included in the following state-level planning documents and goals. These targets and plans are important, as they enable state agencies and others to pursue and invest in related efforts:

- **Global Warming Response Act.** Passed in 2007, this act mandates statewide greenhouse gas (GHG) emissions reductions through 2050. Strategies to achieve these goals include LEV requirements, an assessment of needs for AFV fueling infrastructure, implementation of AFV initiatives and demonstration programs, and development of a Green Corridor of PEV charging infrastructure and NGV fueling stations.^{103,104}
- **New Jersey Energy Master Plan.** The 2011 Energy Master Plan encourages the use of alternative fuels as a means to reduce reliance on petroleum and GHG emissions. It encourages investments in charging infrastructure, expedited permitting for charging infrastructure, promotion of public-private partnerships for PEV and charging infrastructure awareness and market adoption, incentives for fleet deployment of NGVs (including waste haulers, package and delivery services, municipal bus fleets, service vans, and jitneys), and guidance from natural gas utilities on NGV deployment.¹⁰⁵ A recent update of this document, released in 2015, provides an update on activities in this area and suggests that the state continue its efforts, specifically deployment of NGVs in heavy-duty fleet applications and development of policies to remove barriers to the adoption of these vehicles.¹⁰⁶

Partnerships and Other Activities

As outlined in the Electric Vehicle and Natural Gas Vehicle Readiness Planning sections, public-private partnerships, metropolitan planning organizations, nonprofit organizations, and utilities also play a key role in the advancement of AFVs. In New Jersey, the following organizations have been active in this area:

- **Sustainable Jersey.** This nonprofit administers a certification program for municipalities in New Jersey that want to “go green.” The NJTPA collaborated with Sustainable Jersey on the development of two “action items,” or recommended measures, to facilitate the adoption of PEVs. In October 2014, Sustainable Jersey added the Make Your Town Electric Vehicle Friendly and Public Vehicle Charging Infrastructure action items. Completion of these activities will help a community earn a certification through Sustainable Jersey. Sustainable Jersey also provides tools, training, and other types of support to communities as they pursue this action.¹⁰⁷

¹⁰² NJDEP, Air Quality, Energy & Sustainability, Office of Sustainability, Sustainable Business Initiative, <http://www.state.nj.us/dep/ages/os-sbi.html>. Accessed September 6, 2016.

¹⁰³ NJDEP, Air Quality, Energy & Sustainability, Statewide Greenhouse Gas Inventory, <http://www.nj.gov/dep/ages/sqgi.html>. Accessed September 6, 2016.

¹⁰⁴ NJDEP, *Meeting New Jersey's 2020 GHG Limit: New Jersey's Global Warming Response Act Recommendations Report*, http://www.nj.gov/dep/sage/docs/njgrwa_final_report_and_appendices_dec2009.pdf. December 2009.

¹⁰⁵ *ibid*

¹⁰⁶ NJBPU and NJDEP, *New Jersey Energy Master Plan Update*, http://nj.gov/emp/docs/pdf/New_Jersey_Energy_Master_Plan_Update.pdf. December 2015.

¹⁰⁷ Sustainable Jersey, Sustainable Jersey Actions, <http://www.sustainablejersey.com/actions-certification/actions/>. Accessed September 6, 2016.

- **New Jersey Clean Cities Coalition.** This U.S. DOE-designated coalition is the only statewide entity exclusively focused on promoting of public-private partnerships related to the development and use of alternative fuels, advanced technology vehicles, and the appropriate related infrastructure. The coalition brings together stakeholders to address these issues by providing education, securing grant funding, and overcoming challenges.¹⁰⁸ Notably, New Jersey Clean Cities led the New Jersey CNG Refuse Trucks, Shuttle Buses, and Infrastructure Project, a U.S. DOE-funded AFV deployment program awarded in 2009. This effort resulted in the deployment of more than 300 CNG refuse trucks and shuttle buses in local public and private fleets, as well as six new CNG fueling stations throughout the state.¹⁰⁹
- **Utilities.** The Electric Vehicle and Natural Gas Vehicle Readiness Planning sections stress the importance of utility involvement in readiness planning efforts. Electric and natural gas utilities in New Jersey have already been engaged. For example, PSE&G provides an incentive for workplace charging infrastructure for employees. Specifically, PSE&G is offering approximately 120 charging stations for free on a first-come, first-served basis to private companies in the utility's service territory. The actual infrastructure is free, but PSE&G does not pay for installation. As of July 2016, the utility had distributed 60 charging stations to 11 partners.¹¹⁰ On the natural gas side, New Jersey Natural Gas, South Jersey Gas, and Elizabethtown Gas have invested in CNG fueling infrastructure over the last five years.¹¹¹

Key Finding for the NJTPA Study

AFV readiness planning efforts should include collaboration with organizations already working towards similar goals, including Sustainable Jersey, New Jersey Clean Cities Coalition, and utilities. These efforts are already underway. For instance, the New Jersey Clean Cities Coalition is part of the project team for this NJTPA effort.

North Jersey Regional Planning Efforts

In addition to supporting many of the initiatives above, the NJTPA and its regional partners are investing in efforts in the North Jersey region specifically. Plan 2040, the NJTPA's Regional Transportation Plan, makes recommendations for making economically competitive investments to protect the environment and reduce transportation emissions.¹¹² Efforts to facilitate market adoption of AFV align with these goals.

¹⁰⁸ New Jersey Clean Cities, <https://www.njcleancities.com/>. Accessed September 6, 2016.

¹⁰⁹ U.S. DOE, American Recovery and Reinvestment Act, Clean Cities Project Awards, http://www.afdc.energy.gov/uploads/publication/arra_cc_project_awards.pdf. August 2016.

¹¹⁰ Kenny Esser, PSE&G, phone conversation, July 25, 2016.

¹¹¹ NJBPU and NJDEP, *New Jersey Energy Master Plan Update*, http://nj.gov/emp/docs/pdf/New_Jersey_Energy_Master_Plan_Update.pdf. December 2015.

¹¹² NJTPA, *Plan 2040*, <http://www.njtpa.org/planning/plan-update-to-2040/plan2040final.aspx>. November 2013.

In 2013, as part of their involvement with a U.S. DOE grant for the Northeast Electric Vehicle Network, the NJTPA hosted “Plug It In: Advancing Electric Vehicle Adoption in New Jersey,” a public symposium featuring a panel of PEV experts. On a broader level, the grant focused on the infrastructure needed to promote and support AFVs in the Northeast and Mid-Atlantic states. Many of the resulting publications and guidelines are included in this literature review.

In 2015, the NJTPA, with the other stakeholders of Together North Jersey—a consortium of public, private and nonprofit groups—released *The Plan 2015*. Together North Jersey seeks to support and facilitate the adoption of municipal, county and state actions to advance AFVs across the region. One of the strategies proposed in *The Plan 2015* is “Reduce Transportation Petroleum Use,” which includes incentive programs for AFVs, as well as PEV charging and alternative fueling stations.¹¹³

Key Finding for the NJTPA Study

The study should capitalize and build upon previous efforts to engage stakeholders and the public in readiness planning efforts. Where appropriate, the team can call upon established goals and priorities mentioned in this section when reaching out to potential stakeholders.

¹¹³ Together North Jersey, *The Plan 2015*, <http://togethernorthjersey.com/wp-content/uploads/2016/05/TNJ-Plan-v5-5-16-for-website-small.pdf>. November 2015.

Key Findings to Inform Readiness Planning in North Jersey

While specific key findings and best practices are presented above, this section provides high-level conclusions based on the established literature.

Lessons Learned

- **Readiness Planning is Important to Success.** The deployment of PEVs and NGVs has the potential to reduce GHG emissions and petroleum consumption dramatically, and increase energy independence through the utilization of locally and regionally produced energy. However, the success of these long-term goals will depend on the near-term deployment of vehicles and fueling infrastructure, and the associated planning required by stakeholders. The value of readiness planning is highlighted by the body of literature reviewed here. Best practices are starting to emerge from this relatively new discipline. Furthermore, researchers at U.S. DOE national laboratories demonstrated a correlation between higher PEV deployments and infrastructure utilization and areas that undertook readiness planning efforts, even after isolating for factors such as cold weather and incentive availability.^{114,115}
- **Stakeholder Engagement and Partnerships are Key.** Preparing consumers, communities, and fleets for PEV and NGV deployment is a complex process involving a variety of players, including codes developers, permitting authorities, transportation planners, parking authorities, business owners, fleet managers, consumers, and local nonprofits. It is critical to tap these actors early for input into the readiness planning effort, and circle back with any outcomes and to address any education and training needs. In fact, continuous engagement following the initial readiness planning effort is integral to keeping the key players accountable. The literature includes a variety of methodologies for stakeholder engagement, including interviews, focus groups, and surveys.

Gaps Identified

- **The Literature Lacks NGV Readiness Planning Guidance.** The literature review reveals a significant knowledgebase, including case studies and lessons learned, for PEV readiness. For NGVs, there appears to be a reliance on industry documents, rather than actual municipal planning documentation that can be used as examples for other local governments. While the consumer attention on PEVs is significant, NGVs are important alternatives to conventional vehicles in the medium- and heavy-duty fleet space. The project team should not lose sight of this during the readiness planning process, and address this deficiency in project deliverables.
- **Readiness Planning Should Focus on Local Challenges for PEV and NGV Deployment.** While the national, and even regional literature is robust – particularly for PEV readiness – the project team should focus on identifying specific barriers and challenges to adoption in the North Jersey region. For example, natural gas quality has been an issue in the region, where it is not typically a problem at the national level. As stated earlier, this information can be collected through consumer surveys, stakeholder interviews and meetings, and regulatory research. It should also be noted that historically, readiness

¹¹⁴ DJ Santini, Electric Drive Technology Market Trends, 2015 Clean Cities Strategy, https://cleancities.energy.gov/files/u/news_events/document/document_url/108/2015_strategic_planning_presentation_electric_drive.pdf. February 2015.

¹¹⁵ Idaho National Laboratory, *How Does Utilization of Non-Residential EVSE Compare Between those Installed in Oregon in Planned versus Unplanned Locations?*. <https://avt.inl.gov/sites/default/files/pdf/EVProj/UtilizationOfNonResEVSEInstallationVsPlan.pdf>. April 2015.

planning focuses nationally, at the state level, or regionally. However, the literature emphasizes that local planning is incredibly important. For example, the International Council on Clean Transportation (ICCT) assessed actions taken at the municipal level and concluded that a) there is quantitative support for the “ecosystem approach” as a best practice, where many stakeholders (including local municipalities) have key roles in enabling PEV growth and b) “cities are focal points for collaboration among governments, the auto industry, utilities, and advocates on electric vehicles.” The project team will need to focus on actionable recommendations that will be useful for the pilot municipalities involved and replicable for others in the region.

- **The Literature Lacks Evidence-based Approaches.** A closer look at the literature shows that there are fewer best practices in the area of readiness planning than one might at first think. There are certainly examples and case studies available for review; however, there is little evidence or metric tracking to ensure that readiness actions are in fact facilitating deployment. The ICCT study is unique in this regard, and while encouraging, their results are not absolute. The more the project team can incorporate tracking metrics – quantitative and qualitative – into an ongoing engagement process, the more likely that the study determines what is actually, and more importantly what is *not* actually, working.
- **Stakeholders Would Benefit from More Living Documents and Resources.** Case studies, and even guidance documents, quickly become outdated following publication. The industry, consumer and fleet markets, and political climate are always changing. At any given time, it is difficult to know whether static readiness planning literature provides the most accurate and up-to-date thinking. Municipal planners and other stakeholders would benefit from a “living” central resource allowing them to share the most recent techniques, methodologies, and templates within the region. Interactive toolkits and social media tools, such as blogs with guest contributors, can also be a creative way to ensure active engagement. This will also address the consistency in permitting, training, and other activities raised above.

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Hydrogen Energy Center	Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England	10, 27, 32, 34, 36
Idaho National Laboratory	How Does Utilization of Non-Residential EVSE Compare Between those Installed in Oregon in Planned versus Unplanned Locations?	42
Kenny Esser, PSE&G	Phone conversation	40
Luskin Center at University of California – Los Angeles	Western Riverside PEV Deployment Plan	14
M. Simpson	EVSE Residential Permit Template	16
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New Jersey Department of Community Affairs	Codes and Regulations	15
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NGVAmerica	CNG Station Business Models	35
NGVAmerica	CNG Station Construction and Economics	34
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NJBPU and NJDEP	New Jersey Energy Master Plan Update	39, 40
NJDEP	Air Quality, Energy & Sustainability, Office of Sustainability, Sustainable Business Initiative	39
NJDEP	Air Quality, Energy & Sustainability, Statewide Greenhouse Gas Inventory	39
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NJDEP	It Pay\$ to Plug In	7
NJDEP	Meeting New Jersey's 2020 GHG Limit: New Jersey's Global Warming Response Act Recommendations Report	39
NJTPA	Plan 2040	40
North Carolina State University Clean Energy Technology Center	Planning and Installation Guide: North Carolina Compressed Natural Gas Fueling Stations	29, 31
NREL	Building a Business Case for CNG in Fleet Applications	25, 30

Interagency Collaboration on Alternately Fueled Vehicle Infrastructure: Literature Review

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NYSERDA	Site Design for EV Charging Stations	15
Redwood Coast Energy Authority	North Coast Plug-in Electric Vehicle Readiness Plan	20
Siskiyou County Economic Development Council	Upstate PEV Readiness Plan	21
Sustainable Jersey	Sustainable Jersey Actions	39
TIAX	Natural Gas Vehicle Market Analysis	29, 31, 33, 35, 36
Together North Jersey	The Plan 2015	41
U.S. DOE	A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects	17, 22
U.S. DOE	Alternative Fueling Stations by Fuel Type	1
U.S. DOE	Alternative Fuels Data Center, Emissions from Hybrid and Plug-In Electric Vehicles	7
U.S. DOE	Alternative Fuels Data Center, Laws and Incentives Database	17, 33, 37, 38
U.S. DOE	Alternative Fuels Data Center, Station Locator	9, 14, 28
U.S. DOE	American Recovery and Reinvestment Act, Clean Cities Project Awards	40
U.S. DOE	Fact #876: June 8, 2015 PEV Vehicle Penetration by State, 2014	11
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Appendix A:
Literature Review Summary

Title	Author Organization	Web Link	Geographic Focus	Date of Publication	Vehicle(s) of Focus	General Overview	Relevance and Overall Usefulness to North Jersey Municipalities	Study Methodology	Techniques for Market Assessment					Policy and Regulatory Frameworks						Strategies for Advancement					
									Market Status	Challenges	Benefits	Niches	Siting	Frameworks	Zoning	Parking Codes	Permitting	Building Codes	Incentives	Utility	Partners	Corridors	Procurement	Education	Other
1. Model Municipal Plug-In Electric Vehicle Planning Documents and Guidance																									
Plug-In Electric Vehicle (PEV) Community Readiness – Regional Reports and Statewide Toolkit	California PEV Collaborative	http://www.pevcollaborative.org/pev-readiness	California	Various Dates	Electric	These reports and guidebooks provide recommendations and best practices, in addition to analyses on the benefits and challenges to PEV and electric vehicle supply equipment (EVSE) deployment.	Not geographically relevant but many of the conclusions and recommendations may apply in North Jersey municipalities.	Literature review, regulatory research, stakeholder interviews, and consumer surveys.	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	No	No	Yes	No	
Electric Vehicle Charging Station Installation Best Practices: A Guide for San Diego Region Local Governments and Contractors	Center for Sustainable Energy; Plug-in San Diego	http://www.sandag.org/uploads/projectid/projectid_511_19815.pdf	San Diego, CA	June 2016	Electric	This report serves as a resource to promote regionally consistent residential and commercial electric vehicle supply equipment (EVSE) permitting, inspection, and installation in the San Diego region. It includes a review of codes and standards related to installations, common challenges, and best practices to assist building departments and contractors to prepare.	A great example of a regional EVSE guide focused on installation benefits, challenges, and requirements.	Literature review, regulatory research, and stakeholder interviews.	No	Yes	Yes	No	No	Yes	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Electric Vehicle Charging Station Permitting and Inspection Best Practices: A Guide for San Diego Region Local Governments	Center for Sustainable Energy; Plug-in San Diego	http://www.sandag.org/uploads/projectid/projectid_511_19814.pdf	San Diego, CA	June 2016	Electric	This report serves as a resource to promote regionally consistent residential and commercial electric vehicle supply equipment (EVSE) permitting, inspection, and installation in the San Diego region. It provides an overview of common barriers to EVSE installations (i.e., permit application delays), a catalogue of existing permit processes and compliance requirements, and permitting and inspection best practices to assist local building departments in preparing for an increase in EVSE permits.	Good resource for best practices specific to developing streamlined, consistent permitting process.	Literature review, regulatory research, and stakeholder interviews.	No	Yes	No	No	No	No	No	No	Yes	No	Yes	No	No	No	No	Yes	Yes
Electric Vehicle Development: Municipal Best Practices Study	City of Atlanta	http://www.rmi.org/Content/Files/Atlanta%20EV%20Readiness%20Study%20.pdf	Atlanta, GA	October 2010	Electric	After the Metro Atlanta Plug-in Electric Vehicle (PEV) Readiness Task Force (MAPEVRTF) executed a memorandum of understanding with Nissan in 2010, the city has been working to eradicate barriers to PEV adoption. The city conducted a survey to collect knowledge from other cities with PEV implementation experiences. This report is "a compilation of data from best practices surveys from 13 municipal entities with experience in meeting the needs of their residents who are choosing to become electric vehicle owners."	- Can provide municipalities with background information about the experiences of other cities. - As this report is from 2010, it is outdated, but many best practices are still applicable.	Survey	No	No	No	No	No	No	No	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No
Creating Electric Vehicle-Ready Towns and Cities: A Guide to Planning and Policy Tools	Georgetown Climate Center	http://www.transportationandclimate.org/sites/default/files/EVSE_Planning_and_Policy_Tool_Guide.pdf	Mid-Atlantic	November 2012	Electric	This resource helps local governments make their communities plug-in electric vehicle (PEV)-ready. Includes in-depth look at five policy tools (and related best practices) to enable PEV readiness: zoning and parking ordinances, codes, permitting, and building interagency or business partnership.	- Locally relevant, including market analysis that could be useful in urban areas of Northern New Jersey. - Targeted towards policymakers who are developing, enacting or enforcing strategic plans, regulations and legislation, industry stakeholders, or members of the private sector. - Outdated; written when PEVs just hitting the market.	Literature review; consumer, local government, and manufacturer interviews; and national survey data.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No

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Zero-Emission Vehicles (ZEVs) in California: Community Readiness Guidebook	Governor's Office of Planning and Research, State of California	https://www.opr.ca.gov/docs/ZEV_Guidebook.pdf	California	2013	Electric	California is paving the way for ZEV market growth as a strategy for greener transportation in the state. California's governor released an Executive Order directing agencies to achieve ZEV readiness benchmarks. The report covers plug-in electric vehicles (PEVs) and hydrogen fuel cell electric vehicles (FCEVs). California municipalities have adopted PEV-friendly zoning policies, codes, and infrastructure, and examples in this report show different methods and opportunities for achieving greater adoption. "Each recommendation in the Guidebook includes a brief snapshot of the issue, a series of key steps that communities can take related to that topic and, when applicable, a featured resource that provides more information. Examples and case studies are included throughout the document. The Guidebook is written as a "living document" that can be updated as new resources become available and as ZEV technology and the market for these vehicles evolve."	- The appendices include a checklist and templates for municipal codes that communities can adapt for their own unique situations. - The target audience for this guidebook is local and regional governments, so New Jersey municipalities can discover recommended actions and helpful tools for towns like their own. It is particularly relevant, as New Jersey has adopted the California ZEV sales regulations. - Communities may find the PEV Community Readiness Scorecard beneficial for planning.	The report presents relevant information and specific actions intended for local governments to use in their planning phases. It includes comprehensive guide to municipalities who want to enhance PEV readiness with the tools, templates, and guidance presented here.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	
Assessment of Leading Electric Vehicle Promotion Activities in United States Cities	International Council on Clean Transportation	http://www.theicct.org/sites/default/files/publications/ICCT_EV_promotion-US-cities_20150729.pdf	United States	July 2015	Electric	This report includes original research on state, local, and utility actions that are spurring plug-in electric vehicle (PEV) deployment, including a city specific analysis of policy benefits in 25 urban areas.	- Includes some geographically relevant examples. - One of the few documents focused solely on incentives and taking a deeper dive into the subject, versus most others which provide a general overview and best practices.	Regulatory research and literature review.	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	
Local Zoning & Electric Vehicle Infrastructure Resources	Municipal Research & Services Center of Washington	http://mrsc.org/Home/Explore/Topics/Environment/Energy/Topics/Planning-for-Electric-Vehicles.aspx	Washington State	January 2016	Electric	This website provides a breadth of resources on the various components required for plug-in electric vehicle (PEV) readiness, including local zoning provisions, electric vehicle supply equipment (EVSE) installation best practices, PEV infrastructure requirements, and PEV related statutes in the State of Washington.	- Locally focused. - Would be a good resource for specific regulatory wording and examples.	Literature review.	No	No	No	No	No	Yes	Yes	No	Yes	No	No	No	No	No	No	No	No
Electric Vehicle Advisory Committee: Report of Recommendations 2015	New York City Department of Transportation	http://www.nyc.gov/html/om/downloads/pdf/2015-electric-vehicle-report.pdf	New York City, NY	2015	Electric	This report addresses the current state of plug-in electric vehicle (PEV) use in New York City and recommends potential actions that the city and other members of the committee can take to encourage the use of PEVs.	- Locally relevant - Discussion of EVSE challenges in similar geography (high population density)	Literature review, regulatory research, and stakeholder interviews.	Yes	Yes	No	No	Yes	No	No	No	No	No	No	Yes	No	No	No	No	No
Exploring Electric Vehicle Adoption in New York City	New York City/McKinsey & Company	http://www.nyc.gov/html/om/pdf/2010/pr10_nyc_electric_vehicle_adoption_study.pdf	New York City, NY	January 2010	Electric	To achieve the emissions goals in PlaNYC, the city's comprehensive sustainability plan, and to address the new vehicles coming to market, the city commissioned this study to "identify what factors would drive early consumers to purchase electric vehicles, and what the city and other stakeholders could do to facilitate early adoption of this technology in the short term."	- Locally relevant, including market analysis that could be useful in urban areas of North Jersey. - Outdated; written when plug-in electric vehicles (PEVs) were just becoming commercially available and the local market penetration was unclear.	Consumer interviews and focus groups, quantitative consumer surveys, consumer and industry expert workshops, grid and vehicle adoption analysis in conjunction with the local utility, and FAQ development.	Yes	Yes	Yes	No	Yes	Yes	No	No	No	Yes	Yes	No	No	No	Yes	No	
Residential Electric Vehicle Supply Equipment (EVSE) Permit Process Best Practices	New York State Energy Research and Development Authority (NYSERDA)	http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/Permit-Process-Streamlining.pdf	New York State	April 2013	Electric	This guidebook provides an overview of the EVSE permitting processes in the region, followed by sample permits and recommended best practices to pave the way for PEVs.	- Geographically relevant. - Includes specific wording, which may be helpful for permit streamlining in the area.	Regulatory research, literature review, and stakeholder interviews.	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No

Title	Author Organization	Web Link	Geographic Focus	Date of Publication	Vehicle(s) of Focus	General Overview	Relevance and Overall Usefulness to North Jersey Municipalities	Study Methodology	Techniques for Market Assessment					Policy and Regulatory Frameworks						Strategies for Advancement					
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Electric Vehicle Infrastructure: A Guide for Local Governments in Washington State	Puget Sound Regional Council	http://www.psrc.org/assets/4325/EVI_full_report.pdf	Washington State	July 2010	Electric	This document provides guidance for local governments in Washington State to comply with legislation aimed at promoting plug-in electric vehicles (PEVs) and charging stations throughout the state. In particular, the report covers model ordinance, model development regulations, and other general guidance related to PEV infrastructure and batteries in the context of the new (at the time) law (House Bill 1481).	Checklists, templates, and data are presented that could be applied to New Jersey municipalities in the planning stages of PEV implementation.	While the majority of the document provides information for municipalities, the appendices include survey and interview results, research on batteries, and model installation guidance. Elsewhere, the report provides model ordinance and regulations so that municipalities can structure their plans accordingly and borrow language. The authors conducted background research to identify existing codes and best practices.	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Project Get Ready: Helping Communities Become Electrified Vehicle Pioneers	Rocky Mountain Institute	http://www.rmi.org/Content/Files/Project%20Get%20Ready%20Menu.pdf	United States	March 2009	Electric	This menu lays out the "must have" and "nice to have" actions for a community to prepare for plug-in electric vehicles (PEVs) from the perspective of municipal government, utilities, civic groups, local businesses, and consumers; also provides a summary of costs and benefits of PEVs from each standpoint.	- Locally focused. - Provides a valuable opportunity to learn from other municipalities already seeking to do the same.	Case studies, as well as interviews and feedback from local and regional stakeholders.	No	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Make Your Town Electric Vehicle Friendly	Sustainable Jersey	http://www.sustainablejersey.com/actions-certification/actions/?type=1336777436&tx_sjcert_action%5BactionObject%5D=520&tx_sjcert_action%5BactionObject%5D=getPDF&tx_sjcert_action%5Bcontroller%5D=Action&controller%5D=38e44e6f3893e6fef20fca68f3539fd	New Jersey	October 2014	Electric	This document describes an action that municipalities in New Jersey may choose to implement in order to achieve certification from Sustainable Jersey. The action aims to increase plug-in electric vehicle (PEV) adoption by consumers, and identifies tasks, costs, and timeframes for municipalities to achieve this goal. Tasks municipalities can complete include hosting awareness or training events, promoting public chargers, updating building ordinances, and providing chargers for workplaces and multi-family units.	- Highly relevant to New Jersey municipalities. - Outlines specific steps municipalities can take to increase adoption.	Describes a course of possible actions that municipalities are encouraged to take, designed in conjunction with Sustainable Jersey partners.	No	No	Yes	No	No	No	Yes	Yes	No	Yes	No	No	Yes	No	No	No	No
The City of Loveland – Marrying Functionality and Economics, The City of Loveland on Integrating Electric Vehicles into Fleet Operations	The Electrification Coalition	http://www.cityofloveland.org/Modules/ShowDocument.aspx?documentID=22227	Loveland, CO	2012	Electric	Motivated by volatile fuel prices, the City of Loveland integrated plug-in electric vehicles (PEVs) into its fleet. This document discusses costs, purchasing partnerships, usage patterns, expectations, and realities of using two Nissan Leaf vehicles in the city's fleet.	Describes a municipality's decision process to incorporate PEVs into its fleet, including a discussion of lease options.	Interview with Loveland fleet manager.	No	Yes	Yes	No	No	No	No	No	No	No	No	No	Yes	No	Yes	No	No
Electric Vehicle-Ready Codes for the Built Environment: Electric Vehicle Supply Equipment (EVSE) Support Study	Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center	http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/EV-Ready-Codes-for-the-Built-Environment.pdf	Northeast & Mid-Atlantic	November 2012	Electric	This report describes the role of building and electrical codes in encouraging or inhibiting the implementation of EVSE to aid local and state leaders in assessing local code-specific barriers and identifying the appropriate code provisions.	One of the only publications summarizing the important role that codes can play in plug-in electric vehicle (PEV) and EVSE deployment.	Regulatory and policy research, literature review, and stakeholder interviews for case studies.	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No
Houston Energizes Deployment of Plug-In Electric Vehicles (PEVs)	U.S. Department of Energy	http://www.afdc.energy.gov/case/1003	Houston, TX	September 2014	Electric	Vehicle electrification has become a key focus of mobile source emissions-reduction strategies in Houston -- this case study provides overview of Houston's Electric Vehicle Initiative and the city's streamlined electric vehicle supply equipment (EVSE) permitting and installation processes, which have been central to the area's PEV readiness efforts.	Not geographically relevant, but provides example of permit/installation streamlining efforts.	Legislative and policy research and stakeholder interviews.	Yes	No	No	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	No

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									Market Status	Challenges	Benefits	Niches	Siting	Frameworks	Zoning	Parking Codes	Permitting	Building Codes	Incentives	Utility	Partners	Corridors	Procurement	Education	Other
Los Angeles Sets the Stage for Plug-In Electric Vehicles (PEVs)	U.S. Department of Energy	http://www.afdc.energy.gov/case/1002	Los Angeles, CA	September 2014	Electric	This case study is an overview of the Los Angeles Department of Water & Power (LADWP) Electric Vehicle Program, with rebates and expedited permitting and installation processes to encourage PEV deployment, as well as the associated progress to date.	Not geographically relevant, but provides example of permit/installation streamlining efforts as well as rebates to consider, including analysis of success to date.	Legislative and policy research and stakeholder interviews.	Yes	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No	No	No
Raleigh, North Carolina, Paves the Way for Plug-In Electric Vehicle (PEV) Success	U.S. Department of Energy	http://www.afdc.energy.gov/case/1001	Raleigh, NC	September 2014	Electric	Raleigh is paving the way for successful plug-in electric vehicles (PEV) and electric vehicle supply equipment (EVSE) deployment -- this case study summarizes partnerships and efforts implemented through Project Get Ready's regional program, as well as associated progress to date.	- Some geographic relevance. - Provides tangible examples of permit and installation streamlining processes, partnerships that could be pursued in New Jersey, and the critical role that utilities play in PEV readiness.	Legislative and policy research and stakeholder interviews.	Yes	No	No	Yes	No	No	No	Yes	No	No	Yes	Yes	No	No	No	Yes	No
2. Model Regional Plug-In Electric Vehicle Planning Documents and Guidance																									
Plug-In Electric Vehicle (PEV) Readiness Plan	Bay Area Air Quality Management District	http://www.baaqmd.gov/~media/files/strategic-incentives/ev-ready/bay-area-pev-readiness-plan-background-and-analysis-web-pdf.pdf?la=en	Bay Area, CA	December 2013	Electric	This readiness plan provides a comprehensive, regionally coordinated approach to introducing PEVs and electric vehicle supply equipment (EVSE) into the Bay Area and encouraging adoption and deployment.	Although not geographically relevant, locally focused; includes market analysis and PEV feasibility study that could be useful, as well as case studies and templates which could be applied to Northern Jersey municipalities.	Literature review; interviews and feedback from regional stakeholders (consumer interviews and focus groups); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	
Upstate Plug-In Electric Vehicle (PEV) Readiness Plan	California Energy Commission and partners	https://static1.squarespace.com/static/53764d9fe4b0cb63d6f97b20/t/546bbf05e4b02cdf60e99f49/1416347462203/Readiness+Plan	Northern California	2014	Electric	This report provides an overview of the Upstate PEV Readiness Project, including the goals and objectives of the project, projected benefits and challenges, and a breakdown of the project's approach, methods, and results (e.g., cost of electric vehicle supply equipment (EVSE), macro-level deployment, micro-siting, future infrastructure strategy, permitting). It also discusses important partnerships in the project, as well as the role of public education and outreach, incentives, and fleet PEV and EVSE adoption.	Not geographically relevant but relatively up-to-date with a local/municipal focus and valuable insight into corridor planning across municipalities.	Literature review, survey data, and project feedback.	No	Yes	Yes	No	Yes	No	No	Yes	No	Yes	No	Yes	Yes	No	Yes	No	

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Electric Vehicle Readiness Plan for Ventura, Santa Barbara, and San Luis Obispo Counties (Central Coast)	California Energy Commission; Electric Vehicle Communities Alliance	http://www.vcapcd.org/pubs/Rules/homepage/PlugInCentralCoastEVReadinessPlan_201400715.pdf	Central California	July 2014	Electric	This plug-in electric vehicle (PEV) readiness plan guides the development of PEV charging infrastructure in the central-coast California region to encourage and facilitate the mass adoption of PEVs in the area. Topics include: summary of PEV goals; overview of key barriers and recommended solutions for the deployment of PEVs and for the development of a comprehensive charging network; effective marketing, training/education, and outreach efforts; and sample documents.	Not geographically relevant but relatively up-to-date with a local and municipal focus and valuable insight into the pieces necessary for cohesive regulatory framework that facilitates PEV deployment and the role that local governments can play in the process.	Literature review; interviews and feedback from regional stakeholders (consumer interview and focus groups; regional, state, and federal funding agency input; interviews with PEV industry); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes; includes a plan for outreach and education to all stakeholders, including building inspectors, utilities, public works personnel, first responders, and public safety officers; also discusses sharing of best practices for	No
Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action plan - Volume I	Delaware Valley Regional Planning Commission; ICF International	http://www.dvrpc.org/energyclimate/AlternativeFuelVehicles/EVs/ ; http://www.dvrpc.org/reports/12055A.pdf	Southeastern Pennsylvania	June 2013	Electric	This readiness plan provides a comprehensive, regionally coordinated approach to introducing plug-in electric vehicles (PEVs) and electric vehicle supply equipment (EVSE) into the five counties of southeastern Pennsylvania and encouraging adoption and deployment.	Locally relevant, including market analysis and PEV feasibility study that could be useful in urban areas of North Jersey; case studies and templates which could be applied to Northern Jersey municipalities.	Literature review; interviews and feedback from regional stakeholders (consumer interviews and focus groups); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action plan - Volume II	Delaware Valley Regional Planning Commission; ICF International	http://www.dvrpc.org/energyclimate/AlternativeFuelVehicles/EVs/ ; http://www.dvrpc.org/reports/12055B.pdf	Southeastern Pennsylvania	June 2013	Electric	This readiness plan provides a comprehensive, regionally coordinated approach to introducing plug-in electric vehicles (PEVs) and electric vehicle supply equipment (EVSE) into the five counties of southeastern Pennsylvania and encouraging adoption and deployment.	Locally relevant, including market analysis and PEV feasibility study that could be useful in urban areas of North Jersey; case studies and templates which could be applied to Northern Jersey municipalities.	Literature review; interviews and feedback from regional stakeholders (consumer interviews and focus groups); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

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Electric Vehicle Readiness: Energy Efficiency through Regional Planning	Des Moines Area Metropolitan Planning Organization; Iowa Economic Development	https://dmampodem.o.files.wordpress.com/2014/12/electric-vehicle-report1.pdf	Des Moines, IA	August 2014	Electric	This report outlines some of the first steps the Des Moines metro region can take to support and encourage plug-in electric vehicle (PEV) adoption by private consumers. It discusses PEV benefits, technology basics, and recommendations for local government actions, in addition to providing resources on education and outreach materials, site design and permitting, and sample zoning and codes.	Not geographically relevant but relatively up-to-date with a local and municipal focus.	Literature review, interviews and feedback from regional stakeholders (consumer interviews and focus groups), and quantitative consumer surveys.	No	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No	No
Coachella Valley Plug-In Electric Vehicle (PEV) Readiness Plan: Summary 2014	ICF International; Coachella Valley Association of Governments	https://www.cvag.org/library/pdf_files/tran/CVAG_PEV_Readiness_Plan%20(FINAL%20Print).pdf	Coachella Valley, CA	April 2014	Electric	This plan provides an introduction to PEVs and associated charging infrastructure. It reviews the readiness elements associated with local and regional government and provides recommendations to attract PEV-related enterprise into the Coachella Valley and facilitate PEV deployment among individuals and fleets.	Not geographically relevant but relatively up-to-date with a local and municipal focus and valuable insight into the pieces necessary for cohesive regulatory framework that facilitates PEV deployment.	Literature review; interviews and feedback from regional stakeholders (consumer interview and focus groups; regional, state, and federal funding agency input; interviews with PEV industry); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	
South Bay Cities Plug-In Electric Vehicle (PEV) Plan	Luskin Center at University of California - Los Angeles	http://innovation.luskin.ucla.edu/content/south-bay-cities-plug-electric-vehicle-plan	South Bay Cities, CA	July 2013	Electric	This paper is a regional electric vehicle supply equipment (EVSE) deployment plan that provides spatial analyses of the area through inventories of land uses at the sub-regional and municipal level to help prioritize PEV planning, evaluate of land parcels to host PEV charging, and map PEV registrations and travel patterns.	- Not geographically relevant, but unique spatial analysis for PEV siting and infrastructure development planning. - Quantitative approach to PEV forecasting compared to most other reports in literature review.	Market data analysis, stakeholder feedback, and local property analysis.	Yes	No	No	No	Yes	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No	
Western Riverside Plug-In Electric Vehicle (PEV) Deployment Plan	Luskin Center at University of California - Los Angeles	http://innovation.luskin.ucla.edu/content/western-riverside-plug-electric-vehicle-deployment-plan	Western Riverside, CA	July 2013	Electric	This paper is a regional electric vehicle supply equipment (EVSE) deployment plan that provides spatial analyses of the area through inventories of land uses at the sub-regional and municipal level to help prioritize PEV planning, evaluation of land parcels to host PEV charging, and maps of PEV registrations and travel patterns.	- Not geographically relevant, but unique spatial analysis for PEV siting and infrastructure development planning. - Quantitative approach to PEV forecasting compared to most other reports in literature review.	Market data analysis, stakeholder feedback, and local property analysis.	Yes	No	No	No	Yes	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No	

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North Coast Plug-In Electric Vehicle (PEV) Readiness Plan	Redwood Coast Energy Authority	http://www.redwoodenergy.org/images/Files/EV/FINAL%20North-Coast-EV-Readiness-Plan.pdf	Northern California	July 2014	Electric	This plan outlines the goals and projected benefits of PEVs and outlines an approach to electric vehicle supply equipment (EVSE) infrastructure development, associated permitting, public education and outreach, incentives, and fleet adoption.	Not geographically relevant but relatively up-to-date with a municipal focus and insight into planning required for a charging corridor, as well as comprehensive look at incentive options at the local level.	Literature review, manufacturer interviews, stakeholder feedback, and market data.	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No	Yes	No	Yes	Yes	No	Yes	No
San Diego Regional Plug-In Electric Vehicle (PEV) Readiness Plan	San Diego Association of Governments; Center for Sustainable Energy of California	https://energycenter.org/sites/default/files/docs/nav/programs/pev-planning/san-diego/San_Diego_PEV_Readiness_Planning_Guide-2013_low-resolution.pdf	San Diego, CA	January 2014	Electric	This plan addresses the current environment for PEVs in the San Diego region. It outlines benefits and barriers to adoption of PEVs and lays out a comprehensive set of recommendations to pave the way for increased PEV deployment in the area.	Not geographically relevant, but relatively up-to-date with a local and municipal focus and valuable insight into the pieces necessary for cohesive regulatory framework that facilitates PEV deployment and the role that local governments can play in the process.	Literature review; interviews and feedback from regional stakeholders (consumer interviews and focus groups; regional, state, and federal funding agency input; and interviews with staff from the PEV industry); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with utility capacity feedback.	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	
Plug-In Electric Vehicle (PEV) Deployment in the Northeast: A Market Overview & Literature Review	Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center	http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/PEV-Deployment-in-the-Northeast.pdf	New England	September 2012	Electric	This review provides a broad overview of PEV deployment in the Northeast, including a discussion of PEV vehicle and charging technology, a detailed market assessment, and analysis of both the benefits of PEV deployment and challenges to wider adoption.	Slightly out of date, but good geographic relevance and great foundational information for literature review.	Literature review, interviews and feedback from regional stakeholders (consumer interviews/focus groups), quantitative consumer surveys, and grid/vehicle adoption analysis in conjunction with local utilities.	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	No	Yes	Yes	No	No	No	Yes	No
A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects	U.S. Department of Energy	http://www.afdc.energy.gov/uploads/publication/guide_ev_projects.pdf	United States	January 2014	Electric	This report provides recommendations and best practices based on lessons learned from municipalities around the United States that implemented plug-in electric vehicle (PEV) readiness projects under the Clean Cities grant.	- Locally focused. - Provides a valuable opportunity to learn from other municipalities already seeking to do the same. By diving deep into the methodologies and best practices from a variety of readiness planning activities, provides significant insight into lessons learned.	Case studies and interviews and feedback from local and regional stakeholders.	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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3. Model State Plug-in Electric Vehicle Planning Documents and Guidance																									
Taking Charge: Establishing California Leadership in the Plug-IN Electric Vehicle Marketplace	California Plug-in Electric Vehicle (PEV) Collaborative	http://www.pevcollaborative.org/sites/all/themes/pev/files/docs/Taking_Charge_final_2.pdf	California	December 2010	Electric	Describes activities to meet six goals for California's PEV market through 2020: (1) overwhelmingly positive PEV consumer experiences; (2) competitive PEV costs; (3) PEV charging smoothly integrated with electricity grid; (4) PEVs advancing energy security, air quality, climate change, and public health goals; (5) strategic actions to create jobs through PEV manufacturing; and (6) moving the PEV market beyond early adopters to mainstream consumers.	- Outdated; written when PEVs just becoming commercially available and the local market penetration was unclear. - Insights regarding market launch relevant in region where PEVs are not established.	Literature review, as well as legislative and policy research.	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes	No	No	Yes	No
It Pay\$ to Plug in page	New Jersey Department of Environmental Protection	http://www.drivegreen.nj.gov/programs.html	New Jersey	June 2016	Electric	This website provides information about New Jersey's workplace charging grant program to offset cost of purchasing and installing charging stations, including requirements and funds available and step-by-step of how to apply.	- Geographically relevant; provides context in terms of state-level, related programs already in place. - Current information.	Incentive summary.	No	No	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No
Clean Vehicles page	New Jersey Department of Environmental Protection	http://www.nj.gov/dep/cleanvehicles/	New Jersey	June 2016	Electric; Natural Gas	This website provides information about clean vehicle availability and registrations in the state, updates on relevant incentives and regulations, and FAQs related to New Jersey's Low Emission Vehicle Program, Drive Green program, and workplace charging grants.	- Geographically relevant; provides context in terms of state-level, related programs already in place. - Current information.	Incentive and policy summary.	Yes	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Drive Green New Jersey page	New Jersey Department of Environmental Protection	http://www.drivegreen.nj.gov/index.html	New Jersey	June 2016	Electric	This website provides basic information about plug-in electric vehicles (PEVs), including the benefits of PEVs, how to charge them, a business case and cost breakdown; it also provides resources for individuals to learn about incentives and regulations, as well as which vehicle is right for them.	- Geographically relevant; provides context in terms of state-level, related programs already in place. - Current information.	Education materials, incentive summary.	Yes	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
2011 Energy Master Plan Note: The 2015 Energy Master Plan Update provides a summary of actions to date and encourages continued commitment in the areas identified in the 2011 plan.	State of New Jersey	http://www.nj.gov/emp/	New Jersey	December 2011	Electric; Natural Gas	This plan documents the Christie Administration's strategic vision for the energy use, management, and development through 2021.	Geographically relevant; provides context for political priorities in the area.	Policy research; state data analysis.	No	No	No	No	No	No	No	No	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes
4. Model International Plug-in Electric Vehicle Planning Documents and Guidance																									
Canadian Electric Vehicle Infrastructure Deployment Guidelines 2014	CEATI International, Inc., Natural Resources Canada and BC Hydro, Electric Transportation Engineering Corporation	http://pluginbc.ca/wp/wp-content/uploads/2014/07/DC14-071-Canadian-EV-Infrastructure-Deployment-Guidelines-2014_web.pdf	Quebec, Canada	March 2014	Electric	This report provides information and resources to implement plug-in electric vehicle (PEV) charging infrastructure, including power requirements, PEV technology, Canadian legislative codes and standards, and charging station site planning.	- Not geographically relevant in terms of policy and regulations, but similar weather - Report targets engineers, architects, developers, and campus planners.	Literature review; consumer, local government, and manufacturer interviews; utility input; and survey data.	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	Yes
Strategies for the Uptake of Electric Vehicles and Associated Infrastructure Implications, Final Report	The Committee on Climate Change	https://www.theccc.org.uk/archive/aws2/Element_Energy_-_EV_infrastructure_report_for_CCC_2009_final.pdf	United Kingdom	October 2009	Electric	This report discusses strategies to incentivize plug in electric vehicle (PEV) deployment and provides an in-depth look at infrastructure implications associated with vehicle adoption.	Provides look at nationally relevant incentives/regulations.	Literature review, consumer surveys, and manufacturer and utility input.	Yes	No	Yes	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No

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Electric Vehicles: Literature Review of Technology Costs and Carbon Emissions	Transportation Research Board	http://www.theicct.org/sites/default/files/publications/ICCT_LitRvw_EV-tech-costs_201607.pdf	International	July 2016	Electric	In the context of European emissions regulations for new vehicles, this study looks at how plug-in electric vehicle (PEV) adoption fits into a lower carbon future in Europe. Specifically, "this paper focuses on collecting, analyzing, and aggregating the available research literature on the underlying technology costs and carbon emissions...[for] three electric propulsion systems: battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and hydrogen fuel cell electric vehicles (FCEVs)." The information collected demonstrates how the costs of fuel cells and lithium ion batteries have changed over time.	- Provides an overview of the market and technology, and presents robust, aggregated cost data that can help municipalities make the case for how and why PEVs are a valuable component of a modernizing fleet. - Emphasizes that policy intervention is crucial for reducing emissions of vehicles.	Uses a bottom-up cost approach to estimate trends in the fuel cell and battery implementation markets. Analyzes the greenhouse gas emissions from vehicles, comparing conventional vehicles to alternative vehicles.	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	Yes	
Plug-In Electric Vehicles (PEVs): A Case Study of Seven Markets	Transportation Research Board; Institute of Transportation Studies - University of California - Davis	https://merritt.cdlib.org/d/ark:%252F13030%252Fm5fb6h7g/1/produser%252F896212116.pdf	International	October 2014	Electric	This paper provides insights into the growth of PEV markets in the United States, California, and five other nations. It compares markets and determines factors that are primary determinants of PEV market share in each region.	Limited geographic relevance but relatively up-to-date information and provides high-level view of PEVs in the United States.	Literature review and data analysis.	Yes	No	No	No	No	Yes	No	No	No	No	Yes	No	No	No	No	No	No	No	
Strategies, Policies, and Initiatives to Enhance Electric Vehicle Adoption; Other Resources from Vancouver	Vancouver EV Association British Columbia, Canada	https://engage.gov.bc.ca/climateleadership/files/2015/12/095-Vancouver-Electric-Vehicle-Association.pdf	Vancouver, Canada	January 2013	Electric	In light of slower plug-in electric vehicle (PEV) adoption in British Columbia than hoped, this plan outlines 11 key barriers, an analysis of each situation, and recommendations to address the challenge.	Not geographically relevant in terms of policy and regulations, but similar weather and many overlapping barriers to Mid-Atlantic region.	Literature review; ECOtality data; and government, utility and other stakeholder feedback.	No	Yes	No	No	No	Yes	No	No	No	Yes	Yes	No	No	Yes	No	No	Yes	No	
EVUE Electric Vehicles in Urban Europe: London Local Action Plan	Various	http://urbact.eu/sites/default/files/import/Projects/EVUE/output_s_media/London_Action_Plan.pdf	London, England	August 2012	Electric	The plan discusses the development and progression of plug-in electric vehicle (PEV) adoption efforts in London. An Electric Vehicle Readiness Index was developed to help planners identify issues, benefits, and challenges associated with PEV adoption.	The SWOT (strengths, weaknesses, opportunities, and threats) analysis, as well as the readiness index, could be beneficial for municipalities to replicate or learn from.	Working groups identified their concerns and expectations, and these were translated into a scale from low to high level of importance.	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	
5. Consumer and Fleet Plug-in Electric Vehicle Guidance																											
Chevrolet website	Chevrolet	http://www.chevrolet.com/volt-electric-car.html	United States	Accessed August 2016	Electric	This page provides information about currently available plug-in electric vehicle (PEV) models, benefits of PEVs, and current station availability in the United States.	Current information about vehicle and charging technology, as well as infrastructure availability.	Manufacturer specifications and infrastructure data.	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	
Ford website	Ford	http://www.ford.com/green/fuel-efficiency/	United States	Accessed August 2016	Electric	This page provides information about currently available plug-in electric vehicle (PEV) models, benefits of PEVs, and current station availability in the United States.	Current information about vehicle and charging technology, as well as infrastructure availability.	Manufacturer specifications and infrastructure data.	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	

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Nissan website	Nissan	http://www.nissanusa.com/electric-cars/leaf/	United States	Accessed August 2016	Electric	This page provides information about currently available plug-in electric vehicle (PEV) models, benefits of PEVs, and current station availability in the United States.	Current information about vehicle and charging technology, as well as infrastructure availability.	Manufacturer specifications and infrastructure data.	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Tesla website	Tesla	https://www.tesla.com/	United States	Accessed August 2016	Electric	This page provides information about currently available plug-in electric vehicle (PEV) models, benefits of PEVs, and current supercharger station availability in the United States	Current information about vehicle and charging technology, as well as infrastructure availability.	Manufacturer specifications and infrastructure data.	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Plug-In Electric Vehicle (PEV) Handbook for Consumers	U.S. Department of Energy	http://www.afdc.energy.gov/uploads/publication/pev_consumer_handbook.pdf	United States	April 2012 (in the process of being updated)	Electric	This handbook is a PEV 101 document for consumers, providing an overview of what PEVs are, the benefits of choosing one over a conventional vehicle, how to identify the right PEV, and, after purchase, how to charge and maintain a PEV.	- Provides basic PEV information and an example of consumer education resource. - This document could also be distributed in North Jersey as part of outreach efforts.	Market and industry research.	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No	No	No	No	No	No
Plug-In Electric Vehicle (PEV) Handbook for Electrical Contractors	U.S. Department of Energy	http://www.afdc.energy.gov/pdfs/51228.pdf	United States	April 2012 (in the process of being updated)	Electric	This handbook provides an introduction to PEVs, electric vehicle supply equipment (EVSE), and PEV charging basics; it discusses EVSE site assessment an planning as well as specific considerations for residential versus non-residential installation; it also includes an overview of EVSE training opportunities for electrical contractors.	- Provides basic EVSE siting and installation information relevant to electrical contractors, as well as training options for contractors, all of which are important component to any municipality's PEV readiness. - This document could also be distributed in North Jersey as part of outreach efforts.	Market and industry research.	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No
Plug-In Electric Vehicle (PEV) Handbook for Fleet Managers	U.S. Department of Energy	http://www.afdc.energy.gov/pdfs/pev_handbook.pdf	United States	April 2012 (in the process of being updated)	Electric	This handbook is a PEV 101 document for fleet managers providing an overview of what PEVs are, the benefits of choosing one over a conventional vehicle from a fleet manager's perspective, how to identify the right PEVs, and, after purchase, how to charge and maintain PEVs.	- Provides basic PEV information and example of resource for local fleet managers. - This document could also be distributed in North Jersey as part of outreach efforts.	Market and industry research.	No	No	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No
Plug-In Electric Vehicle (PEV) Handbook for Public Charging Station Hosts	U.S. Department of Energy	http://www.afdc.energy.gov/pdfs/51227.pdf	United States	April 2012 (in the process of being updated)	Electric	This handbook provides an introduction to PEVs and electric vehicle supply equipment (EVSE); it dives into the benefits and costs of hosting a public charging station, as well as an overview of the existing station network and common public charging station owners; it also describes the different ownership and payment models available to owners as well as the ins and outs of installing and maintaining their EVSE.	- Provides basic PEV information relevant to public charging hosts, which is critical in North Jersey. - This document could also be distributed in North Jersey as part of outreach efforts.	Market and industry research.	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Plug-In Electric Vehicle (PEV) Handbook for Workplace Charging Hosts	U.S. Department of Energy	http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf	United States	April 2012 (in the process of being updated)	Electric	This handbook provides an introduction to PEVs and electric vehicle supply equipment (EVSE); it dives into the benefits and costs of hosting a workplace charging station, as well as the unique evaluation and planning considerations required; it also describes the different management and policy planning necessary for workplace EVSE owners, as well as the ins and outs of installing and maintaining their EVSE.	- Provides basic PEV information relevant to workplace charging hosts, which is critical in North Jersey. - This document could also be distributed in North Jersey as part of outreach efforts.	Market and industry research.	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No

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Multi-unit Dwellings (MUDs) page	California Air Resources Board	http://www.drivclea.n.ca.gov/pev/Charging/Home_Charging/Multi-unit_Dwellings.php	California	Accessed August 2016	Electric	This website provides resources specific to plug-in electric vehicle (PEV) and electric vehicle supply equipment (EVSE) deployment in MUDs.	Valuable information specific to MUDs and rentals, which North Jersey will need to address.	Regulatory research and literature review.	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	No	No	No	No	Yes	
6. Plug-In Electric Vehicle Charging Station Host Guidance and Analysis																											
Literature Review Summary: Electric Vehicle Supply Equipment (EVSE) Signage Guidance	New York State Research and Development Authority	http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/EVSE-Signage-Overview.pdf	New York	October 2013	Electric	This manual provides best practices on EVSE signage to help plug-in electric vehicle (PEV) drivers identify charging stations.	Universal guidance; important information for any PEV readiness program.	Regulatory and best practice research.	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Site Design for Electric Vehicle Charging Stations	New York State Research and Development Authority	http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/Site-Design-for-EV-Charging-Stations.pdf	New York	July 2012	Electric	This report is targeted as those responsible for plug-in electric vehicle (PEV) charging station installation design. It addresses the equipment currently available and how parking facility design offers both opportunities and challenges for charging station installations.	- Geographic relevance. - Slightly out of date but focused discussion of charging infrastructure considerations.	Literature review.	Yes	Yes	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Public Electric Vehicle (PEV) Charging Infrastructure	Sustainable Jersey	http://www.sustainablejersey.com/actions-certification/actions/?type=1336777436&tx_sjcert_action%5BactionObject%5D=521&tx_sjcert_action%5BactionObject%5D=getPDF&tx_sjcert_action%5Bcontroller%5D=Action&cHash=e136260b594094a98ecb6f78df43448a	New Jersey	October 2014	Electric	This document describes an action that municipalities in New Jersey may choose to implement in order to achieve certification from Sustainable Jersey. Municipalities are encouraged to install publically available charging stations for PEVs. Sustainable Jersey describes the benefits of making charging stations ubiquitous in the community, including decreasing "range anxiety" and increasing adoption of PEVs.	- Highly relevant to New Jersey municipalities. - Outlines specific steps municipalities can take to increase adoption.	Describes a course of possible actions that municipalities are encouraged to take, designed in conjunction with Sustainable Jersey partners.	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Lessons from Early Deployments of Electric Vehicle Charging Stations: Case Studies from the Northeast and Mid-Atlantic Regions	Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center	http://www.transportationandclimate.org/sites/default/files/Lessons%20From%20Early%20Deployments%20of%20EV%20Charging%20Stations.pdf	Northeast and Mid-Atlantic	May 2013	Electric	Using examples from Mid-Atlantic and Northeast states, this report offers a glimpse into the challenges, successes, and progress experienced by a number of local-level plug-in electric vehicle (PEV) projects. The focus of the case studies is on PEV charging stations. The study objectives were "to provide stakeholders with actionable information that they can use to support the deployment of electric vehicle charging infrastructure; and to show prospective owners of electric vehicle charging infrastructure installation stories that they can relate to and help them understand some of the issues that they may encounter and opportunities that they may benefit from."	New Jersey municipalities would benefit from the local-level applications presented here. Examples are mostly at the sub-municipal level (e.g., just one building), but still show how these projects succeeded in the context of municipal regulations or actions.	Case studies organized into "clusters" by installation type (e.g., multifamily housing); also evaluated the number of charging stations and connectors in each state within the study region.	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No	Yes

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Siting and Design Guidelines for Electric Vehicle Supply Equipment (EVSE)	Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center	http://www.transportationandclimate.org/sites/default/files/EV_Siting_and_Design_Guidelines.pdf	United States	November 2012	Electric	The focus of these guidelines is on incorporating EVSE into municipal infrastructure, from planning phase through installation. Specifically, this guidance examines the 10-20% of charging activity that occurs in multi-unit housing, public charging stations, on-street or highway parking spaces, and private locations. By expanding offerings at these locations, the guidance hopes to make plug-in electric vehicles (PEVs) accessible to a broader array of drivers.	- Detailed approach to siting and design considerations. - Provides thoughtful questions and assessment techniques that New Jersey municipalities could integrate into their own planning process.	Gives overview of technology and comparison between approaches.	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No
7. Other Plug-In Electric Vehicle Resources, Studies, and Analysis																									
Needs Assessment for Alternative Fuel Vehicle Training in California	Bay Area Air Quality Management District	https://energycenter.org/sites/default/files/docs/nav/policy/research-and-reports/needs-assessment_for_AFC_training.pdf	California	December 2013	Electric; Natural Gas	This report details the availability of safety and technical training in alternative fuel vehicles for emergency personnel and transportation fleet staff in California and provides recommendations to improve it. It provides training curriculums, findings from first responder and fleet surveys, and recommendations specific to each stakeholder type in the industry.	Valuable resource to address the safety and training component of plug-in electric vehicle (PEV) and natural gas vehicle (NGV) readiness in New Jersey.	Stakeholder interviews and survey data.	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes
2016 conference materials and presentations	EVS29, EV Roadmap 9, ACT Expo/EDTA	http://www.evs29.org/ ; http://evroadmapconference.com/program/ ; http://www.actexpo.com/	International	2016	Electric	A number of conferences and expositions are held each year as venues for sharing knowledge about emerging trends in the plug-in electric vehicle (PEV) industry. This review covers a number of conference presentations and documents from events held in 2016.	Municipalities may find the conference materials helpful in that they are full of the latest information and present topics in new and informative ways. These are some of the most up-to-date sources available, and much of the information is applicable at a local level.	Various presentations and materials. Information on corridor analyses that used surveys and observed the areas where most vehicle miles are traveled. Other presentations showed data from studies conducting a supply-side industry analysis, end-user primary research, technology trend assessment, assessment of demand, and fleet experiences with PEVs.	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Plug-In Electric Vehicle (PEV) and Infrastructure Analysis	Idaho National Laboratory	https://avt.inl.gov/sites/default/files/pdf/arra/ARRAPEVnInfrastructureFinalReportLqlySept2015.pdf	United States	September 2015	Electric	By collecting data from real-world projects in PEV and electric vehicle supply equipment (EVSE) demonstrations, this document analyzes the challenges and benefits associated with PEV use. Topics covered include charging behaviors, driving patterns, cost estimations, experiences with PEV adoption, and condensed lessons learned from each project analyzed. Examples of projects analyzed include The EV Project and ChargePoint America, which together constitute the world's largest PEV infrastructure demonstration project to date.	- Includes many figures and graphs which can help communities compare information more easily. - Some of the behavioral analysis may prove especially useful for municipalities looking to understand how infrastructure will be used, who will be using it, and where and when they will charge.	Data collection and analysis. Findings are sometimes broken down by vehicle model. Classifies charging infrastructure by technology and type of venue as well as sub-venue. Sources included not only data from the project leads, but also publically available information sources such as Google Street View, ReCarGo, PlugShare, and ESRI.	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	

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									Market Status	Challenges	Benefits	Niches	Siting	Frameworks	Zoning	Parking Codes	Permitting	Building Codes	Incentives	Utility	Partners	Corridors	Procurement	Education	Other	
2012 U.S. Battery Electric Vehicle Market Study - Battery Electric Vehicle Challenge	J.D. Power	https://store.jdpower.com/products/2012-us-bev-market-study-bev-challenge	United States	March 2012	Electric	This report serves as a precursor to J.D. Power and Associates' "U.S. Electric Vehicle Ownership Experience Study." It addresses the primary benefits and challenges to plug-in electric vehicle (PEV) acceptance by consumers.	- Provides a purely consumer-focused perspective on PEVs, as well as insight regarding effective marketing approach to PEVs. - Could be relevant for North Jersey training and education.	Market research and survey data analysis	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No
Executive Summary: Plug-In Electric Vehicles (PEVs)	Pike Research	http://www.navigantresearch.com/wp-assets/uploads/2012/06/PEV-12-Executive-Summary.pdf	United States	June 2012	Electric	This executive summary includes an analysis of PEV sales as well as a market forecast. It provides an overview of Pike Research's scope of study, sources, and methodology.	- Valuable national market analysis - The full report (available for purchase) provides in-depth supply and demand analysis, as well as sales data by region.	Interviews with industry leaders, literature review, and survey analysis.	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	
The Promotion of Electric Vehicles in the United States (A Landscape Assessment)	Plug In America	http://images.plugina.com/Landscape/The-Promotion-of-Electric-Vehicles-in-the-US-final.pdf	United States	April 2015	Electric	The report presents the findings of research conducted by Plug In America. According to the authors, "the goal of our research for this report was not so much to identify what has gone right so far — we certainly want more of that — but to pinpoint where improvements need to be made." The report's themes include public policy, marketing, and partnerships.	- National level, but focus on marketing strategies and consumer perception provides valuable tools for targeting their message and increasing positive perception among the market of potential customers. - Covers the perspective of municipalities in plug-in electric vehicle (PEV) marketing and promotion.	Literature review and interviews with participants including government agencies, nongovernmental organizations, and manufacturers.	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes	No	No	Yes	Yes	
Electric Vehicle Supply Equipment (EVSE) Cluster Analysis: EVSE Support Study	Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center	http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/EVSE-Cluster-Analysis.pdf	Northeast and Mid-Atlantic	December 2012	Electric	This report provides a qualitative analysis of potential charging station clusters and prioritizes a group of high-potential locations that exist in communities along the Eastern Seaboard. It builds on the quantitative findings of Transportation & Climate Initiative's companion document, which provides maps and data on current plug-in electric (PEV) ownership and EVSE installations.	- Geographically relevant. - Provides valuable perspective on infrastructure planning and development with local, regional, and state-level focus.	Literature review; feedback from Clean Cities coordinators, manufacturers, energy providers, government representatives, and other stakeholders; and survey data.	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	
Assessment of Current Electric Vehicle Supply Equipment (EVSE) & Electric Vehicle Deployment: EVSE Support Study	Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center	http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/Assessment-of-Current-EVSE-and-EV.pdf	Northeast and Mid-Atlantic	November 2012	Electric	This report analyzes the patterns of current plug-in electric vehicle (PEV) ownership and EVSE installations based on a range of geographic, demographic, and policy-based concerns across 11 Mid-Atlantic and Northeast states and Washington, DC. The findings highlight the greatest concentrations of PEV ownership, trends in EVSE locations, recommendations to maximize the impacts of EVSE installations on PEV usage, and recommendations for further areas of study.	- Geographically relevant. - Provides valuable market analysis and perspective on infrastructure planning and development with local, regional, and state-level focus.	Literature review; feedback from Clean Cities coordinators, manufacturers, energy providers, government representatives, and other stakeholders; and survey data.	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	
Menu of Plug-In Electric Vehicle (PEV) Incentives	Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center	http://www.transportationandclimate.org/sites/default/files/Menu%20of%20Plug-In%20EV%20Incentives_Final.pdf	Northeast and Mid-Atlantic	March 2013	Electric	Intended as a resource for states, this document offers a "broad overview of the types of PEV incentives that states can and do offer, and is a resource for state policy makers who are seeking new ideas for ways that their state may promote PEV adoption."	State level, so not directly applicable to municipalities, but could be relevant for understanding the broad array of incentives that exist.	Incentive summaries and analysis.	No	No	No	Yes	No	No	No	No	No	No	Yes	Yes	No	No	No	Yes	Yes	

Title	Author Organization	Web Link	Geographic Focus	Date of Publication	Vehicle(s) of Focus	General Overview	Relevance and Overall Usefulness to North Jersey Municipalities	Study Methodology	Techniques for Market Assessment					Policy and Regulatory Frameworks						Strategies for Advancement							
									Market Status	Challenges	Benefits	Niches	Siting	Frameworks	Zoning	Parking Codes	Permitting	Building Codes	Incentives	Utility	Partners	Corridors	Procurement	Education	Other		
Overcoming Barriers to Deployment of Plug-In Electric Vehicles (PEVs)	Transportation Research Board	http://www.trb.org/Main/Blurbs/172475.aspx	United States	2015	Electric	This committee-led investigation into the PEV market and its barriers presents recommendations and strategic actions that stakeholders can implement to increase PEV adoption. After presenting a comparison of technologies and vehicles, the committee provides tools for understanding the market and the motivations and needs of potential customers. The report then covers considerations for electric utilities and consumers motivated by incentives, as well as government involvement and partnerships to accelerate PEV acceptance.	- Municipalities may find the comparisons and tables informative as they plan their actions and identify strengths and weaknesses in their community's market. - The specific recommendations can be adapted for municipal planning purposes. The range of topics covered makes this document relevant regardless of the planning process stage.	A committee of experts was assembled to conduct an analysis of PEV infrastructure requirements, barriers to implementation, and benefits of higher PEV market penetration. Also evaluates consumer diffusion models for five unique markets, and categorizes the demographic traits of adopters.	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes		
8. Model Natural Gas Vehicle Planning Documents and Guidance																											
Natural Gas Works for Cities: Ideas for Mayors	America's Natural Gas Alliance	http://www.anga.us/media/blog/CE74DE44-938B-DF68-DD25B58FF7FFCCE1/files/anga_mayorfs_finally.pdf	United States	June 2010	Natural Gas	This document is structured as a series of fact sheets, each highlighting a natural gas project implemented by a city or region. Each fact sheet incorporates information about benefits and the unique challenges faced by the different municipalities.	Provides concrete examples of successes and challenges faced by other municipalities and regions of varying sizes. New Jersey cities (Newark, Camden, Trenton, Atlantic City, and Egg Harbor Township) are highlighted as one of the examples.	Case studies.	Yes	No	Yes	Yes	No	Yes	No	No	No	No	Yes	No	Yes	No	No	Yes	No	No	
Permitting Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) Stations: Best Practices Guide for Host Sites and Local Permitting Authorities	California Statewide Alternative Fuel and Fleets Project/ Clean Fuel Connection, Inc.	http://www.baaqmd.gov/~media/files/strategic_incentives/alt_fuels/cng-and-lng_best-practices-9-30-14-final.pdf	California	2014	Natural Gas	"The purpose of this Guide is to two-fold: 1. To provide those agencies and businesses considering natural gas fueling infrastructure the tools to plan, design, permit, build and operate a compressed natural gas fueling station. 2. To provide local authorities information to properly evaluate proposed CNG or LNG fueling installations."	- Written for California development, but applicable to New Jersey municipalities as it includes a thorough description of the cost, technical, siting, and maintenance considerations that any developer would need to take into account. - Case studies show how these concepts are transferrable beyond the California market.	Information and technical background, as well as case studies.	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	No	Yes	No	No		
Natural Gas Vehicles (NGVs) The Here and Now Technology: A Workshop for New England	Clean Cities Coalitions of Northern New England	http://web.uri.edu/ceoc/files/CNG_Workshop_GPCOG_for_USDOE_RI_11202014.pdf	New England	November 2014	Natural Gas	This presentation was developed for a Clean Cities Coalition workshop, and covers a variety of natural gas-related topics, starting with basic compressed natural gas vehicle information and benefits, and progressing to an overview of the market and technology. Provides beneficial information about the specific types of vehicles available for each fleet, as well as a comparison of the types of fueling infrastructure available.	- Regionally applicable. - Provides thorough assessment of benefits of natural gas vehicles and practical considerations to take into account when incorporating vehicles into fleets.	Slide format.	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	No	Yes	No	Yes	No	No		
Experiences with Compressed Natural Gas (CNG) in Colorado Vehicle Fleets	Colorado Energy Office	https://www.colorado.gov/pacific/sites/default/files/atoms/files/CNG%20Case%20Studies.pdf	Colorado	August 2012	Natural Gas	This report is comprised of a series of case studies of diverse fleets that have successfully implemented natural gas vehicles (NGVs) and associated fueling infrastructure.	Local focus; addresses fleet application.	Fleet manager interviews, economic data analysis, and literature review.	No	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes	No	Yes	Yes	Yes	Yes		

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									Market Status	Challenges	Benefits	Niches	Siting	Frameworks	Zoning	Parking Codes	Permitting	Building Codes	Incentives	Utility	Partners	Corridors	Procurement	Education	Other	
Natural Gas Vehicle (NGV) Market Implementation Plan	Colorado Energy Office	https://www.codot.gov/programs/planning/documents/stac-archives/2013-stac/june-2013/ngv-implementation-plan-pres	Colorado	June 2013	Natural Gas	The Colorado Energy Office outlines its vision for implementing NGVs into fleets. The plan describes the diverse benefits of NGVs, and provides a step-by-step guide to implementation.	Information is mostly presented at the state level, but some of the broader concepts may be applicable to municipalities.	Plan and vision statement.	Yes	No	Yes	No	No	Yes	No	No	No	No	Yes	No	Yes	Yes	Yes	No	No	
Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England	Hydrogen Energy Center	http://www.gpcog.org/wp-content/uploads/2015/03/Final-HEC-report.pdf	New England	January 2015	Electric; Natural Gas	This report seeks to answer the question: What regulatory, permitting, approval and administrative policies and procedures by governments and private standards organizations are creating impediments to the implementation of alternative fueling stations and what measures can be taken to minimize or remove these obstacles? It dives into permitting, zoning, codes, standards, regulations, utility rules, and incentives.	Geographically relevant; up-to-date information.	Interviews with supply companies, advocacy organizations and government agencies; interviews with other related entities; and data analysis.	No	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No	No	
Planning and Installation Guide: North Carolina Compressed Natural Gas (CNG) Fueling Stations	North Carolina State University Clean Energy Technology Center	https://nccleantech.ncsu.edu/wp-content/uploads/CNG-Station-Installation-Guide.pdf	North Carolina	Unknown	Natural Gas	This document outlines the process for planning the installation of a new CNG station, from deciding if a station is needed for your fleet, to choosing a site and selecting a vendor. While the guidance only offers a brief overview and includes some details specific to North Carolina, it identifies questions and challenges that all CNG planners should consider. A planning checklist at the end of the document can help fleet managers track their progress towards installing a station.	- Intended for planners in North Carolina, applicable to New Jersey municipalities. - Checklist at the end of the document is useful to any municipality.	Unknown.	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	
Alternative Fuel Corridor Plan	Weld County Natural Gas Coalition	http://www.weldsmarterenergy.org/assets/8058c45794c8c982572.pdf	Weld County, CO	Unknown, likely before 2011	Natural Gas	The county discusses its plan to create a comprehensive alternative fuel corridor between Colorado and Wyoming along the US-85 corridor. This plan also discusses the reasons natural gas would be beneficial to the region, including not only economic benefits, but also compliance with air quality standards as Weld County is located in an 8-Hour Ozone Non-Attainment zone.	Focus on local government approach should be informative to New Jersey municipalities.	Outside economic impact study that quantifies the benefits of natural gas on the U.S. economy.	No	Yes	Yes	No	Yes	No	No	No	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	
9. Other Natural Gas Vehicle Resources, Studies, and Analysis																										
Costs Associated With Compressed Natural Gas (CNG) Vehicle Fueling Infrastructure	National Renewable Energy Laboratory	http://www.afdc.energy.gov/uploads/publication/cng_infrastructure_costs.pdf	United States	September 2014	Natural Gas	By examining a variety of cost factors, this report provides fleet managers with tools for infrastructure-related decision making. The focus of this report is on CNG vehicle infrastructure, not the vehicles themselves. Factors considered in the development of a station cost estimate include demand for fuel, the fleet's main purpose and patterns of usage, installation, and permitting.	The authors warn that this document should not be used to determine a cost estimate for any individual project; however, New Jersey municipalities may find the cost estimation process and the factors considered here useful for planning.	General guidance document.	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No	No	No	No	No	No	No	No
Building a Business Case for Compressed Natural Gas (CNG) in Fleet Applications	National Renewable Energy Laboratory	http://www.afdc.energy.gov/uploads/publication/business_case_cng_fleets.pdf	United States	March 2015	Natural Gas	Using National Renewable Energy Laboratory's Vehicle Infrastructure and Cash Flow Evaluation (VICE) model, this report provides guidance to fleets and businesses determine the profitability of CNG projects, and describes how to use the model.	Municipalities may choose to use this tool in determining the profitability of proposed CNG vehicle and infrastructure projects.	Cost calculator.	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No	No	

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									Market Status	Challenges	Benefits	Niches	Siting	Frameworks	Zoning	Parking Codes	Permitting	Building Codes	Incentives	Utility	Partners	Corridors	Procurement	Education	Other
Various resources (e.g., Compressed Natural Gas (CNG) Station Business Models, CNG Station Construction and Economics, CNG Station Design, Vehicle Availability Page (including associated documents), Transit Page)	NGV America	http://www.ngvamerica.org/stations/cng-station-business-models/ ; http://www.ngvamerica.org/stations/cng-station-construction-and-economics/ ; http://www.ngvamerica.org/stations/cng-station-design/ ; https://www.ngvamerica.org/vehicles/vehicle-availability/ ; http://www.ngvamerica.org/vehicles/fleets/transit/	United States	Accessed August 2016	Natural Gas	Throughout a series of separate websites, NGV America provides information and guidance about business models, construction, economics, fueling, and other aspects of planning for natural gas.	This information is concise and easily accessible for New Jersey municipalities looking for guidance.	Various.	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Yes	No	No	No	No
Natural Gas Vehicle (NGV) Market Analysis	TIAX	https://www.aga.org/tiax-natural-gas-vehicle-market-analysis	United States and Canada	Unknown, likely 2012	Natural Gas	This report is presented in two separate parts: liquefied natural gas (LNG) and compressed natural gas (CNG). Production and distribution is emphasized in both of these reports, but both touch on the market conditions and opportunities necessary to facilitate NGV market growth.	Municipalities can use the information about demand and supply, as well as the detailed information about the NG supply chain, to maximize the benefits realized in their town. This report provides specific information, such as company data and station design layouts, which can help communities determine what to look for and what questions to ask when they start developing infrastructure.	This market analysis relies on "segmentation of the vehicle market, identification of market decision drivers, assessment of market development actions, analysis of competing technologies, analysis of market scenarios, and integration of overall market development opportunities."	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No
American Recovery and Reinvestment Act: Clean Cities Project Awards	U.S. Department of Energy	http://www.afdc.energy.gov/uploads/publication/arra_cc_project_awards.pdf	United States (various projects)	August 2016	Electric; Natural Gas	This report provides a summary of the 25 cost-share projects under the Clean Cities program funded through the American Recovery and Reinvestment Act of 2009. These projects resulted in 542 fueling stations and more than 9,000 alternative fuel vehicles deployed nationwide. This includes 855 electric vehicle supply equipment stations, 143 compressed natural gas (CNG), and nine liquefied natural gas stations. The report provides brief project summaries and case studies, and includes a summary of the New Jersey Compressed Natural Gas Refuse Trucks, Shuttle Buses, and Infrastructure Project. This project was led by New Jersey Clean Cities with support from partners.	- Locally relevant information, as well as national best practices. - Recent data and lessons learned.	Data collection, analysis, and case studies.	No	Yes	Yes	Yes	No	No	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes	No

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Literature Review Detail

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** Also covers the other vehicle type—PEV or NGV.*

Model Municipal Plug-In Electric Vehicle Planning Documents and Guidance

Plug-In Electric Vehicle (PEV) Community Readiness – Regional Reports and Statewide Toolkit

Author Organization: California PEV Collaborative

Web Link: <http://www.pevcollaborative.org/pev-readiness>

Geographic Focus: California

Date of Publication: Various Dates

Vehicle(s) of Focus: Electric

General Overview: These reports and guidebooks provide recommendations and best practices, in addition to analyses on the benefits and challenges to PEV and electric vehicle supply equipment (EVSE) deployment.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant but many of the conclusions and recommendations may apply in North Jersey municipalities.

Study Methodology: Literature review, regulatory research, stakeholder interviews, and consumer surveys.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; two resources address challenges to EVSE deployment in multi-family developments and common challenges associated with permitting process.

Benefits Evaluation: Yes; the PEV fact sheet provides overview on benefits to drivers of owning and using PEVs.

Niche Applications Considered: Yes, "Ready Set Charge" includes short section on encouraging PEV adoption in fleets and car-sharing programs.

Infrastructure Siting Vision and Goals: Yes; "Ready Set Charge" includes a vision of accelerating EVSE deployment and how to achieve this.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: Yes; several guides include parking code examples.

Permitting: Yes; one report specifically focused on streamlining the permitting process and common challenges.

Building Codes: No, not in-depth.

Incentives: No, not in-depth.

Utility and Grid Concerns: Yes; the Advanced Energy Community Planning Guide (a resource included in the toolkit but produced by the North Carolina utility) provides information about utility involvement in PEV readiness planning.

Strategies for Advancement

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
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Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; the Advanced Energy Community Planning Guide provides information about education and training for various stakeholders in PEV industry.

Other Strategies: No

Electric Vehicle Charging Station Installation Best Practices: A Guide for San Diego Region Local Governments and Contractors

Author Organization: Center for Sustainable Energy; Plug-in San Diego

Web Link: http://www.sandag.org/uploads/projectid/projectid_511_19815.pdf

Geographic Focus: San Diego, CA

Date of Publication: June 2016

Vehicle(s) of Focus: Electric

General Overview: This report serves as a resource to promote regionally consistent residential and commercial electric vehicle supply equipment (EVSE) permitting, inspection, and installation in the San Diego region. It includes a review of codes and standards related to installations, common challenges, and best practices to assist building departments and contractors to prepare.

Relevance and Overall Usefulness to North Jersey Municipalities: A great example of a regional EVSE guide focused on installation benefits, challenges, and requirements.

Study Methodology: Literature review, regulatory research, and stakeholder interviews.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; discusses common barriers to EVSE installation.

Benefits Evaluation: Yes; discusses why EVSE installation is important for PEV deployment.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No; however, report does discuss requirements (consistent siting, appropriate multi-unit dwelling chargers, public chargers, and workplace charging) to achieve the organization's vision for a robust charging station network.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; discusses codes and standards relevant to EVSE installation.

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: Yes; discusses the importance of standardization of EVSE building codes and installation requirements.

Incentives: Yes; discusses best practices for EVSE incentives and financing programs.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

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Procurement Practices: No

Education and Training: Yes; discusses best practices for training electrical contractors.

Other Strategies: Yes; notes that EVSE installation checklist to facilitate consistency are a best practice.

Electric Vehicle Charging Station Permitting and Inspection Best Practices: A Guide for San Diego Region Local Governments

Author Organization: Center for Sustainable Energy; Plug-in San Diego

Web Link: http://www.sandag.org/uploads/projectid/projectid_511_19814.pdf

Geographic Focus: San Diego, CA

Date of Publication: June 2016

Vehicle(s) of Focus: Electric

General Overview: This report serves as a resource to promote regionally consistent residential and commercial electric vehicle supply equipment (EVSE) permitting, inspection, and installation in the San Diego region. It provides an overview of common barriers to EVSE installations (i.e., permit application delays), a catalogue of existing permit processes and compliance requirements, and permitting and inspection best practices to assist local building departments in preparing for an increase in EVSE permits.

Relevance and Overall Usefulness to North Jersey Municipalities: Good resource for best practices specific to developing streamlined, consistent permitting process.

Study Methodology: Literature review, regulatory research, and stakeholder interviews.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; discusses common barriers to PEV installation.

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No; however, report does discuss requirements (consistent siting, appropriate multi-unit dwelling chargers, public chargers, and workplace charging) to achieve the organization's vision for a robust charging station network.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; discusses existing permit submittal processes and best practices for specific, fillable applications and online permitting and inspection services.

Building Codes: No

Incentives: Yes; discusses permit fee incentives.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
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Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; discusses clear and consistent website information on permitting processes as a best practice.

Other Strategies: Yes; notes that EVSE installation checklist to facilitate consistency are a best practice.

Electric Vehicle Development: Municipal Best Practices Study

Author Organization: City of Atlanta

Web Link: <http://www.rmi.org/Content/Files/Atlanta%20EV%20Readiness%20Study%20.pdf>

Geographic Focus: Atlanta, GA

Date of Publication: October 2010

Vehicle(s) of Focus: Electric

General Overview: After the Metro Atlanta Plug-in Electric Vehicle (PEV) Readiness Task Force (MAPEVRTF) executed a memorandum of understanding with Nissan in 2010, the city has been working to eradicate barriers to PEV adoption. The city conducted a survey to collect knowledge from other cities with PEV implementation experiences. This report is "a compilation of data from best practices surveys from 13 municipal entities with experience in meeting the needs of their residents who are choosing to become electric vehicle owners."

Relevance and Overall Usefulness to North Jersey Municipalities: - Can provide municipalities with background information about the experiences of other cities.

- As this report is from 2010, it is outdated, but many best practices are still applicable.

Study Methodology: Survey

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; discusses permitting best practices.

Building Codes: Yes; one survey response says their Building Codes division released permitting and inspection protocols.

Incentives: Yes; describes a number of incentives offered in the cities surveyed, including home charging station incentives.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; discusses partnerships with the private sector, as well as partnerships between city governments.

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Corridor Planning: Yes; response from Eugene, OR identifies an I-5 corridor project to increase charging stations between Eugene and Seattle.

Procurement Practices: No

Education and Training: Yes; some survey responses mention educational or training programs in their communities, but no assessment of education and training is provided.

Other Strategies: No

Creating Electric Vehicle-Ready Towns and Cities: A Guide to Planning and Policy Tools

Author Organization: Georgetown Climate Center

Web Link:

http://www.transportationandclimate.org/sites/default/files/EVSE_Planning_and_Policy_Tool_Guide.pdf

Geographic Focus: Mid-Atlantic

Date of Publication: November 2012

Vehicle(s) of Focus: Electric

General Overview: This resource helps local governments make their communities plug-in electric vehicle (PEV)-ready. Includes in-depth look at five policy tools (and related best practices) to enable PEV readiness: zoning and parking ordinances, codes, permitting, and building interagency or business partnership.

Relevance and Overall Usefulness to North Jersey Municipalities: - Locally relevant, including market analysis that could be useful in urban areas of North Jersey.

- Targeted towards policymakers who are developing, enacting or enforcing strategic plans, regulations and legislation, industry stakeholders, or members of the private sector.

- Outdated; written when PEVs just hitting the market.

Study Methodology: Literature review; consumer, local government, and manufacturer interviews; and national survey data.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; including multi-unit dwelling and commercial electric vehicle supply equipment (EVSE) installations, EVSE standardization, electrical code, and outdated zoning regulations.

Benefits Evaluation: Yes, at the high level; including emissions and air pollution, as well as economic development benefits.

Niche Applications Considered: Yes; consumer vehicles and government fleets.

Infrastructure Siting Vision and Goals: Yes; discusses need for residential and public charging and role of zoning and codes to develop this infrastructure.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; discusses local zoning, codes, and permitting.

Zoning: Yes; mentions leveraging zoning ordinances to shape scope of EVSE deployment.

Parking Codes: Yes; mentions regulating EVSE through parking ordinances, encouraging EVSE in wide range of installation scenarios (public/private, new and existing), and public-private partnership opportunities.

Permitting: Yes; focuses on defining EVSE in the permitting process expediting efforts for single-family, multifamily, and commercial settings, reducing fees, and standardizing fees.

Building Codes: Yes; advises to leverage codes for consistent EVSE regulations, establish buy-in from the development community, and implement state versus local code flexibility.

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Incentives: Yes; local zoning incentives, parking incentives, EVSE incentives (financial/zoning), and developer incentives (e.g., pre-wiring, dedicated parking spaces).

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; high level discussion of manufacturer partnerships, effective public-private partnerships, successful state and local partnerships, and private-private partnerships.

Corridor Planning: No

Procurement Practices: Yes; stresses the need for local/state/federal procurement policies to link government fleets with private innovation; also includes discussion of limitations.

Education and Training: Yes; brief discussion of training electricians and EVSE inspectors.

Other Strategies: No

Zero-Emission Vehicles (ZEVs) in California: Community Readiness Guidebook

Author Organization: Governor's Office of Planning and Research, State of California

Web Link: https://www.opr.ca.gov/docs/ZEV_Guidebook.pdf

Geographic Focus: California

Date of Publication: 2013

Vehicle(s) of Focus: Electric

General Overview: California is paving the way for ZEV market growth as a strategy for greener transportation in the state. California's governor released an Executive Order directing agencies to achieve ZEV readiness benchmarks. The report covers plug-in electric vehicles (PEVs) and hydrogen fuel cell electric vehicles (FCEVs). California municipalities have adopted PEV-friendly zoning policies, codes, and infrastructure, and examples in this report show different methods and opportunities for achieving greater adoption. "Each recommendation in the Guidebook includes a brief snapshot of the issue, a series of key steps that communities can take related to that topic and, when applicable, a featured resource that provides more information. Examples and case studies are included throughout the document. The Guidebook is written as a "living document" that can be updated as new resources become available and as ZEV technology and the market for these vehicles evolve."

Relevance and Overall Usefulness to North Jersey Municipalities: - The appendices include a checklist and templates for municipal codes that communities can adapt for their own unique situations.

- The target audience for this guidebook is local and regional governments, so North Jersey municipalities can discover recommended actions and helpful tools for towns like their own. It is particularly relevant, as North Jersey has adopted the California ZEV sales regulations.

- Communities may find the PEV Community Readiness Scorecard beneficial for planning.

Study Methodology: The report presents relevant information and specific actions intended for local governments to use in their planning phases. It includes comprehensive guide to municipalities who want to enhance PEV readiness with the tools, templates, and guidance presented here.

Techniques for Market Assessment

Market Status Evaluation: Yes; does not go into an in-depth market assessment, but provides local planners with tools to assess their own market's conditions. For example, the readiness scorecard includes questions that planners can answer to help determine the market's strength and weaknesses.

Key Challenges Evaluation: Yes; touches on the major challenges that a local government would likely encounter during planning for PEV readiness, and offers targeted approaches and solutions to overcoming those challenges.

Benefits Evaluation: Yes; discusses the benefits of ZEVs and community readiness overall. Benefits include reduction in noise pollution and greenhouse gas emissions, cost, and convenience. Additionally, communities that are "ZEV-ready" can attract drivers to commercial areas, improve infrastructure for the whole community, and increase energy independence.

Niche Applications Considered: Yes; lists best practices for overcoming barriers to adoption in rural communities.

Infrastructure Siting Vision and Goals: Yes; the California regulation sets goals for the availability and accessibility of electric vehicle supply equipment (EVSE) in municipalities throughout the state. The report

discusses the ways that planners can use community trends and data to determine if and where EVSE is needed.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; information about California state policies, but could be relevant to other states' regulatory frameworks. Also considers federal laws and programs.

Zoning: Yes; provides recommendations and gives an example of a zoning municipal code, covering public and private stations. Shows a table of where types of charging stations are best zoned.

Parking Codes: Yes; provides recommendations and includes a template for municipalities to incorporate a PEV parking designation into their codes.

Permitting: Yes; provides recommendations relating to infrastructure permitting for local governments. Also has a permitting checklist for the Los Angeles area that could be a model for other towns.

Building Codes: Yes; provides recommendations and includes a model building code for including PEV charging stations, which local governments can reference as they adopt their own language.

Incentives: Yes; includes a table covering incentives at all levels, including tax credits, free use of high occupancy toll lanes for ZEV drivers, carpool lane access, free charging, and financing to install chargers at home. Gives specific examples of municipally-led rebates. Also mentions installation of infrastructure counting towards Leadership in Energy & Environmental Design (LEED) certification for buildings.

Utility and Grid Concerns: Yes; provides examples of incentives run by utilities, such as discounted rates for PEV charging, free DC fast charging, and monthly fee waivers. Also provides recommended strategies for local governments to work with utilities to ensure PEV readiness.

Strategies for Advancement

Key Partnerships: Yes; identifies partnerships as good options for overcoming funding barriers and for increasing accessibility to rural communities. Gives specific examples of partners for California planners to consider, but parallel organizations may exist in New Jersey.

Corridor Planning: Yes; identifies the prioritization of transportation corridors as a best practice to overcome barriers to PEV readiness in rural communities.

Procurement Practices: No

Education and Training: Yes; does not assess education and training in detail, but gives strategies for education and outreach.

Other Strategies: Yes; provides targeted strategies for homeowners associations and landlords. Provides strategies for local governments to take action on a number of fronts, including increasing workplace charging station use and increasing EVSE use in commercial areas. Recommends facilitating "ride-and-drive" events with local ZEV dealers so that customers can experience driving the cars and overcome any uncertainties. Gives examples of signage.

Assessment of Leading Electric Vehicle Promotion Activates in United States Cities

Author Organization: International Council on Clean Transportation

Web Link: http://www.theicct.org/sites/default/files/publications/ICCT_EV-promotion-US-cities_20150729.pdf

Geographic Focus: United States

Date of Publication: July 2015

Vehicle(s) of Focus: Electric

General Overview: This report includes original research on state, local, and utility actions that are spurring plug-in electric vehicle (PEV) deployment, including a city-specific analysis of policy benefits in 25 urban areas.

Relevance and Overall Usefulness to North Jersey Municipalities: - Includes some geographically relevant examples.

- One of the few documents focused solely on incentives and taking a deeper dive into the subject, versus most others which provide a general overview and best practices.

Study Methodology: Regulatory research and literature review.

Techniques for Market Assessment

Market Status Evaluation: Yes; a brief overview is included in the introduction as context for the role of incentives.

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; includes a deep dive into existing actions and statistical analysis of the connection between incentives and PEV adoption.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

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Procurement Practices: No

Education and Training: No

Other Strategies: No

Local Zoning & Electric Vehicle Infrastructure Resources

Author Organization: Municipal Research & Services Center of Washington

Web Link: <http://mrsc.org/Home/Explore-Topics/Environment/Energy-Topics/Planning-for-Electric-Vehicles.aspx>

Geographic Focus: Washington State

Date of Publication: January 2016

Vehicle(s) of Focus: Electric

General Overview: This website provides a breadth of resources on the various components required for plug-in electric vehicle (PEV) readiness, including local zoning provisions, electric vehicle supply equipment (EVSE) installation best practices, PEV infrastructure requirements, and PEV related statutes in the State of Washington.

Relevance and Overall Usefulness to North Jersey Municipalities: - Locally focused.

- Would be a good resource for specific regulatory wording and examples.

Study Methodology: Literature review.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes

Zoning: Yes; includes a section devoted to examples of zoning provisions enacted by Washington local governments, websites providing citizens information about planning for EVSE and locations of public EVSE.

Parking Codes: No

Permitting: Yes; includes community brochure on permitting.

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

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Education and Training: No

Other Strategies: No

Electric Vehicle Advisory Committee: Report of Recommendations 2015

Author Organization: New York City Department of Transportation

Web Link: <http://www.nyc.gov/html/dot/downloads/pdf/2015-electric-vehicle-report.pdf>

Geographic Focus: New York City, NY

Date of Publication: 2015

Vehicle(s) of Focus: Electric

General Overview: This report addresses the current state of plug-in electric vehicle (PEV) use in New York City and recommends potential actions that the city and other members of the committee can take to encourage the use of PEVs.

Relevance and Overall Usefulness to North Jersey Municipalities: - Locally relevant

- Discussion of EVSE challenges in similar geography (high population density)

Study Methodology: Literature review, regulatory research, and stakeholder interviews.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides current state of the PEV industry and analysis of national, regional, and local PEV sales.

Key Challenges Evaluation: Yes; discusses PEV charging challenges for New York City.

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; discusses charging options in New York City and the power of expanded publically available infrastructure to inspire purchaser confidence and stimulate market demand.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; includes recommendation to coordinate with the New York State PEV Working Group to promote PEVs.

Corridor Planning: No

Procurement Practices: No

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Education and Training: No

Other Strategies: No

Exploring Electric Vehicle Adoption in New York City

Author Organization: New York City/ McKinsey & Company

Web Link: http://www.nyc.gov/html/om/pdf/2010/pr10_nyc_electric_vehicle_adoption_study.pdf

Geographic Focus: New York City, NY

Date of Publication: January 2010

Vehicle(s) of Focus: Electric

General Overview: To achieve the emissions goals in PlaNYC, the city's comprehensive sustainability plan, and to address the new vehicles coming to market, the city commissioned this study to "identify what factors would drive early consumers to purchase electric vehicles, and what the city and other stakeholders could do to facilitate early adoption of this technology in the short term."

Relevance and Overall Usefulness to North Jersey Municipalities: - Locally relevant, including market analysis that could be useful in urban areas of North Jersey.

- Outdated; written when plug-in electric vehicles (PEVs) were just becoming commercially available and the local market penetration was unclear.

Study Methodology: Consumer interviews and focus groups, quantitative consumer surveys, consumer and industry expert workshops, grid and vehicle adoption analysis in conjunction with the local utility, and FAQ development.

Techniques for Market Assessment

Market Status Evaluation: Yes; looks at manufacturer vehicle availability, vehicle ownership, and attitudinal segmentation.

Key Challenges Evaluation: Yes; including lack of individual vehicle ownership, incremental cost (though study found early adopters were willing to pay), constrained vehicle supply, multi-unit dwelling electric vehicle supply equipment (EVSE), and EVSE standardization.

Benefits Evaluation: Yes; including relatively high assigned parking spots in the region, early adopter recognition, smart charging, and emissions (high level discussion).

Niche Applications Considered: No; just consumer vehicles.

Infrastructure Siting Vision and Goals: Yes; mentions the need for residential charging, including smart chargers.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; No local discussion, beyond possible incentives and recognition; mentions federal Corporate Average Fuel Economy standards.

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; federal research and development incentives and tax credits mentioned. Suggested early adopters would respond to a local rebate or tax credit, discounted parking, free towing, preferred lanes, time-of-use charging rates, and special license plates.

Utility and Grid Concerns: Yes; including the importance of utility planning and market analysis (e.g., to identify potential "clusters").

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; measured public familiarity with PEVs and suggested targeted education (e.g., informational website and hotline, distributing materials at dealerships, dedicated test drive showroom, training program for mechanics, school program).

Other Strategies: No

Residential Electric Vehicle Supply Equipment (EVSE) Permit Process Best Practices

Author Organization: New York State Energy Research and Development Authority (NYSERDA)

Web Link: <http://www.nyseda.ny.gov/-/media/Files/Programs/ChargeNY/Permit-Process-Streamlining.pdf>

Geographic Focus: New York State

Date of Publication: April 2013

Vehicle(s) of Focus: Electric

General Overview: This guidebook provides an overview of the EVSE permitting processes in the region, followed by sample permits and recommended best practices to pave the way for PEVs.

Relevance and Overall Usefulness to North Jersey Municipalities: - Geographically relevant.

- Includes specific wording, which may be helpful for permit streamlining in the area.

Study Methodology: Regulatory research, literature review, and stakeholder interviews.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; entire document addresses permit process and recommendations to streamline EVSE installation.

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Electric Vehicle Infrastructure: A Guide for Local Governments in Washington State

Author Organization: Puget Sound Regional Council

Web Link: http://www.psrc.org/assets/4325/EVI_full_report.pdf

Geographic Focus: Washington State

Date of Publication: July 2010

Vehicle(s) of Focus: Electric

General Overview: This document provides guidance for local governments in Washington State to comply with legislation aimed at promoting plug-in electric vehicles (PEVs) and charging stations throughout the state. In particular, the report covers model ordinance, model development regulations, and other general guidance related to PEV infrastructure and batteries in the context of the new (at the time) law (House Bill 1481).

Relevance and Overall Usefulness to North Jersey Municipalities: cChecklists, templates, and data are presented that could be applied to North Jersey municipalities in the planning stages of PEV implementation.

Study Methodology: While the majority of the document provides information for municipalities, the appendices include survey and interview results, research on batteries, and model installation guidance. Elsewhere, the report provides model ordinance and regulations so that municipalities can structure their plans accordingly and borrow language. The authors conducted background research to identify existing codes and best practices.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; challenges are addressed throughout the document, including battery recycling and handling, funding, and compliance with the state legislation.

Benefits Evaluation: Yes; benefits are mentioned throughout, but the purpose of the document is not to provide municipalities with the resources to convince potential customers of PEV benefits, as the state regulation is already in place.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; siting requirements for the state are determined by the regulation, but the document does include suggestions for siting and accessibility.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; the report is focused on examining issues and opportunities in the light of a new regulation.

Zoning: Yes; the new law has zoning requirements. Example regulations are included for municipalities to determine zoning.

Parking Codes: Yes; provides example regulations for municipalities that choose to enforce parking restrictions (either on non-PEVs in PEV spaces, or on PEVs parked in non-approved times/locations).

Permitting: Yes; touches on permitting for PEV spaces and infrastructure.

Building Codes: Yes; the state building code council is required to address PEV infrastructure requirements, while considering national and international code standards.

Incentives: Yes; mentions some grants available to state municipalities.

Utility and Grid Concerns: Yes; includes discussion of how utilities would be affected and mentions some options for overcoming challenges related to the authority of electric utilities.

Strategies for Advancement

Key Partnerships: Yes; to create this guidance, a technical advisory committee consisting of utilities, state and local government agencies, ports, consumer interests, and PEV vendors collaborated and shared ideas.

Corridor Planning: Yes; the regulation has requirements for different parts of the state based on their proximity to a freeway, in order to increase connectivity. The report includes maps showing how connectivity will look along major interstates.

Procurement Practices: No

Education and Training: No

Other Strategies: Yes; regulation requires state and local government agencies to transition their fleets to 100% electricity or biofuel by a certain date.

Project Get Ready: Helping Communities Become Electrified Vehicle Pioneers

Author Organization: Rocky Mountain Institute

Web Link: <http://www.rmi.org/Content/Files/Project%20Get%20Ready%20Menu.pdf>

Geographic Focus: United States

Date of Publication: March 2009

Vehicle(s) of Focus: Electric

General Overview: This menu lays out the "must have" and "nice to have" actions for a community to prepare for plug-in electric vehicles (PEVs) from the perspective of municipal government, utilities, civic groups, local businesses, and consumers; also provides a summary of costs and benefits of PEVs from each standpoint.

Relevance and Overall Usefulness to North Jersey Municipalities: - Locally focused.

- Provides a valuable opportunity to learn from other municipalities already seeking to do the same.

Study Methodology: Case studies, as well as interviews and feedback from local and regional stakeholders.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; addresses top 12 barriers and actions to combat them.

Benefits Evaluation: Yes; includes discussion of benefits of PEVs, including business case (financial) and non-monetized benefits.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: Yes; included in actions municipal government can take to facilitate PEV deployment (page 8).

Permitting: Yes; included in actions municipal government can take to facilitate PEV deployment (page 8).

Building Codes: Yes; brief mention in 15 "must have" actions to facilitate PEV deployment.

Incentives: Yes; includes discussion of incentives possible from variety of actors (e.g., government, manufacturers, utilities).

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

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Procurement Practices: No

Education and Training: No

Other Strategies: No

Make Your Town Electric Vehicle Friendly

Author Organization: Sustainable Jersey

Web Link: http://www.sustainablejersey.com/actions-certification/actions/?type=1336777436&tx_sjcert_action%5BactionObject%5D=520&tx_sjcert_action%5Baction%5D=getPDF&tx_sjcert_action%5Bcontroller%5D=Action&cHash=38e44e6f3893e6fef20fca68f3539fd

Geographic Focus: New Jersey

Date of Publication: October 2014

Vehicle(s) of Focus: Electric

General Overview: This document describes an action that municipalities in New Jersey may choose to implement in order to achieve certification from Sustainable Jersey. The action aims to increase plug-in electric vehicle (PEV) adoption by consumers, and identifies tasks, costs, and timeframes for municipalities to achieve this goal. Tasks municipalities can complete include hosting awareness or training events, promoting public chargers, updating building ordinances, and providing chargers for workplaces and multi-family units.

Relevance and Overall Usefulness to North Jersey Municipalities: - Highly relevant to North Jersey municipalities.

- Outlines specific steps municipalities can take to increase adoption.

Study Methodology: Describes a course of possible actions that municipalities are encouraged to take, designed in conjunction with Sustainable Jersey partners.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: Yes; mentions the benefit of improving air quality and reducing greenhouse gas emissions by increasing PEV use.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: Yes; states that zoning must be updated.

Parking Codes: Yes, states that parking ordinances must be updated.

Permitting: No

Building Codes: Yes; gives towns the option of updating building ordinances.

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; considers team members and partners that could be involved in various actions.

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

The City of Loveland – Marrying Functionality and Economics, The City of Loveland on Integrating Electric Vehicles into Fleet Operations

Author Organization: The Electrification Coalition

Web Link: <http://www.cityofloveland.org/Modules/ShowDocument.aspx?documentID=22227>

Geographic Focus: Loveland, CO

Date of Publication: 2012

Vehicle(s) of Focus: Electric

General Overview: Motivated by volatile fuel prices, the City of Loveland integrated plug-in electric vehicles (PEVs) into its fleet. This document discusses costs, purchasing partnerships, usage patterns, expectations, and realities of using two Nissan Leaf vehicles in the city's fleet.

Relevance and Overall Usefulness to North Jersey Municipalities: Describes a municipality's decision process to incorporate PEVs into its fleet, including a discussion of lease options.

Study Methodology: Interview with Loveland fleet manager.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; mentions some initial challenges, such as "range anxiety" and concerns about vehicle reliability.

Benefits Evaluation: Yes; discusses cost benefits.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; discusses partnership with Nissan.

Corridor Planning: No

Procurement Practices: Yes

Education and Training: No

Other Strategies: No

Electric Vehicle-Ready Codes for the Built Environment: Electric Vehicle Supply Equipment (EVSE) Support Study

Author Organization: Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center

Web Link: <http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/EV-Ready-Codes-for-the-Built-Environment.pdf>

Geographic Focus: Northeast & Mid-Atlantic

Date of Publication: November 2012

Vehicle(s) of Focus: Electric

General Overview: This report describes the role of building and electrical codes in encouraging or inhibiting the implementation of EVSE to aid local and state leaders in assessing local code-specific barriers and identifying the appropriate code provisions.

Relevance and Overall Usefulness to North Jersey Municipalities: One of the only publications summarizing the important role that codes can play in plug-in electric vehicle (PEV) and EVSE deployment.

Study Methodology: Regulatory and policy research, literature review, and stakeholder interviews for case studies.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: Yes; takes a deep dive into building code best practices and the role they play in EVSE deployment; includes sample building and electrical code amendments.

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

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Education and Training: No

Other Strategies: No

Houston Energizes Deployment of Plug-In Electric Vehicles (PEVs)

Author Organization: U.S. Department of Energy

Web Link: <http://www.afdc.energy.gov/case/1003>

Geographic Focus: Houston, TX

Date of Publication: September 2014

Vehicle(s) of Focus: Electric

General Overview: Vehicle electrification has become a key focus of mobile source emissions-reduction strategies in Houston -- this case study provides overview of Houston's Electric Vehicle Initiative and the city's streamlined electric vehicle supply equipment (EVSE) permitting and installation processes, which have been central to the area's PEV readiness efforts.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant, but provides example of permit/installation streamlining efforts.

Study Methodology: Legislative and policy research and stakeholder interviews.

Techniques for Market Assessment

Market Status Evaluation: Yes; in the context of program progress.

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No, although includes links for the city's long-range plan and vision.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; discusses Houston's expedited EVSE permitting and installation processes and includes city resources provided for consumers and installers to guide the process.

Building Codes: No

Incentives: No; although includes link to state incentives and laws.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes

Corridor Planning: No

Procurement Practices: No

Education and Training: No

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Other Strategies: No

Los Angeles Sets the Stage for Plug-In Electric Vehicles (PEVs)

Author Organization: U.S. Department of Energy

Web Link: <http://www.afdc.energy.gov/case/1002>

Geographic Focus: Los Angeles, CA

Date of Publication: September 2014

Vehicle(s) of Focus: Electric

General Overview: This case study is an overview of the Los Angeles Department of Water & Power (LADWP) Electric Vehicle Program, with rebates and expedited permitting and installation processes to encourage PEV deployment, as well as the associated progress to date.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant, but provides example of permit/installation streamlining efforts as well as rebates to consider, including analysis of success to date.

Study Methodology: Legislative and policy research and stakeholder interviews.

Techniques for Market Assessment

Market Status Evaluation: Yes; in the context of program progress.

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: Yes; discusses municipal parking code requiring a minimum number of PEV-ready parking spaces in new construction.

Permitting: Yes; overview of Los Angeles Department of Building & Safety Express Permit System for electric vehicle supply equipment (EVSE) installations.

Building Codes: No

Incentives: Yes; discusses a rebate program and LADWP upgrades provided for publicly accessible EVSE.

Utility and Grid Concerns: Yes, to the extent that the document is focused on a utility program.

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

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Education and Training: No

Other Strategies: No

Raleigh, North Carolina, Paves the Way for Plug-In Electric Vehicle (PEV) Success

Author Organization: U.S. Department of Energy

Web Link: <http://www.afdc.energy.gov/case/1001>

Geographic Focus: Raleigh, NC

Date of Publication: September 2014

Vehicle(s) of Focus: Electric

General Overview: Raleigh is paving the way for successful plug-in electric vehicles (PEV) and electric vehicle supply equipment (EVSE) deployment -- this case study summarizes partnerships and efforts implemented through Project Get Ready's regional program, as well as associated progress to date.

Relevance and Overall Usefulness to North Jersey Municipalities: - Some geographic relevance.

- Provides tangible examples of permit and installation streamlining processes, partnerships that could be pursued in North Jersey, and the critical role that utilities play in PEV readiness.

Study Methodology: Legislative and policy research and stakeholder interviews.

Techniques for Market Assessment

Market Status Evaluation: Yes; in the context of program progress.

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: Yes; brief discussion of utility fleet implementation by Duke Energy.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; discusses Raleigh's development and implementation of expedited EVSE permitting and installation processes and includes city resources provided for consumers and installers to guide the process.

Building Codes: No

Incentives: No; although includes link to state incentives and laws.

Utility and Grid Concerns: Yes; provides overview of Duke's activities to contribute to PEV readiness in Raleigh, including infrastructure research.

Strategies for Advancement

Key Partnerships: Yes; explores successful partnerships established among diverse stakeholders in Raleigh through Project Get Ready.

Corridor Planning: No

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Procurement Practices: No

Education and Training: Yes; includes examples of Duke's customer and stakeholder education efforts.

Other Strategies: No

Model Regional Plug-In Electric Vehicle Planning Documents and Guidance

Plug-In Electric Vehicle (PEV) Readiness Plan

Author Organization: Bay Area Air Quality Management District

Web Link: <http://www.baaqmd.gov/~media/files/strategic-incentives/ev-ready/bay-area-pev-readiness-plan-background-and-analysis-web-pdf.pdf?la=en>

Geographic Focus: Bay Area, CA

Date of Publication: December 2013

Vehicle(s) of Focus: Electric

General Overview: This readiness plan provides a comprehensive, regionally coordinated approach to introducing PEVs and electric vehicle supply equipment (EVSE) into the Bay Area and encouraging adoption and deployment.

Relevance and Overall Usefulness to North Jersey Municipalities: Although not geographically relevant, locally focused; includes market analysis and PEV feasibility study that could be useful, as well as case studies and templates which could be applied to Northern Jersey municipalities.

Study Methodology: Literature review; interviews and feedback from regional stakeholders (consumer interviews and focus groups); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.

Techniques for Market Assessment

Market Status Evaluation: Yes; overview of PEV and EVSE deployment in Bay Area as well as PEV and EVSE deployment forecasts.

Key Challenges Evaluation: Yes; addresses barriers to PEV adoption.

Benefits Evaluation: No

Niche Applications Considered: Yes; various discussions of PEVs in local fleets.

Infrastructure Siting Vision and Goals: Yes; includes comprehensive regional siting plan.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; includes an analysis of regulatory trends in near-, mid-, and long-term.

Zoning: Yes; discusses the role of zoning; issues, gaps, and deficiencies in Bay Area; and recommendations to encourage PEV adoption.

Parking Codes: Yes; discusses the role of parking rules; issues, gaps, and deficiencies in Bay Area; and recommendations to encourage PEV adoption.

Permitting: Yes; discusses the role of permitting and inspection; issues, gaps, and deficiencies in Bay Area; and recommendations to streamline process and facilitate EVSE network development.

Building Codes: Yes; discusses the role of building codes in PEV adoption; issues, gaps and deficiencies; and recommended changes to facilitate PEV and EVSE deployment.

Incentives: Yes; discusses current monetary and non-monetary incentives at regional, state, and federal levels.

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Utility and Grid Concerns: Yes; discusses potential impacts on the grid; issues, gaps and deficiencies (including a quantitative analysis); example rate structures and billing protocols for PEVs; and guidance to minimize impact and facilitate PEV adoption.

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; discusses the role of stakeholder training and education; issues, gaps and deficiencies; and guidance to develop comprehensive education and training programs.

Other Strategies: No

Upstate Plug-In Electric Vehicle (PEV) Readiness Plan

Author Organization: California Energy Commission and partners

Web Link:

<https://static1.squarespace.com/static/53764d9fe4b0cb63d6f97b20/t/546bbf05e4b02cdf60e99f49/1416347462203/Readiness+Plan>

Geographic Focus: Northern California

Date of Publication: 2014

Vehicle(s) of Focus: Electric

General Overview: This report provides an overview of the Upstate PEV Readiness Project, including the goals and objectives of the project, projected benefits and challenges, and a breakdown of the project's approach, methods, and results (e.g., cost of electric vehicle supply equipment (EVSE), macro-level deployment, micro-siting, future infrastructure strategy, permitting). It also discusses important partnerships in the project, as well as the role of public education and outreach, incentives, and fleet PEV and EVSE adoption.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant but relatively up-to-date with a local/municipal focus and valuable insight into corridor planning across municipalities.

Study Methodology: Literature review, survey data, and project feedback.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; brief discussion of the challenges to widespread adoption.

Benefits Evaluation: Yes; brief discussion of benefits of widespread PEV adoption.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; includes a proposed charging station network and a future infrastructure development strategy.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; has a summary of the current EVSE permitting process and recommendations to streamline process in the region.

Building Codes: No

Incentives: Yes; gives a brief discussion of role incentives can play in encouraging PEVs in the consumer and commercial setting.

Utility and Grid Concerns: No

Strategies for Advancement

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Key Partnerships: Yes, discusses Upstate PEV Coordinating Council, which was used to maintain clear and consistent communication amongst local stakeholders.

Corridor Planning: Yes; the entire report revolves around the process of corridor planning including design and execution.

Procurement Practices: No

Education and Training: Yes; includes a high level discussion of training and education and promotion efforts in the region.

Other Strategies: No

Electric Vehicle Readiness Plan for Ventura, Santa Barbara, and San Luis Obispo Counties (Central Coast)

Author Organization: California Energy Commission; Electric Vehicle Communities Alliance

Web Link:

http://www.vcapcd.org/pubs/Rules/homepage/PlugInCentralCoastEVReadinessPlan_201400715.pdf

Geographic Focus: Central California

Date of Publication: July 2014

Vehicle(s) of Focus: Electric

General Overview: This plug-in electric vehicle (PEV) readiness plan guides the development of PEV charging infrastructure in the central-coast California region to encourage and facilitate the mass adoption of PEVs in the area. Topics include: summary of PEV goals; overview of key barriers and recommended solutions for the deployment of PEVs and for the development of a comprehensive charging network; effective marketing, training/education, and outreach efforts; and sample documents.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant but relatively up-to-date with a local and municipal focus and valuable insight into the pieces necessary for cohesive regulatory framework that facilitates PEV deployment and the role that local governments can play in the process.

Study Methodology: Literature review; interviews and feedback from regional stakeholders (consumer interview and focus groups; regional, state, and federal funding agency input; interviews with PEV industry); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; extensive discussion of challenges to charging network development and electric vehicle supply equipment (EVSE) siting (both residential and public).

Benefits Evaluation: No; only brief mention.

Niche Applications Considered: Yes; includes guidelines for PEV fleets (Appendix J) with purchase and evaluation criteria.

Infrastructure Siting Vision and Goals: Yes; much of plan focuses on vision and goals for EVSE deployment and recommendations to get there. Appendix R also includes a strategic approach to EVSE siting plan along with siting criteria.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: Yes; provides sample zoning code provisions and zoning ordinance amendments for PEV-ready parking.

Parking Codes: Yes; discusses zoning and codes for PEV-ready parking, as well as signage and other components necessary.

Permitting: Yes; provides sample PEV charging permit and jurisdiction checklist, as well as checklist for building inspectors and commercial installations.

Building Codes: Yes; provides model ordinances for charging infrastructure in new construction and remodels, as well as sample building code guidelines for residential EVSE installations.

Incentives: Yes; includes a brief overview of currently available incentives and cites examples of some regional incentives available throughout the United States.

Utility and Grid Concerns: Yes; discusses grid integration issues, including analysis of potential grid impacts and recommendations to manage those (e.g., structured process to notify utilities of new EVSE installations).

Strategies for Advancement

Key Partnerships: Yes; discusses Plug-in Central Coast stakeholders and the role their cooperating plays in the PEV readiness plan.

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; includes a plan for outreach and education to all stakeholders, including building inspectors, utilities, public works personnel, first responders, and public safety officers; also discusses sharing of best practices for infrastructure, inspection, i

Other Strategies: No

Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action plan - Volume I

Author Organization: Delaware Valley Regional Planning Commission; ICF International

Web Link: <http://www.dvrpc.org/energyclimate/AlternativeFuelVehicles/Evs/>;
<http://www.dvrpc.org/reports/12055A.pdf>

Geographic Focus: Southeastern Pennsylvania

Date of Publication: June 2013

Vehicle(s) of Focus: Electric

General Overview: This readiness plan provides a comprehensive, regionally coordinated approach to introducing plug-in electric vehicles (PEVs) and electric vehicle supply equipment (EVSE) into the five counties of southeastern Pennsylvania and encouraging adoption and deployment.

Relevance and Overall Usefulness to North Jersey Municipalities: Locally relevant, including market analysis and PEV feasibility study that could be useful in urban areas of North Jersey; case studies and templates which could be applied to Northern Jersey municipalities.

Study Methodology: Literature review; interviews and feedback from regional stakeholders (consumer interviews and focus groups); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.

Techniques for Market Assessment

Market Status Evaluation: Yes; analyzes manufacturer vehicle availability, vehicle ownership (current and projected future), and attitudinal segmentation.

Key Challenges Evaluation: Yes, including the lack of individual vehicle ownership, incremental cost, constrained vehicle supply, multi-unit dwelling EVSE, EVSE standardization, and commercial EVSE.

Benefits Evaluation: No; only brief mention.

Niche Applications Considered: Yes; analyzes the benefits and challenges to PEVs in government and commercial fleets; includes examples of PEVs in a car share program.

Infrastructure Siting Vision and Goals: Yes; includes projections for residential, workplace, private access, and public access EVSE deployment.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: Yes; includes recommendations for zoning codes to support adoption of EVSE and PEV parking spaces.

Parking Codes: Yes; includes recommendations for the use of parking ordinances for PEV parking spaces.

Permitting: Yes; includes recommendations for an electrician database, checklists to assist PEV owners with installation process, and best practices for inspection streamlining.

Building Codes: Yes; includes recommendations for zoning code amendments to encourage EVSE in existing and new construction.

Incentives: Yes; recommendations for best practices to incentivize demand for PEVs and EVSE (federal, state, and local, as well as consumer and fleet).

Utility and Grid Concerns: Yes; includes recommendations for utilities to identify necessary infrastructure upgrades, consider alternative rate structures, develop an installation notification mechanism, and address smart grid infrastructure installation and vehicle-to-grid technol

Strategies for Advancement

Key Partnerships: Yes, but only at a high level.

Corridor Planning: Yes, but only at a high level.

Procurement Practices: Yes, includes a recommendation for government procurement requirement updates to support PEV deployment in government fleets.

Education and Training: Yes; includes recommendations for education partnerships, consumer education and training materials, electrician and government training, and community marketing.

Other Strategies: No

Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action plan - Volume II

Author Organization: Delaware Valley Regional Planning Commission; ICF International

Web Link: <http://www.dvrpc.org/energyclimate/AlternativeFuelVehicles/EVs/>;
<http://www.dvrpc.org/reports/12055B.pdf>

Geographic Focus: Southeastern Pennsylvania

Date of Publication: June 2013

Vehicle(s) of Focus: Electric

General Overview: This readiness plan provides a comprehensive, regionally coordinated approach to introducing plug-in electric vehicles (PEVs) and electric vehicle supply equipment (EVSE) into the five counties of southeastern Pennsylvania and encouraging adoption and deployment.

Relevance and Overall Usefulness to North Jersey Municipalities: Locally relevant, including market analysis and PEV feasibility study that could be useful in urban areas of North Jersey; case studies and templates which could be applied to Northern Jersey municipalities.

Study Methodology: Literature review; interviews and feedback from regional stakeholders (consumer interviews and focus groups); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.

Techniques for Market Assessment

Market Status Evaluation: Yes; analyzes manufacturer vehicle availability, vehicle ownership (current and projected future), and attitudinal segmentation.

Key Challenges Evaluation: Yes; includes physical challenges, cost of installation and operation, and codes, covenants, and legalities.

Benefits Evaluation: Yes; addresses political, long-term financial, and environmental benefits of PEVs.

Niche Applications Considered: Yes; includes a segment analysis for commercial and government fleets, a local fleet survey, and recommendations for application of procurement policies.

Infrastructure Siting Vision and Goals: Yes; includes projections for residential, workplace, private access, and public access EVSE deployment.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; includes an analysis of regulatory trends in near-, mid-, and long-term, as well as a detailed regulatory framework to facilitate EVSE deployment.

Zoning: Yes; analysis of zoning codes to support EVSE and PEV deployment.

Parking Codes: Yes; includes an analysis of parking rules to support PEV deployment.

Permitting: Yes; includes an analysis of permitting and inspection processes to facilitate EVSE deployment, as well as a sample regulation governing PEV parking spaces.

Building Codes: Yes; includes an analysis of building and electrical codes.

Incentives: Yes; includes an overview of current local and federal PEV and EVSE incentives, and recommendations of sample incentives and initiatives to promote PEV deployment in the study region.

Utility and Grid Concerns: Yes; includes an analysis of the Pennsylvania electricity market and local utility involvement in PEV deployment, research on grid impacts from PEV deployment, and plans to minimize grid impacts from PEVs and EVSE. Also includes a summary of potential gri

Strategies for Advancement

Key Partnerships: Yes; analyzes public-private partnerships and multi-party partnerships (government/private/utility).

Corridor Planning: Yes, but only at a high level.

Procurement Practices: Yes; includes an analysis of procurement policies to support EVSE deployment in fleets.

Education and Training: Yes; includes examples of education and outreach for consumers and other stakeholders; also a plan to develop a PEV training program (for electricians and government officials) and plan for developing a PEV education, outreach, and marketing campaign.

Other Strategies: No

Electric Vehicle Readiness: Energy Efficiency through Regional Planning

Author Organization: Des Moines Area Metropolitan Planning Organization; Iowa Economic Development

Web Link: <https://dmampodemo.files.wordpress.com/2014/12/electric-vehicle-report1.pdf>

Geographic Focus: Des Moines, IA

Date of Publication: August 2014

Vehicle(s) of Focus: Electric

General Overview: This report outlines some of the first steps the Des Moines metro region can take to support and encourage plug-in electric vehicle (PEV) adoption by private consumers. It discusses PEV benefits, technology basics, and recommendations for local government actions, in addition to providing resources on education and outreach materials, site design and permitting, and sample zoning and codes.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant but relatively up-to-date with a local and municipal focus.

Study Methodology: Literature review, interviews and feedback from regional stakeholders (consumer interviews and focus groups), and quantitative consumer surveys.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: Yes; discusses benefits as they relate to energy security, fuel costs, emissions, infrastructure availability, competitive business advantage, and popular image.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; discusses local government leadership and regulatory actions to set stage for PEV deployment.

Zoning: Yes; sample zoning language included in Resources section.

Parking Codes: Yes; sample parking code language included.

Permitting: Yes; permitting guidelines included.

Building Codes: No

Incentives: Yes; although only brief discussion of incentives that local governments can provide to incentivize PEV adoption.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

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Procurement Practices: No

Education and Training: No

Other Strategies: No

Coachella Valley Plug-In Electric Vehicle (PEV) Readiness Plan: Summary 2014

Author Organization: ICF International; Coachella Valley Association of Governments

Web Link:

[https://www.cvag.org/library/pdf_files/trans/CVAG_PEV_Readiness_Plan%20\(FINAL%20print\).pdf](https://www.cvag.org/library/pdf_files/trans/CVAG_PEV_Readiness_Plan%20(FINAL%20print).pdf)

Geographic Focus: Coachella Valley, CA

Date of Publication: April 2014

Vehicle(s) of Focus: Electric

General Overview: This plan provides an introduction to PEVs and associated charging infrastructure. It reviews the readiness elements associated with local and regional government and provides recommendations to attract PEV-related enterprise into the Coachella Valley and facilitate PEV deployment among individuals and fleets.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant but relatively up-to-date with a local and municipal focus and valuable insight into the pieces necessary for cohesive regulatory framework that facilitates PEV deployment.

Study Methodology: Literature review; interviews and feedback from regional stakeholders (consumer interview and focus groups; regional, state, and federal funding agency input; interviews with PEV industry); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with local utilities.

Techniques for Market Assessment

Market Status Evaluation: Yes; discusses vehicle and charging infrastructure deployment conditions and trends in the region, as well as an overview of readiness in the area.

Key Challenges Evaluation: Yes; reviews barriers to adoption.

Benefits Evaluation: Yes; brief discussion of greenhouse gas reduction potential associated with PEV deployment.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; discusses local and regional government actions necessary to develop cohesive regulatory framework, including building and parking codes and permitting and inspection protocols.

Zoning: Yes; includes discussion of zoning in the context of land planning to make it easier to install EVSE in current and new construction.

Parking Codes: Yes; includes recommendations regarding parking requirements and other relevant codes to facilitate public EVSE.

Permitting: Yes; includes an entire section devoted to permitting and inspection best practices to encourage EVSE and PEV deployment.

Building Codes: Yes; includes discussion of adopting standards for EVSE and requirements of pre-wiring EVSE into the local and state building codes.

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Incentives: Yes; high level discussion of current incentives available, as well as recommendations for additional incentives to encourage PEV and EVSE purchases.

Utility and Grid Concerns: Yes, but only in the context of utility notification for PEV purchases and EVSE installation.

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; extensive discussion of current regional stakeholder training and education efforts, as well as additional opportunities for consumer education.

Other Strategies: No

South Bay Cities Plug-In Electric Vehicle (PEV) Plan

Author Organization: Luskin Center at University of California - Los Angeles

Web Link: <http://innovation.luskin.ucla.edu/content/south-bay-cities-plug-electric-vehicle-plan>

Geographic Focus: South Bay Cities, CA

Date of Publication: July 2013

Vehicle(s) of Focus: Electric

General Overview: This paper is a regional electric vehicle supply equipment (EVSE) deployment plan that provides spatial analyses of the area through inventories of land uses at the sub-regional and municipal level to help prioritize PEV planning, evaluate of land parcels to host PEV charging, and map PEV registrations and travel patterns.

Relevance and Overall Usefulness to North Jersey Municipalities: - Not geographically relevant, but unique spatial analysis for PEV siting and infrastructure development planning.

- Quantitative approach to PEV forecasting compared to most other reports in literature review.

Study Methodology: Market data analysis, stakeholder feedback, and local property analysis.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides quantitative analysis of "current" PEV demand in the county and projections based on current growth rates.

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; includes land inventory, analysis of parking opportunities and multi-unit dwelling charging opportunities to analyze the opportunities for EVSE deployment across the county, and workplace and retail charging opportunities in the region.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: Yes; has a brief discussion of important role that zoning codes can play in EVSE development and charging station placement.

Parking Codes: No

Permitting: Yes; has a brief discussion of importance of streamlined permitting in facilitating EVSE deployment.

Building Codes: Yes; has a brief discussion of importance of updating building codes to facilitate EVSE deployment.

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

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Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Western Riverside Plug-In Electric Vehicle (PEV) Deployment Plan

Author Organization: Luskin Center at University of California - Los Angeles

Web Link: <http://innovation.luskin.ucla.edu/content/western-riverside-plug-electric-vehicle-deployment-plan>

Geographic Focus: Western Riverside, CA

Date of Publication: July 2013

Vehicle(s) of Focus: Electric

General Overview: This paper is a regional electric vehicle supply equipment (EVSE) deployment plan that provides spatial analyses of the area through inventories of land uses at the sub-regional and municipal level to help prioritize PEV planning, evaluation of land parcels to host PEV charging, and maps of PEV registrations and travel patterns.

Relevance and Overall Usefulness to North Jersey Municipalities: - Not geographically relevant, but unique spatial analysis for PEV siting and infrastructure development planning.

- Quantitative approach to PEV forecasting compared to most other reports in literature review.

Study Methodology: Market data analysis, stakeholder feedback, and local property analysis.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides a quantitative analysis of the current PEV demand in the county and projections based on current growth rates.

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; includes a land inventory and analysis of parking opportunities and multi-unit dwelling charging opportunities to analyze the opportunities for EVSE deployment across the county; also discusses workplace and retail charging opportunities in the region.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: Yes; has a brief discussion of important role that zoning codes can play in EVSE development and charging station placement.

Parking Codes: No

Permitting: Yes; has a brief discussion of importance of streamlined permitting in facilitating EVSE deployment.

Building Codes: Yes; has brief discussion of importance of updating building codes to facilitate EVSE deployment.

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

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Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

North Coast Plug-In Electric Vehicle (PEV) Readiness Plan

Author Organization: Redwood Coast Energy Authority

Web Link: <http://www.redwoodenergy.org/images/Files/EV/FINAL%20North-Coast-EV-Readiness-Plan.pdf>

Geographic Focus: Northern California

Date of Publication: July 2014

Vehicle(s) of Focus: Electric

General Overview: This plan outlines the goals and projected benefits of PEVs and outlines an approach to electric vehicle supply equipment (EVSE) infrastructure development, associated permitting, public education and outreach, incentives, and fleet adoption.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant but relatively up-to-date with a municipal focus and insight into planning required for a charging corridor, as well as comprehensive look at incentive options at the local level.

Study Methodology: Literature review, manufacturer interviews, stakeholder feedback, and market data.

Techniques for Market Assessment

Market Status Evaluation: Yes; evaluates current PEV penetration and provides quantitative projections and analysis of PEV adoption in the area.

Key Challenges Evaluation: No

Benefits Evaluation: Yes; discusses the projected benefits of achieving the plan's goals for the region, including energy independence, lower fuel cost, and reduced operating costs.

Niche Applications Considered: Yes; includes a plan to accelerate PEV adoption in fleets and discussion of considerations (e.g., fleet charging stations, appropriate vehicles for particular tasks) applicable in fleet scenarios.

Infrastructure Siting Vision and Goals: Yes; the plan is set up to support California's goal to have the infrastructure to support 1 million vehicles by 2020; it includes projections of PEV adoption.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; provides overview of current EVSE permitting process and outlines recommendations to streamline process in the North Coast region to facilitate infrastructure development.

Building Codes: No

Incentives: Yes; provides detailed discussion of ways that municipal governments, utilities, and communities can each incentivize PEV adoption with specific examples for each.

Utility and Grid Concerns: No

Strategies for Advancement

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Key Partnerships: Yes; outlines North Coast Plug-In Electric Vehicle Coordinating Council members' role in developing and executing the PEV readiness plan.

Corridor Planning: Yes; discusses efforts to develop a North Coast PEV Charging Network, including siting and pricing structure.

Procurement Practices: No

Education and Training: Yes; outlines an approach to public education and outreach in order to promote PEV adoption.

Other Strategies: No

San Diego Regional Plug-In Electric Vehicle (PEV) Readiness Plan

Author Organization: San Diego Association of Governments; Center for Sustainable Energy of California

Web Link: https://energycenter.org/sites/default/files/docs/nav/programs/pev-planning/san-diego/San_Diego_PEV_Readiness_Planning_Guide-2013_low-resolution.pdf

Geographic Focus: San Diego, CA

Date of Publication: January 2014

Vehicle(s) of Focus: Electric

General Overview: This plan addresses the current environment for PEVs in the San Diego region. It outlines benefits and barriers to adoption of PEVs and lays out a comprehensive set of recommendations to pave the way for increased PEV deployment in the area.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant, but relatively up-to-date with a local and municipal focus and valuable insight into the pieces necessary for cohesive regulatory framework that facilitates PEV deployment and the role that local governments can play in the process.

Study Methodology: Literature review; interviews and feedback from regional stakeholders (consumer interviews and focus groups; regional, state, and federal funding agency input; and interviews with staff from the PEV industry); quantitative consumer surveys; and grid/vehicle adoption analysis in conjunction with utility capacity feedback.

Techniques for Market Assessment

Market Status Evaluation: Yes; describes existing PEVs and charging infrastructure in San Diego Region; locations of current public charging stations; and forecasts future PEVs and electric vehicle supply equipment (EVSE) demand in the future.

Key Challenges Evaluation: Yes; identifies regional barriers to EVSE deployment and key recommendations to address those (e.g., regional planning for public EVSE siting, permitting process, utility collaboration).

Benefits Evaluation: Yes; discusses benefits in the context of the justification for developing the plan.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; estimates future demand for EVSE in the region and provides recommendations for regional planning for public EVSE throughout the area.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; discusses all the components of a comprehensive regulatory framework (e.g., zoning, permitting, incentives, building codes), as well as how they all can work together to pave the way for PEV deployment.

Zoning: Yes; focused discussion of zoning and parking policies for PEVs.

Parking Codes: Yes; focused discussion of zoning and parking policies for PEVs.

Permitting: Yes; includes entire section devoted to an overview of current permitting for EVSE by scenario (single family residence, multi-unit dwellings, commercial/public sites, and workplace) and recommendations to streamline the process.

Building Codes: Yes; includes recommendations for building code changes to facilitate EVSE availability for PEV owners.

Incentives: Yes; gives a brief overview of the currently available incentives and sites examples of some regional incentives available throughout the United States.

Utility and Grid Concerns: Yes; includes an entire section devoted to utility solutions to minimize impact on grid of PEV charging and recommendations for notification protocol and time-of-use rates. Also addresses role of education and outreach in this area.

Strategies for Advancement

Key Partnerships: Yes; includes an in-depth description of the San Diego Regional Electric Vehicle Infrastructure Working Group and stakeholders, including background/purpose, stakeholder engagement, and role they have played in overcoming regional barriers to PEV infrastructure development.

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; discussed in the context of utility solutions to minimize impact on grid; also provides example fact sheets for different stakeholders and outreach materials by groups in the area.

Other Strategies: No

Plug-In Electric Vehicle (PEV) Deployment in the Northeast: A Market Overview & Literature Review

Author Organization: Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center

Web Link: <http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/PEV-Deployment-in-the-Northeast.pdf>

Geographic Focus: New England

Date of Publication: September 2012

Vehicle(s) of Focus: Electric

General Overview: This review provides a broad overview of PEV deployment in the Northeast, including a discussion of PEV vehicle and charging technology, a detailed market assessment, and analysis of both the benefits of PEV deployment and challenges to wider adoption.

Relevance and Overall Usefulness to North Jersey Municipalities: Slightly out of date, but good geographic relevance and great foundational information for literature review.

Study Methodology: Literature review, interviews and feedback from regional stakeholders (consumer interviews/focus groups), quantitative consumer surveys, and grid/vehicle adoption analysis in conjunction with local utilities.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides national market analysis, including market forecast and consumer demand; discusses regional (Northeast and Mid-Atlantic) market growth and potential.

Key Challenges Evaluation: Yes; discusses vehicle incremental cost (in the context of the appeal); consumer uncertainty and range anxiety; charging station access (residential, public, and workplace), including the permitting process and EVSE financing; and potential impacts on the

Benefits Evaluation: Yes; discuss decreased reliance on oil, as well as potential for economic growth, improved local air quality, and impact on global climate change.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; discusses importance of charging station build-out in the context of barriers to PEV deployment.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; discusses policy options and frameworks in the context of each set of PEV deployment challenges.

Zoning: No

Parking Codes: No

Permitting: Yes; discusses importance of streamlined permitting for PEV deployment and possible policy solutions to address this challenge.

Building Codes: No

Incentives: Yes; provides overview of state and federal government incentives (monetary and non-monetary) and provides recommendations of additional incentives that can help.

Utility and Grid Concerns: Yes; provides an in-depth discussion of possible grid impacts with PEV deployment and possible solutions.

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes, although only brief discussion in the context of solutions to increase PEV appeal to consumers.

Other Strategies: No

A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects

Author Organization: U.S. Department of Energy

Web Link: http://www.afdc.energy.gov/uploads/publication/guide_ev_projects.pdf

Geographic Focus: United States

Date of Publication: January 2014

Vehicle(s) of Focus: Electric

General Overview: This report provides recommendations and best practices based on lessons learned from municipalities around the United States that implemented plug-in electric vehicle (PEV) readiness projects under the Clean Cities grant.

Relevance and Overall Usefulness to North Jersey Municipalities: - Locally focused.

- Provides a valuable opportunity to learn from other municipalities already seeking to do the same. By diving deep into the methodologies and best practices from a variety of readiness planning activities, provides significant insight into lessons learned.

Study Methodology: Case studies and interviews and feedback from local and regional stakeholders.

Techniques for Market Assessment

Market Status Evaluation: Yes; describes how readiness plans assess the PEV market and provide forecasts for the market in the future. Includes a discussion of "overviews of the PEV options that are currently available to consumers, assessments of the suitability of PEVs for satisfying the driving needs of consumers, analyses of the total cost of ownership of PEVs compared to conventional vehicles, and data on the current rate of PEV adoption in their study areas."

Key Challenges Evaluation: Yes; discusses costs and access to charging (at home, at work, and around town), consumer education, outdated policies, electrical grid effects, transportation infrastructure funding effects, and equity concerns. Also discusses methodology for assessing t

Benefits Evaluation: Yes; assesses the benefits of PEVs, including enhanced energy security, lower emissions, economic benefits, opportunities to leverage renewable sources, and electric utility benefits.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; discusses the importance of a mix of residential, fleet, and workplace charging, and how readiness plans assess siting concerns (e.g., household travel data to conduct geographic analysis of residential charging; survey data, traffic data, employment data, and data on popular destinations to site commercial charging).

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: Yes; addresses local zoning ordinances to encourage PEV and electric vehicle supply equipment (EVSE) deployment. Notes that, "Zoning ordinances can be amended to define where charging stations are permitted, whether the nature of the permit is outright or

Parking Codes: Yes; addresses parking codes to encourage PEV and EVSE deployment. Notes that, "Local parking ordinances can specify the terms of use for public charging stations, standardize charging station signage, and specify how charging station rules will be enforced

Permitting: Yes; addresses permitting and inspection processes that ease PEV and EVSE deployment. Explains opportunities: "(1) adopting clear local ordinances, permits, and procedures to enable straightforward compliance and minimize administrative burdens; (2) reduc

Building Codes: Yes; addresses building codes that will facilitate PEV and EVSE deployment. Summarized that, "Grantees agreed that existing codes do not present a significant barrier to charging station deployment, but building and electrical codes do present opportuniti

Incentives: Yes; discusses incentives for PEVs and EVSE, including difficulties with tax incentives. Also includes a discussion on the importance expanding and sustaining incentives.

Utility and Grid Concerns: Yes; discusses grid planning and electric utility policies, including notification protocols, grid impact modeling, planning for grid system upgrades, smart grid technologies, and third-party roles in charging services. Also discusses vehicle-to-building

Strategies for Advancement

Key Partnerships: Yes; discusses stakeholder partnerships to set the stage for PEV/EVSE deployment, as well as the importance of business investment.

Corridor Planning: Yes; discusses corridors, including examples in Texas, Oregon, the Midwest, and Florida.

Procurement Practices: Yes; discusses an Ohio readiness planning effort that recommended policies to require municipal fleets to acquire a certain percentage of PEVs. Also mentions the possibility of partnerships for procurement.

Education and Training: Yes; addresses outreach (including to tourism industry), education, training (including municipal personnel, first responders, auto dealerships, electricians, parking attendants, vehicle fleet managers, technicians), and marketing lessons learned and best

Other Strategies: Yes; discusses the importance of including PEVs and EVSE into the local master plan.

Model State Plug-In Electric Vehicle Planning Documents and Guidance

Taking Charge: Establishing California Leadership in the Plug-IN Electric Vehicle Marketplace

Author Organization: California Plug-in Electric Vehicle (PEV) Collaborative

Web Link: http://www.pevcollaborative.org/sites/all/themes/pev/files/docs/Taking_Charge_final2.pdf

Geographic Focus: California

Date of Publication: December 2010

Vehicle(s) of Focus: Electric

General Overview: Describes activities to meet six goals for California's PEV market through 2020: (1) overwhelmingly positive PEV consumer experiences; (2) competitive PEV costs; (3) PEV charging smoothly integrated with electricity grid; (4) PEVs advancing energy security, air quality, climate change, and public health goals; (5) strategic actions to create jobs through PEV manufacturing; and (6) moving the PEV market beyond early adopters to mainstream consumers.

Relevance and Overall Usefulness to North Jersey Municipalities: - Outdated; written when PEVs just becoming commercially available and the local market penetration was unclear.

- Insights regarding market launch relevant in region where PEVs are not established.

Study Methodology: Literature review, as well as legislative and policy research.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides an overview of the PEV landscape in California.

Key Challenges Evaluation: Yes; discussion of current challenges to deployment and how six overarching goals tie into and address those challenges.

Benefits Evaluation: Yes; discussion of how PEVs could lead to job creation and economic benefit in California.

Niche Applications Considered: Yes; recommendations include a plan to encourage local and regional government PEV deployment and fleet purchases of PEVs.

Infrastructure Siting Vision and Goals: Yes; builds out a vision for successful market development, including EVSE deployment strategy.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; addresses incentives currently in place at local and regional levels to encourage PEVs.

Utility and Grid Concerns: Yes; analyzes charging and today's electricity grid.

Strategies for Advancement

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Key Partnerships: Yes; explores successful stakeholder partnerships to-date in California.

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; focuses on consumer education to increase PEV and electric vehicle supply equipment demand.

Other Strategies: No

It Pay\$ to Plug In page

Author Organization: New Jersey Department of Environmental Protection

Web Link: <http://www.drivegreen.nj.gov/programs.html>

Geographic Focus: New Jersey

Date of Publication: June 2016

Vehicle(s) of Focus: Electric

General Overview: This website provides information about New Jersey's workplace charging grant program to offset cost of purchasing and installing charging stations, including requirements and funds available and step-by-step of how to apply.

Relevance and Overall Usefulness to North Jersey Municipalities: - Geographically relevant; provides context in terms of state-level, related programs already in place.

- Current information.

Study Methodology: Incentive summary.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: Yes; workplace charging and fleets may apply.

Infrastructure Siting Vision and Goals: Yes; provides vision for workplace charging network across New Jersey.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; discusses funding available through the program and requirements for eligibility.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
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Other Strategies: No

Clean Vehicles page

** Also classified under Other Natural Gas Vehicle Resources, Studies, and Analysis*

Author Organization: New Jersey Department of Environmental Protection

Web Link: <http://www.nj.gov/dep/cleanvehicles/>

Geographic Focus: New Jersey

Date of Publication: June 2016

Vehicle(s) of Focus: Electric; Natural Gas

General Overview: This website provides information about clean vehicle availability and registrations in the state, updates on relevant incentives and regulations, and FAQs related to New Jersey's Low Emission Vehicle Program, Drive Green program, and workplace charging grants.

Relevance and Overall Usefulness to North Jersey Municipalities: - Geographically relevant; provides context in terms of state-level, related programs already in place.

- Current information.

Study Methodology: Incentive and policy summary.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides plug-in electric vehicle and natural gas vehicle registrations in New Jersey.

Key Challenges Evaluation: No

Benefits Evaluation: Yes; includes a high-level discussion about benefits of purchasing a cleaner vehicle.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; provides information about all federal and state-level incentives currently available.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
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Education and Training: No

Other Strategies: No

Drive Green New Jersey page

Author Organization: New Jersey Department of Environmental Protection

Web Link: <http://www.drivegreen.nj.gov/index.html>

Geographic Focus: New Jersey

Date of Publication: June 2016

Vehicle(s) of Focus: Electric

General Overview: This website provides basic information about plug-in electric vehicles (PEVs), including the benefits of PEVs, how to charge them, a business case and cost breakdown; it also provides resources for individuals to learn about incentives and regulations, as well as which vehicle is right for them.

Relevance and Overall Usefulness to North Jersey Municipalities: - Geographically relevant; provides context in terms of state-level, related programs already in place.

- Current information.

Study Methodology: Education materials, incentive summary.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides PEV registrations and electric vehicle supply equipment (EVSE) located throughout New Jersey.

Key Challenges Evaluation: No

Benefits Evaluation: Yes; includes high-level discussion about benefits of purchasing a cleaner vehicle.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; provides information about all federal and state-level incentives currently available.

Utility and Grid Concerns: no

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
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Other Strategies: No

2011 Energy Master Plan

** Also classified under Other Natural Gas Vehicle Resources, Studies, and Analysis*

Note: The 2015 Energy Master Plan Update provides a summary of actions to date and encourages continued commitment in the areas identified in the 2011 plan.

Author Organization: State of New Jersey

Web Link: <http://www.nj.gov/emp/>

Geographic Focus: New Jersey

Date of Publication: December 2011

Vehicle(s) of Focus: Electric; Natural Gas

General Overview: This plan documents the Christie Administration's strategic vision for the energy use, management, and development through 2021.

Relevance and Overall Usefulness to North Jersey Municipalities: Geographically relevant; provides context for political priorities in the area.

Study Methodology: Policy research; state data analysis.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; encourages expedited permitting.

Building Codes: No

Incentives: Yes; encourages incentives for vehicle adoption.

Utility and Grid Concerns: Yes; encourages guidance from utilities on natural gas vehicles.

Strategies for Advancement

Key Partnerships: Yes; encourages public-private partnerships for advancement of alternative fuel vehicles.

Corridor Planning: No

Procurement Practices: No

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Education and Training: Yes; encourages education for public and fleet awareness.

Other Strategies: Indicates that the state is committed to promote infrastructure necessary to induce deployment of natural gas and plug-in electric vehicles.

Model International Plug-In Electric Vehicle Planning Documents and Guidance

Canadian Electric Vehicle Infrastructure Deployment Guidelines 2014

Author Organization: CEATI International, Inc., Natural Resources Canada and BC Hydro, Electric Transportation Engineering Corporation

Web Link: http://pluginbc.ca/wp/wp-content/uploads/2014/07/DC14-071-Canadian-EV-Infrastructure-Deployment-Guidelines-2014_web.pdf

Geographic Focus: Quebec, Canada

Date of Publication: March 2014

Vehicle(s) of Focus: Electric

General Overview: This report provides information and resources to implement plug-in electric vehicle (PEV) charging infrastructure, including power requirements, PEV technology, Canadian legislative codes and standards, and charging station site planning.

Relevance and Overall Usefulness to North Jersey Municipalities: - Not geographically relevant in terms of policy and regulations, but similar weather

- Report targets engineers, architects, developers, and campus planners.

Study Methodology: Literature review; consumer, local government, and manufacturer interviews; utility input; and survey data.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: Yes; extensive discussion of utility demand response, pricing models, vehicle-to-grid technology, and utility tariffs and incentives. Also addresses utility considerations associated with DC fast charging deployment.

Strategies for Advancement

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Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: Specific discussion of EVSE installations in flood zones and snow zones, which is relevant to New Jersey region and a topic not discussed by many other resources. Report also addresses station ownership and safety issues and access considerations.

Strategies for the Uptake of Electric Vehicles and Associated Infrastructure Implications, Final Report

Author Organization: The Committee on Climate Change

Web Link: https://www.theccc.org.uk/archive/aws2/Element_Energy_-_EV_infrastructure_report_for_CCC_2009_final.pdf

Geographic Focus: United Kingdom

Date of Publication: October 2009

Vehicle(s) of Focus: Electric

General Overview: This report discusses strategies to incentivize plug-in electric vehicle (PEV) deployment and provides an in-depth look at infrastructure implications associated with vehicle adoption.

Relevance and Overall Usefulness to North Jersey Municipalities: Provides look at nationally relevant incentives/regulations.

Study Methodology: Literature review, consumer surveys, and manufacturer and utility input.

Techniques for Market Assessment

Market Status Evaluation: Yes; discusses demographics of PEV users, daily vehicle usage patterns, the PEV purchasing decision, etc. (however note that these are likely British demographics).

Key Challenges Evaluation: No

Benefits Evaluation: Yes; discusses decreases in greenhouse gas emissions possible with increased PEV adoption.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; cites Energy Independence and Security Act's Advanced Technology Vehicles Manufacturing Loan Program (ATVMLP) to incentivize advanced technology vehicle development in the United States.

Utility and Grid Concerns: Yes; includes an in-depth discussion of electric vehicle supply equipment network impacts (though may not be geographically relevant).

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
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Procurement Practices: No

Education and Training: No

Other Strategies: No

Electric Vehicles: Literature Review of Technology Costs and Carbon Emissions

Author Organization: Transportation Research Board

Web Link: http://www.theicct.org/sites/default/files/publications/ICCT_LitRvw_EV-tech-costs_201607.pdf

Geographic Focus: International

Date of Publication: July 2016

Vehicle(s) of Focus: Electric

General Overview: In the context of European emissions regulations for new vehicles, this study looks at how plug-in electric vehicle (PEV) adoption fits into a lower carbon future in Europe. Specifically, "this paper focuses on collecting, analyzing, and aggregating the available research literature on the underlying technology costs and carbon emissions...[for] three electric propulsion systems: battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and hydrogen fuel cell electric vehicles (FCEVs)." The information collected demonstrates how the costs of fuel cells and lithium ion batteries have changed over time.

Relevance and Overall Usefulness to North Jersey Municipalities: - Provides an overview of the market and technology, and presents robust, aggregated cost data that can help municipalities make the case for how and why PEVs are a valuable component of a modernizing fleet.

- Emphasizes that policy intervention is crucial for reducing emissions of vehicles.

Study Methodology: Uses a bottom-up cost approach to estimate trends in the fuel cell and battery implementation markets. Analyzes the greenhouse gas emissions from vehicles, comparing conventional vehicles to alternative vehicles.

Techniques for Market Assessment

Market Status Evaluation: Yes; looks at the application and incremental costs of different types of power trains, all within the context of reducing greenhouse gas emissions. Costs are driven primarily by battery and fuel cell costs. Also includes a Market Overview section which describes the size of the PEV and electric vehicle supply equipment (EVSE) market and the distribution of vehicles internationally. Compares production costs of fuel cells and batteries.

Key Challenges Evaluation: Yes; mentions that to achieve maximum emissions reductions, there must be advancements made in making electricity sources cleaner and less carbon-centric. Discusses challenges related to technology limitations, such the higher costs of large batteries, an

Benefits Evaluation: Yes; includes a thorough discussion of emissions benefits associated with using PEVs. Compares energy demand and energy efficiency of different vehicles.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; while it does not go into detail about specific siting goals, as the focus is at a more macro/international level, it includes data comparing the level and primary user type of charging infrastructure to initial investment cost (in Euros).

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; the entire report is in the context of meeting regulation targets, and the findings indicate that "the expected cost reductions and potential [greenhouse gas] emission cuts will not be achieved with targeted policy intervention."

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: Yes; discusses the reduction of emissions by creating a cleaner electricity supply (e.g., wind power), advancing battery technology to reduce the cost of batteries, and thereby reducing the cost of the entire vehicle and making the market more accessible.

Plug-In Electric Vehicles (PEVs): A Case Study of Seven Markets

Author Organization: Transportation Research Board; Institute of Transportation Studies - University of California - Davis

Web Link: <https://merritt.cdlib.org/d/ark:%252F13030%252Fm5fb6h7g/1/producer%252F896212116.pdf>

Geographic Focus: International

Date of Publication: October 2014

Vehicle(s) of Focus: Electric

General Overview: This paper provides insights into the growth of PEV markets in the United States, California, and five other nations. It compares markets and determines factors that are primary determinants of PEV market share in each region.

Relevance and Overall Usefulness to North Jersey Municipalities: Limited geographic relevance but relatively up-to-date information and provides high-level view of PEVs in the United States.

Study Methodology: Literature review and data analysis.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides overview of introduction of PEVs in United States and annual growth since then.

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; provides overview of notable regulations that have impacted PEV and electric vehicle supply equipment (EVSE) deployment in the United States.

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; discusses key incentives available in the United States.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
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Other Strategies: No

Strategies, Policies, and Initiatives to Enhance Electric Vehicle Adoption; Other Resources from Vancouver

Author Organization: Vancouver EV Association British Columbia, Canada

Web Link: https://engage.gov.bc.ca/climateleadership/files/2015/12/095_-Vancouver-Electric-Vehicle-Association.pdf

Geographic Focus: Vancouver, Canada

Date of Publication: January 2013

Vehicle(s) of Focus: Electric

General Overview: In light of slower plug-in electric vehicle (PEV) adoption in British Columbia than hoped, this plan outlines 11 key barriers, an analysis of each situation, and recommendations to address the challenge.

Relevance and Overall Usefulness to North Jersey Municipalities: Not geographically relevant in terms of policy and regulations, but similar weather and many overlapping barriers to Mid-Atlantic region.

Study Methodology: Literature review; ECOTality data; and government, utility and other stakeholder feedback.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; addresses 11 key barriers to PEV adoption.

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; discusses on-road vehicle and emission regulations to incentivize PEV adoption versus conventional vehicles.

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: Yes; addresses power of building codes to enable PEV home charging.

Incentives: Yes; discusses impact of high-occupancy lane access, PEV rebates, and home retrofit rebates on vehicle adoption.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: Yes; discusses potential of "Green Highway"/DC fast charging station corridor to provide accessible charging for PEV drivers.

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Procurement Practices: No

Education and Training: Yes; addresses the importance of easy-to-digest information to educate consumers about PEVs and electric vehicle supply equipment and includes recommendations to improve education efforts.

Other Strategies: No

EVUE Electric Vehicles in Urban Europe: London Local Action Plan

Author Organization: Various

Web Link:

http://urbact.eu/sites/default/files/import/Projects/EVUE/outputs_media/London_Action_Plan.pdf

Geographic Focus: London, England

Date of Publication: August 2012

Vehicle(s) of Focus: Electric

General Overview: The plan discusses the development and progression of plug-in electric vehicle (PEV) adoption efforts in London. An Electric Vehicle Readiness Index was developed to help planners identify issues, benefits, and challenges associated with PEV adoption.

Relevance and Overall Usefulness to North Jersey Municipalities: The SWOT (strengths, weaknesses, opportunities, and threats) analysis, as well as the readiness index, could be beneficial for municipalities to replicate or learn from.

Study Methodology: Working groups identified their concerns and expectations, and these were translated into a scale from low to high level of importance.

Techniques for Market Assessment

Market Status Evaluation: Yes; discusses the importance of public and private sector support at early phases of development.

Key Challenges Evaluation: Yes; discusses challenges in governance between mayor's responsibilities and local authorities' responsibilities; challenges are also quantified in the readiness index.

Benefits Evaluation: Yes; mentions benefits but does not provide a full evaluation.

Niche Applications Considered: Yes; logistics industry.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; discusses role of the London URBACT Local Support Group and other partners .

Corridor Planning: No

Procurement Practices: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
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Education and Training: No

Other Strategies: No

Consumer and Fleet Plug-In Electric Vehicle Guidance

Chevrolet website

Author Organization: Chevrolet

Web Link: <http://www.chevrolet.com/volt-electric-car.html>

Geographic Focus: United States

Date of Publication: Accessed August 2016

Vehicle(s) of Focus: Electric

General Overview: This page provides information about currently available plug-in electric vehicle (PEV) models, benefits of PEVs, and current station availability in the United States.

Relevance and Overall Usefulness to North Jersey Municipalities: Current information about vehicle and charging technology, as well as infrastructure availability.

Study Methodology: Manufacturer specifications and infrastructure data.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; provides link to U.S. Department of Energy's website page with available incentives for prospective buyers.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

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Other Strategies: No

Ford website

Author Organization: Ford

Web Link: <http://www.ford.com/green/fuel-efficiency/>

Geographic Focus: United States

Date of Publication: Accessed August 2016

Vehicle(s) of Focus: Electric

General Overview: This page provides information about currently available plug-in electric vehicle (PEV) models, benefits of PEVs, and current station availability in the United States.

Relevance and Overall Usefulness to North Jersey Municipalities: Current information about vehicle and charging technology, as well as infrastructure availability.

Study Methodology: Manufacturer specifications and infrastructure data.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Nissan website

Author Organization: Nissan

Web Link: <http://www.nissanusa.com/electric-cars/leaf/>

Geographic Focus: United States

Date of Publication: Accessed August 2016

Vehicle(s) of Focus: Electric

General Overview: This page provides information about currently available plug-in electric vehicle (PEV) models, benefits of PEVs, and current station availability in the United States.

Relevance and Overall Usefulness to North Jersey Municipalities: Current information about vehicle and charging technology, as well as infrastructure availability.

Study Methodology: Manufacturer specifications and infrastructure data.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Tesla website

Author Organization: Tesla

Web Link: <https://www.tesla.com/>

Geographic Focus: United States

Date of Publication: Accessed August 2016

Vehicle(s) of Focus: Electric

General Overview: This page provides information about currently available plug-in electric vehicle (PEV) models, benefits of PEVs, and current supercharger station availability in the United States

Relevance and Overall Usefulness to North Jersey Municipalities: Current information about vehicle and charging technology, as well as infrastructure availability.

Study Methodology: Manufacturer specifications and infrastructure data.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Plug-In Electric Vehicle (PEV) Handbook for Consumers

Author Organization: U.S. Department of Energy

Web Link: http://www.afdc.energy.gov/uploads/publication/pev_consumer_handbook.pdf

Geographic Focus: United States

Date of Publication: April 2012 (in the process of being updated)

Vehicle(s) of Focus: Electric

General Overview: This handbook is a PEV 101 document for consumers, providing an overview of what PEVs are, the benefits of choosing one over a conventional vehicle, how to identify the right PEV, and, after purchase, how to charge and maintain a PEV.

Relevance and Overall Usefulness to North Jersey Municipalities: - Provides basic PEV information and an example of consumer education resource.

- This document could also be distributed in North Jersey as part of outreach efforts.

Study Methodology: Market and industry research.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: Yes; discusses fuel economy and cost, low emissions, and opportunity for fueling location diversity.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; case study of Raleigh home electric vehicle supply equipment permitting and installation process.

Building Codes: No

Incentives: Yes; discusses federal incentives for PEVs and the possibility of state, municipal, and utility incentives.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

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Education and Training: No

Other Strategies: No

Plug-In Electric Vehicle (PEV) Handbook for Electrical Contractors

Author Organization: U.S. Department of Energy

Web Link: <http://www.afdc.energy.gov/pdfs/51228.pdf>

Geographic Focus: United States

Date of Publication: April 2012 (in the process of being updated)

Vehicle(s) of Focus: Electric

General Overview: This handbook provides an introduction to PEVs, electric vehicle supply equipment (EVSE), and PEV charging basics; it discusses EVSE site assessment and planning as well as specific considerations for residential versus non-residential installation; it also includes an overview of EVSE training opportunities for electrical contractors.

Relevance and Overall Usefulness to North Jersey Municipalities: - Provides basic EVSE siting and installation information relevant to electrical contractors, as well as training options for contractors, all of which are important components to any municipality's PEV readiness.

- This document could also be distributed in North Jersey as part of outreach efforts.

Study Methodology: Market and industry research.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: Yes; discussion of benefits of PEVs and EVSE in residential and non-residential settings.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; mentions the importance for electrical contractors.

Building Codes: Yes; mentions the importance for electrical contractors.

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

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Education and Training: No

Other Strategies: No

Plug-In Electric Vehicle (PEV) Handbook for Fleet Managers

Author Organization: U.S. Department of Energy

Web Link: http://www.afdc.energy.gov/pdfs/pev_handbook.pdf

Geographic Focus: United States

Date of Publication: April 2012 (in the process of being updated)

Vehicle(s) of Focus: Electric

General Overview: This handbook is a PEV 101 document for fleet managers providing an overview of what PEVs are, the benefits of choosing one over a conventional vehicle from a fleet manager's perspective, how to identify the right PEVs, and, after purchase, how to charge and maintain PEVs.

Relevance and Overall Usefulness to North Jersey Municipalities: - Provides basic PEV information and example of resource for local fleet managers.

- This document could also be distributed in North Jersey as part of outreach efforts.

Study Methodology: Market and industry research.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: Yes; discusses fuel economy and cost, low emissions, and opportunity for fueling location diversity.

Niche Applications Considered: Yes; all topics discussed in the context of PEVs in fleet applications.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; discusses federal incentives for PEVs and the possibility of state, municipal, and utility incentives.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

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Other Strategies: No

Plug-In Electric Vehicle (PEV) Handbook for Public Charging Station Hosts

Author Organization: U.S. Department of Energy

Web Link: <http://www.afdc.energy.gov/pdfs/51227.pdf>

Geographic Focus: United States

Date of Publication: April 2012 (in the process of being updated)

Vehicle(s) of Focus: Electric

General Overview: This handbook provides an introduction to PEVs and electric vehicle supply equipment (EVSE); it dives into the benefits and costs of hosting a public charging station, as well as an overview of the existing station network and common public charging station owners; it also describes the different ownership and payment models available to owners as well as the ins and outs of installing and maintaining their EVSE.

Relevance and Overall Usefulness to North Jersey Municipalities: - Provides basic PEV information relevant to public charging hosts, which is critical in North Jersey.

- This document could also be distributed in North Jersey as part of outreach efforts.

Study Methodology: Market and industry research.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; includes discussion of the costs associated with public EVSE.

Benefits Evaluation: Yes; discusses benefits of PEVs and of developing public charging station network, as well as hosting a public EVSE.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

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Education and Training: No

Other Strategies: No

Plug-In Electric Vehicle (PEV) Handbook for Workplace Charging Hosts

Author Organization: U.S. Department of Energy

Web Link: http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf

Geographic Focus: United States

Date of Publication: April 2012 (in the process of being updated)

Vehicle(s) of Focus: Electric

General Overview: This handbook provides an introduction to PEVs and electric vehicle supply equipment (EVSE); it dives into the benefits and costs of hosting a workplace charging station, as well as the unique evaluation and planning considerations required; it also describes the different management and policy planning necessary for workplace EVSE owners, as well as the ins and outs of installing and maintaining their EVSE.

Relevance and Overall Usefulness to North Jersey Municipalities: - Provides basic PEV information relevant to workplace charging hosts, which is critical in North Jersey.

- This document could also be distributed in North Jersey as part of outreach efforts.

Study Methodology: Market and industry research.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; includes discussion of the costs associated with workplace EVSE.

Benefits Evaluation: Yes; discusses benefits of PEVs and of offering workplace charging stations.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

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Other Strategies: No

Multi-unit Dwellings (MUDs) page

Author Organization: California Air Resources Board

Web Link: http://www.driveclean.ca.gov/pev/Charging/Home_Charging/Multi-unit_Dwellings.php

Geographic Focus: California

Date of Publication: Accessed August 2016

Vehicle(s) of Focus: Electric

General Overview: This website provides resources specific to plug-in electric vehicle (PEV) and electric vehicle supply equipment (EVSE) deployment in MUDs.

Relevance and Overall Usefulness to North Jersey Municipalities: Valuable information specific to MUDs and rentals, which North Jersey will need to address.

Study Methodology: Regulatory research and literature review.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; resource solely devoted to addressing the challenges of PEV charging in MUD residential buildings.

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; includes state and federal regulations specific to MUD EVSE as well as mandatory measures for EVSE at residential buildings.

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: Yes; includes 2014 report to the legislature on CALGreen building codes.

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: Yes; specific requirements for MUD EVSE development.

Plug-In Electric Vehicle Charging Station Host Guidance and Analysis

Literature Review Summary: Electric Vehicle Supply Equipment (EVSE) Signage Guidance

Author Organization: New York State Research and Development Authority

Web Link: <http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/EVSE-Signage-Overview.pdf>

Geographic Focus: New York

Date of Publication: October 2013

Vehicle(s) of Focus: Electric

General Overview: This manual provides best practices on EVSE signage to help plug-in electric vehicle (PEV) drivers identify charging stations.

Relevance and Overall Usefulness to North Jersey Municipalities: Universal guidance; important information for any PEV readiness program.

Study Methodology: Regulatory and best practice research.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

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Other Strategies: Yes; provides information about general service signs, regulatory signs, and special signs, as well as other considerations regarding best practices for EVSE signage.

Site Design for Electric Vehicle Charging Stations

Author Organization: New York State Research and Development Authority

Web Link: <http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/Site-Design-for-EV-Charging-Stations.pdf>

Geographic Focus: New York

Date of Publication: July 2012

Vehicle(s) of Focus: Electric

General Overview: This report is targeted as those responsible for plug-in electric vehicle (PEV) charging station installation design. It addresses the equipment currently available and how parking facility design offers both opportunities and challenges for charging station installations.

Relevance and Overall Usefulness to North Jersey Municipalities: - Geographic relevance.

- Slightly out of date but focused discussion of charging infrastructure considerations.

Study Methodology: Literature review.

Techniques for Market Assessment

Market Status Evaluation: Yes; discusses types of electric vehicle supply equipment (EVSE) available.

Key Challenges Evaluation: Yes; discusses challenges associated with charging station design and placement in parking facilities, on-street parking, and other locations.

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; discusses the importance of robust charging network and details of parking and charging station design.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

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Other Strategies: No

Public Electric Vehicle (PEV) Charging Infrastructure

Author Organization: Sustainable Jersey

Web Link: http://www.sustainablejersey.com/actions-certification/actions/?type=1336777436&tx_sjcert_action%5BactionObject%5D=521&tx_sjcert_action%5Baction%5D=getPDF&tx_sjcert_action%5Bcontroller%5D=Action&cHash=e136260b594094a98ecb6f78df43448a

Geographic Focus: New Jersey

Date of Publication: October 2014

Vehicle(s) of Focus: Electric

General Overview: This document describes an action that municipalities in New Jersey may choose to implement in order to achieve certification from Sustainable Jersey. Municipalities are encouraged to install publically available charging stations for PEVs. Sustainable Jersey describes the benefits of making charging stations ubiquitous in the community, including decreasing "range anxiety" and increasing adoption of PEVs.

Relevance and Overall Usefulness to North Jersey Municipalities: - Highly relevant to North Jersey municipalities.

- Outlines specific steps municipalities can take to increase adoption.

Study Methodology: Describes a course of possible actions that municipalities are encouraged to take, designed in conjunction with Sustainable Jersey partners.

Techniques for Market Assessment

Market Status Evaluation: Yes; discusses different types of charging equipment available and associated costs.

Key Challenges Evaluation: Yes; describes the key challenge of financing charger purchase and installation, and provides four scenarios for supporting the installations, including third-party ownership and partnerships with sponsors.

Benefits Evaluation: Yes; mentions the benefit of increasing new PEV use in the community, but does not go into a detailed evaluation of benefits.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; discusses the need to advertise public chargers as available for use by the general public, versus than household and privately owned charging infrastructure. Discusses some of the ideal locations to install chargers to ease possible "range anxiety."

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; some consideration of partnerships and sponsorships for funding, but does not identify specific partners.

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Lessons from Early Deployments of Electric Vehicle Charging Stations: Case Studies from the Northeast and Mid-Atlantic Regions

Author Organization: Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center

Web Link:

<http://www.transportationandclimate.org/sites/default/files/Lessons%20From%20Early%20Deployments%20of%20EV%20Charging%20Stations.pdf>

Geographic Focus: Northeast and Mid-Atlantic

Date of Publication: May 2013

Vehicle(s) of Focus: Electric

General Overview: Using examples from Mid-Atlantic and Northeast states, this report offers a glimpse into the challenges, successes, and progress experienced by a number of local-level plug-in electric vehicle (PEV) projects. The focus of the case studies is on PEV charging stations. The study objectives were "to provide stakeholders with actionable information that they can use to support the deployment of electric vehicle charging infrastructure; and to show prospective owners of electric vehicle charging infrastructure installation stories that they can relate to and help them understand some of the issues that they may encounter and opportunities that they may benefit from."

Relevance and Overall Usefulness to North Jersey Municipalities: North Jersey municipalities would benefit from the local-level applications presented here. Examples are mostly at the sub-municipal level (e.g., just one building), but still show how these projects succeeded in the context of municipal regulations or actions.

Study Methodology: Case studies organized into "clusters" by installation type (e.g., multifamily housing); also evaluated the number of charging stations and connectors in each state within the study region.

Techniques for Market Assessment

Market Status Evaluation: No; the focus is on already completed projects, so doesn't go into detail about the status of the market in each city, beyond mentioning that certain areas didn't (and still don't) have many PEVs, but the projects were in line with the vision of the developers and hope to promote market expansion in the future.

Key Challenges Evaluation: Yes; case studies identify challenges unique to each project. For example, some installations did not have any users for a year after the charging station went online. Other projects considered challenges with insurance liability, Americans with Disabilit

Benefits Evaluation: Yes; benefits include appealing to client base (for private installations) and promoting the protection of natural resources. Also provides an example of installation at a hotel.

Niche Applications Considered: Yes; considers charging station installation in recreational locations, such as ski resorts, and historic sites.

Infrastructure Siting Vision and Goals: Yes; focus is on electric vehicle supply equipment (EVSE) and the report gives examples of ideal siting conditions and visions of the municipalities implementing these installation projects.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

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Parking Codes: Yes; gives examples of parking limitations but doesn't go into detail about regulation or codes.

Permitting: Yes; an example mentions permitting and approval process from the city government.

Building Codes: No

Incentives: Yes; some projects took advantage of grants or other incentives offered by partnerships with businesses or local government agencies. Projects discussed incentives such as free parking/charging.

Utility and Grid Concerns: Yes; a case study describes the challenges related to complying with utility metering requirements, while still trying to achieve financial benefits.

Strategies for Advancement

Key Partnerships: Yes; some installations were completed through public-private partnerships, including with city, state, and federal government agencies.

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: Yes; some installations used highly visible spaces within parking lot in order to promote awareness. Also includes comparisons between cases where there is a fee for charging and where charging is free and open to the public.

Siting and Design Guidelines for Electric Vehicle Supply Equipment (EVSE)

Author Organization: Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center

Web Link:

http://www.transportationandclimate.org/sites/default/files/EV_Siting_and_Design_Guidelines.pdf

Geographic Focus: United States

Date of Publication: November 2012

Vehicle(s) of Focus: Electric

General Overview: The focus of these guidelines is on incorporating EVSE into municipal infrastructure, from planning phase through installation. Specifically, this guidance examines the 10-20% of charging activity that occurs in multi-unit housing, public charging stations, on-street or highway parking spaces, and private locations. By expanding offerings at these locations, the guidance hopes to make plug-in electric vehicles (PEVs) accessible to a broader array of drivers.

Relevance and Overall Usefulness to North Jersey Municipalities: - Detailed approach to siting and design considerations.

- Provides thoughtful questions and assessment techniques that North Jersey municipalities could integrate into their own planning process.

Study Methodology: Gives overview of technology and comparison between approaches.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides comparison of different charging levels, and the relevant attributes of each. Considers target markets, demand, and host location.

Key Challenges Evaluation: Yes; considers safety, accessibility, and visibility, and how to maximize each of these factors. Also takes into account grid connections and user communication practices, as well as cost and design issues.

Benefits Evaluation: Yes; discusses the benefits associated with consistent, reliable, accessible charging infrastructure, and the different types of charging systems available on the market.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; considers a range of EVSE siting considerations, including design elements, site selection, communication structures, existing infrastructure, and connections to power. Elements include dimensions of parking space, environmental conditions, proximity to traffic, signage, and metering.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; mentions taking regulations into account, but does not go into detail about specific policies.

Zoning: Yes; includes a comparison of commercial, multi-unit residential, on-street, service station, and private fleet locations in terms of legal, operational, and economic factors.

Parking Codes: Yes; does not mention specific codes, but one section focuses on parking interface, including optimal space size, signage, safety, and accessibility.

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: Yes; mentions grid connection, communication, and data exchange with the local utility provider to ensure reliable service.

Strategies for Advancement

Key Partnerships: Yes; host-operator agreements are mentioned in the context of ownership and management structures.

Corridor Planning: Yes; briefly mentions the physical interconnectivity of "electrified corridors" and their ability to extend the effective battery range.

Procurement Practices: No

Education and Training: No

Other Strategies: No

Other PEV Resources, Studies, and Analysis

Needs Assessment for Alternative Fuel Vehicle Training in California

** Also classified under Other Natural Gas Vehicle Resources, Studies, and Analysis*

Author Organization: Bay Area Air Quality Management District

Web Link: https://energycenter.org/sites/default/files/docs/nav/policy/research-and-reports/needs-assessment_for_AFC_training.pdf

Geographic Focus: California

Date of Publication: December 2013

Vehicle(s) of Focus: Electric; Natural Gas

General Overview: This report details the availability of safety and technical training in alternative fuel vehicles for emergency personnel and transportation fleet staff in California and provides recommendations to improve it. It provides training curriculums, findings from first responder and fleet surveys, and recommendations specific to each stakeholder type in the industry.

Relevance and Overall Usefulness to North Jersey Municipalities: Valuable resource to address the safety and training component of plug-in electric vehicle (PEV) and natural gas vehicle (NGV) readiness in North Jersey.

Study Methodology: Stakeholder interviews and survey data.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: Yes; includes discussion of NGVs and PEVs in fleets and recommendations for safety and training in these applications.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

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Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; report focuses on training and education for first responders, fleet managers, and other key stakeholders in terms of vehicle safety.

Other Strategies: Yes; one of the only resources that focuses on training for first responders and vehicle safety.

2016 conference materials and presentations

Author Organization: EVS29, EV Roadmap 9, ACT Expo/EDTA

Web Link: <http://www.evs29.org/>; <http://evroadmapconference.com/program/>; <http://www.actexpo.com/>

Geographic Focus: International

Date of Publication: 2016

Vehicle(s) of Focus: Electric

General Overview: A number of conferences and expositions are held each year as venues for sharing knowledge about emerging trends in the plug-in electric vehicle (PEV) industry. This review covers a number of conference presentations and documents from events held in 2016.

Relevance and Overall Usefulness to North Jersey Municipalities: Municipalities may find the conference materials helpful in that they are full of the latest information and present topics in new and informative ways. These are some of the most up-to-date sources available, and much of the information is applicable at a local level.

Study Methodology: Various presentations and materials. Information on corridor analyses that used surveys and observed the areas where most vehicle miles are traveled. Other presentations showed data from studies conducting a supply-side industry analysis, end-user primary research, technology trend assessment, assessment of demand, and fleet experiences with PEVs.

Techniques for Market Assessment

Market Status Evaluation: Yes; give background of market trends by PEV model, as well as upcoming offering; one presentation discusses an EV consumer survey was conducted to characterize the market-- who is driving EVs and what types of cars are they driving?
(<http://evroadmapconference.com/program/presentations16/BrettWilliams.pdf>)

Key Challenges Evaluation: Yes; presentations describe some cost and ownership challenges, as well as gaining public acceptance and partnering with utilities for ease of implementation.

Benefits Evaluation: Yes; some presentations discusses benefits of corridors, including savings across long distance corridors. Others discuss the benefits and planning for fleet charging. Other presentations address cost benefits and fuel savings, including an assessment of the change in battery costs per kilowatt-hour over time.

Niche Applications Considered: Yes; some examples cover transit systems, delivery fleets, municipal fleets, utility fleets, and school districts (<http://www.actexpo.com/agenda#fndtn-date-5-3-16>).

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; regulations are mentioned throughout many of the presentations, but not significant details.

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

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Incentives: Yes; presentations discuss rebates and time-of-use charging as factors in consumers' decisions to purchase a PEV. Map on slide 6 here shows some good examples of utility incentives (<http://evroadmapconference.com/program/presentations16/DavidPackard.pdf>).

Utility and Grid Concerns: Yes; one presentation offers a table of key challenges faced by utilities, including financial, physical, and market challenges (<http://evroadmapconference.com/program/presentations16/JohnGartner.pdf>). Another presentation focuses on utilities' role in st

Strategies for Advancement

Key Partnerships: Yes; presentations describe how utilities can play a role as partners in supporting the growth of the PEV market.

Corridor Planning: Yes; an analysis of corridor planning is presented here: http://evroadmapconference.com/program/presentations15/Ward_Jacob.pdf

Procurement Practices: No

Education and Training: Yes; a number of presentations focus on community engagement, marketing strategies, and education and outreach. For example: <http://evroadmapconference.com/program/presentations16/AnnieFreyschlag.pdf>

Other Strategies: Yes; presentations include a survey that evaluates consumers' opinions of what messages appeal to them most, and how they obtain their information. A few presentations mentioned focusing on access for under-served communities through car sharing, used car bulk buying programs, marketing, and financing.

Plug-In Electric Vehicle (PEV) and Infrastructure Analysis

Author Organization: Idaho National Laboratory

Web Link:

<https://avt.inl.gov/sites/default/files/pdf/arra/ARRAPEVnInfrastructureFinalReportLqlySept2015.pdf>

Geographic Focus: United States

Date of Publication: September 2015

Vehicle(s) of Focus: Electric

General Overview: By collecting data from real-world projects in PEV and electric vehicle supply equipment (EVSE) demonstrations, this document analyzes the challenges and benefits associated with PEV use. Topics covered include charging behaviors, driving patterns, cost estimations, experiences with PEV adoption, and condensed lessons learned from each project analyzed. Examples of projects analyzed include The EV Project and ChargePoint America, which together constitute the world's largest PEV infrastructure demonstration project to date.

Relevance and Overall Usefulness to North Jersey Municipalities: - Includes many figures and graphs which can help communities compare information more easily.

- Some of the behavioral analysis may prove especially useful for municipalities looking to understand how infrastructure will be used, who will be using it, and where and when they will charge.

Study Methodology: Data collection and analysis. Findings are sometimes broken down by vehicle model. Classifies charging infrastructure by technology and type of venue as well as sub-venue. Sources included not only data from the project leads, but also publically available information sources such as Google Street View, ReCarGo, PlugShare, and ESRI.

Techniques for Market Assessment

Market Status Evaluation: Yes; evaluates how use of public chargers changed over time based on fee structure modifications. Also evaluated use of chargers at different venues such as schools, medical facilities, hotels, or leisure destinations.

Key Challenges Evaluation: Yes; evaluates the tradeoffs between station installation costs and actual station usage. Looks at driver behavior and preferences that, if understood more thoroughly, can help planners determine the appropriate balance of types of EVSE.

Benefits Evaluation: Yes; evaluates the potential cost benefits of EVSE. Describes charging behavior and company initiatives that encouraged optimal use of chargers during the work day (e.g., charger accessible from multiple parking spaces). Shows how these behaviors were beneficial to the increased usage of EVSE. Touches on some environmental benefits.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; includes research supporting the fact that most charging actually takes place at home, followed by work or other destinations. Acknowledges that siting visions and goals will differ based on the developers' motivation for installation--public image versus return on investment. The study found that there was not significant usage variation by charger venue for DC fast chargers.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; mentions regulatory issues in context of other elements, but not discussed in depth.

Zoning: No

Parking Codes: No

Permitting: Yes; includes information about permit fees by market and as percentages of installation costs. Also summarizes permitting practices for one project.

Building Codes: Yes; addresses building code considerations. Table 11-85 shows relevant codes for accessibility.

Incentives: Yes; mentions infrastructure projects that were funded at least in part by federal funds. Also touches on other financial incentives, such as waiving permitting fees.

Utility and Grid Concerns: Yes; mentions how utilities have used and continue to use the published information to assess "the impact of [PEV] charging on the electric grid and pricing elasticity and efficacy of [time-of-use] electricity rates for [PEV] owners." Discusses dynamic lo

Strategies for Advancement

Key Partnerships: Yes; gives examples of possible partners for infrastructure development.

Corridor Planning: Yes; gives examples of how corridor planning has been implemented or at least considered in other projects.

Procurement Practices: No

Education and Training: No

Other Strategies: No

2012 U.S. Battery Electric Vehicle Market Study - Battery Electric Vehicle Challenge

Author Organization: J.D. Power

Web Link: <https://store.jdpower.com/products/2012-us-bev-market-study-bev-challenge>

Geographic Focus: United States

Date of Publication: March 2012

Vehicle(s) of Focus: Electric

General Overview: This report serves as a precursor to J.D. Power and Associates' "U.S. Electric Vehicle Ownership Experience Study." It addresses the primary benefits and challenges to plug-in electric vehicle (PEV) acceptance by consumers.

Relevance and Overall Usefulness to North Jersey Municipalities: - Provides a purely consumer-focused perspective on PEVs, as well as insight regarding effective marketing approach to PEVs.

- Could be relevant for North Jersey training and education.

Study Methodology: Market research and survey data analysis

Techniques for Market Assessment

Market Status Evaluation: Yes; includes an evaluation from the perspective of consumer interest in purchasing PEVs.

Key Challenges Evaluation: Yes; discusses range anxiety, charge station availability concerns, upfront vehicle costs, and marketing disconnects.

Benefits Evaluation: Yes

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

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Education and Training: Yes; discussed in the context of effective versus ineffective marketing for PEVs.

Other Strategies: No

Executive Summary: Plug-In Electric Vehicles (PEVs)

Author Organization: Pike Research

Web Link: <http://www.navigantresearch.com/wp-assets/uploads/2012/06/PEV-12-Executive-Summary.pdf>

Geographic Focus: United States

Date of Publication: June 2012

Vehicle(s) of Focus: Electric

General Overview: This executive summary includes an analysis of PEV sales as well as a market forecast. It provides an overview of Pike Research's scope of study, sources, and methodology.

Relevance and Overall Usefulness to North Jersey Municipalities: - Valuable national market analysis

- The full report (available for purchase) provides in-depth supply and demand analysis, as well as sales data by region.

Study Methodology: Interviews with industry leaders, literature review, and survey analysis.

Techniques for Market Assessment

Market Status Evaluation: Yes; includes an analysis of demand drivers, key industry players, and market forecasts.

Key Challenges Evaluation: Yes; includes an in-depth analysis of technology and market issues.

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No; but does provide in-depth discussion of key industry players.

Corridor Planning: No

Procurement Practices: No

Education and Training: No

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Other Strategies: No

The Promotion of Electric Vehicles in the United States (A Landscape Assessment)

Author Organization: Plug In America

Web Link: <http://images.pluginamerica.org/Landscape/The-Promotion-of-Electric-Vehicles-in-the-US-final.pdf>

Geographic Focus: United States

Date of Publication: April 2015

Vehicle(s) of Focus: Electric

General Overview: The report presents the findings of research conducted by Plug In America. According to the authors, "the goal of our research for this report was not so much to identify what has gone right so far — we certainly want more of that — but to pinpoint where improvements need to be made." The report's themes include public policy, marketing, and partnerships.

Relevance and Overall Usefulness to North Jersey Municipalities: - National level, but focus on marketing strategies and consumer perception provides municipalities with valuable tools for targeting their message and increasing positive perception among the market of potential customers.

- Covers the perspective of municipalities in plug-in electric vehicle (PEV) marketing and promotion.

Study Methodology: Literature review and interviews with participants including government agencies, nongovernmental organizations, and manufacturers.

Techniques for Market Assessment

Market Status Evaluation: Yes; notes that market growth depends not only on strategic partnerships but also seeking guidance from experienced PEV drivers. Graphs and statistics help readers grasp the size and conditions of the national market.

Key Challenges Evaluation: Yes; describes how different levels of government have provided solutions to challenges (perceived or actual) that prevent or hinder PEV market growth.

Benefits Evaluation: Yes; covers benefits such as environmental protection, lower operating costs, convenience, and high customer satisfaction rates. Addresses benefits in terms of consumer perception, which is valuable should municipalities choose to target their marketing message.

Niche Applications Considered: Yes; municipal fleets, car sharing programs, and transit vehicles.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; considers federal, state, and municipal regulations, and explains the role of an increasing PEV market in achieving the goals of many state and federal environmental policies. Encourages policymakers to work for a more robust policy framework that in

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; mentions the positive impact of federal incentives like the American Recovery and Reinvestment Act (ARRA), including tax credits and loan guarantees. Also emphasizes the impact of initiatives for charging infrastructure.

Utility and Grid Concerns: Yes; covers the role that utilities play, specifically offering discounts to PEV owners and rebates for those choosing to install a station at home.

Strategies for Advancement

Key Partnerships: Yes; covers a few options for partnerships. According to the authors, "accelerating the growth of the PEV market requires that stakeholders collaborate more effectively toward a shared aim."

Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; finds that the public lacks awareness about PEVs and the potential benefits they offer. Recommends sending a positive message that the PEV market is inclusive and accessible. One method of doing this is to offer public test driving events, which have

Other Strategies: Yes; discusses regional PEV promotion. For example, the 2013 eight-state memorandum of understanding, committing to get a certain number of PEVs on their roads. Also stresses that nonprofits and philanthropic groups should play a larger role in promotion of PEVs.

Electric Vehicle Supply Equipment (EVSE) Cluster Analysis: EVSE Support Study

Author Organization: Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center

Web Link: <http://www.nyscrda.ny.gov/-/media/Files/Programs/ChargeNY/EVSE-Cluster-Analysis.pdf>

Geographic Focus: Northeast and Mid-Atlantic

Date of Publication: December 2012

Vehicle(s) of Focus: Electric

General Overview: This report provides a qualitative analysis of potential charging station clusters and prioritizes a group of high-potential locations that exist in communities along the Eastern Seaboard. It builds on the quantitative findings of Transportation & Climate Initiative's companion document, which provides maps and data on current plug-in electric (PEV) ownership and EVSE installations.

Relevance and Overall Usefulness to North Jersey Municipalities: - Geographically relevant.

- Provides valuable perspective on infrastructure planning and development with local, regional, and state-level focus.

Study Methodology: Literature review; feedback from Clean Cities coordinators, manufacturers, energy providers, government representatives, and other stakeholders; and survey data.

Techniques for Market Assessment

Market Status Evaluation: No; relies on a different study which does provides comprehensive market status analysis.

Key Challenges Evaluation: Yes; assesses challenges associated with each cluster-type included in report.

Benefits Evaluation: Yes; assesses strengths and opportunities associated with each cluster-type included in report.

Niche Applications Considered: Yes; addresses workplace and fleet charging scenarios.

Infrastructure Siting Vision and Goals: No; relies on different study which does provide EVSE siting vision.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

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Corridor Planning: Yes; discusses how to plan a cohesive cluster of charging stations.

Procurement Practices: No

Education and Training: No

Other Strategies: No

Assessment of Current Electric Vehicle Supply Equipment (EVSE) & Electric Vehicle Deployment: EVSE Support Study

Author Organization: Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center

Web Link: <http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/Assessment-of-Current-EVSE-and-EV.pdf>

Geographic Focus: Northeast and Mid-Atlantic

Date of Publication: November 2012

Vehicle(s) of Focus: Electric

General Overview: This report analyzes the patterns of current plug-in electric vehicle (PEV) ownership and EVSE installations based on a range of geographic, demographic, and policy-based concerns across 11 Mid-Atlantic and Northeast states and Washington, DC. The findings highlight the greatest concentrations of PEV ownership, trends in EVSE locations, recommendations to maximize the impacts of EVSE installations on PEV usage, and recommendations for further areas of study.

Relevance and Overall Usefulness to North Jersey Municipalities: - Geographically relevant.

- Provides valuable market analysis and perspective on infrastructure planning and development with local, regional, and state-level focus.

Study Methodology: Literature review; feedback from Clean Cities coordinators, manufacturers, energy providers, government representatives, and other stakeholders; and survey data.

Techniques for Market Assessment

Market Status Evaluation: Yes; gives an in-depth analysis of current PEV ownership, including PEV background, market, geography of PEV ownership and EVSE installations, and demographics.

Key Challenges Evaluation: Yes; brief discussion of primary PEV challenges specific to the region.

Benefits Evaluation: Yes; discusses energy and emissions benefits and implications from increased PEV deployment in the future.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; includes siting vision in discussion of EVSE location typologies and installations.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

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Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Menu of Plug-In Electric Vehicle (PEV) Incentives

Author Organization: Transportation & Climate Initiative/Clean Cities/Georgetown Climate Center

Web Link: http://www.transportationandclimate.org/sites/default/files/Menu%20of%20Plug-In%20EV%20Incentives_Final.pdf

Geographic Focus: Northeast and Mid-Atlantic

Date of Publication: March 2013

Vehicle(s) of Focus: Electric

General Overview: Intended as a resource for states, this document offers a "broad overview of the types of PEV incentives that states can and do offer, and is a resource for state policy makers who are seeking new ideas for ways that their state may promote PEV adoption."

Relevance and Overall Usefulness to North Jersey Municipalities: State level, so not directly applicable to municipalities, but could be relevant for understanding the broad array of incentives that exist.

Study Methodology: Incentive summaries and analysis.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: No

Benefits Evaluation: No

Niche Applications Considered: Yes; fleets, in general.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; the purpose of this document is to identify the types of incentives available for PEV adoption. Covers incentives to promote purchase, manufacturing and selling incentives, driving experience incentives, incentives for fleets, and incentives for charging.

Utility and Grid Concerns: Yes; provides examples of issues involving utilities, including exemption of charge providers from regulation as utilities and sharing of PEV registration information with local utilities.

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

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Education and Training: Yes; discusses funding for alternative fuel education and training programs, but does not provide an assessment.

Other Strategies: Yes; pilot projects, grants for car sharing organizations, time of use rates for PEV charging, and establishment of advisory councils.

Overcoming Barriers to Deployment of Plug-In Electric Vehicles (PEVs)

Author Organization: Transportation Research Board

Web Link: <http://www.trb.org/Main/Blurbs/172475.aspx>

Geographic Focus: United States

Date of Publication: 2015

Vehicle(s) of Focus: Electric

General Overview: This committee-led investigation into the PEV market and its barriers presents recommendations and strategic actions that stakeholders can implement to increase PEV adoption. After presenting a comparison of technologies and vehicles, the committee provides tools for understanding the market and the motivations and needs of potential customers. The report then covers considerations for electric utilities and consumers motivated by incentives, as well as government involvement and partnerships to accelerate PEV acceptance.

Relevance and Overall Usefulness to North Jersey Municipalities: - Municipalities may find the comparisons and tables informative as they plan their actions and identify strengths and weaknesses in their community's market.

- The specific recommendations can be adapted for municipal planning purposes. The range of topics covered makes this document relevant regardless of the planning process stage.

Study Methodology: A committee of experts was assembled to conduct an analysis of PEV infrastructure requirements, barriers to implementation, and benefits of higher PEV market penetration. Also evaluates consumer diffusion models for five unique markets, and categorizes the demographic traits of adopters.

Techniques for Market Assessment

Market Status Evaluation: Yes; includes a section on "Understanding the Market Development and Customer Purchase Process." Includes graph of national monthly sales by car model. Includes a map of projected annual light-duty PEV sales as a percentage of total light-duty sales; New Jersey's projected sales percentage is 0.5%.

Key Challenges Evaluation: Yes; discusses the challenges of charger accessibility and recommends that incentives and regulation address the limitations preventing drivers from charging and paying at all public stations. Also describes challenges related to customer motivation to pu

Benefits Evaluation: Yes; elaborates on the benefits of decreasing petroleum dependence, as well as reducing emissions.

Niche Applications Considered: Yes; provides information about (and suggestions for) corporate or business fleets and government fleets. Recommends governments adopt PEVs to lead by example.

Infrastructure Siting Vision and Goals: Yes; categorizes the effect that electric vehicle supply equipment (EVSE) has on consumers' decisions, based on location of infrastructure as well as type of charger (e.g., workplace charger, DC fast charge).

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; suggests implementing uniform codes and permitting rules for increased clarity and consistency. Also includes table of permit fees currently in place across cities/states.

Building Codes: Yes; suggests implementing uniform codes and permitting rules for increased clarity and consistency.

Incentives: Yes; suggests how tax incentives can help to overcome consumers' hesitations and barriers to action. Acknowledges that incentives are not always easy to determine as the market isn't mature enough to give examples of effective programs. Recommends a point-of-sale rebate over a tax credit, and urges more research on non-financial purchase incentives. Provides a table of incentives offered by country and state. Examples includes parking discounts and access to restricted freeway lanes.

Utility and Grid Concerns: Yes; mentions the challenges related to utilities and the grid being able to handle the demand for charging. Describes the limitations from the utility sector that could hinder adoption. Recommends that consumers have access to time-of-use or real-time p

Strategies for Advancement

Key Partnerships: Yes; gives example of partnerships between utilities and dealerships, as well as an industry-wide advertising partnership to promote PEV technology. Contains a helpful table showing which stakeholders are involved in each stage of PEV readiness. For example, during the step of training personnel, the municipal government is responsible for first responder safe practices, while the state is responsible for workforce training and permits.

Corridor Planning: Yes; mentions examples of corridors, but does not include a comprehensive discussion.

Procurement Practices: No

Education and Training: Yes; discusses how lack of consumer awareness or education about the technology can limit the willingness to adopt PEVs. Also addresses the lack of available information from dealerships or other points of sale. Includes section on emergency response trai

Other Strategies: Yes; identifies marketing strategies, such as cooperative advertising campaigns. Encourages hands-on engagement opportunities (e.g., test drives) that allow potential customers to experience the technology. Car sharing is another option for those not ready to make a purchasing commitment.

Model Natural Gas Vehicle Planning Documents and Guidance

Natural Gas Works for Cities: Ideas for Mayors

Author Organization: America's Natural Gas Alliance

Web Link: http://www.anga.us/media/blog/CE74DE44-938B-DF68-DD25B58FF7FFCCE1/files/anga_mayorfs_finalaa.pdf

Geographic Focus: United States

Date of Publication: June 2010

Vehicle(s) of Focus: Natural Gas

General Overview: This document is structured as a series of fact sheets, each highlighting a natural gas project implemented by a city or region. Each fact sheet incorporates information about benefits and the unique challenges faced by the different municipalities.

Relevance and Overall Usefulness to North Jersey Municipalities: Provides concrete examples of successes and challenges faced by other municipalities and regions of varying sizes. New Jersey cities (Newark, Camden, Trenton, Atlantic City, and Egg Harbor Township) are highlighted as one of the examples.

Study Methodology: Case studies.

Techniques for Market Assessment

Market Status Evaluation: Yes; the examples are very brief, but does mention economic drivers for implementing natural gas as well as some examples of the vehicles in place.

Key Challenges Evaluation: No; the examples do not go into detail about the challenges faced.

Benefits Evaluation: Yes; each example provides a succinct overview of the benefits the city expects to experience or is experiencing, ranging from environmental benefits and air quality improvement to economic benefits.

Niche Applications Considered: Yes; some examples cover airport fleets.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; a few examples mention compliance with regulations.

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; mentions federal funding and state funding for projects, where applicable.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; touches on partnerships with private sector.

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Corridor Planning: No

Procurement Practices: No

Education and Training: Yes; in the New Jersey example, there is a bullet point about New Jersey's Clean Cities Coalition's projects "to educate the public about the benefits of using clean, domestically produced natural gas in vehicles," but no assessment of training programs o

Other Strategies: No

Permitting Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) Stations: Best Practices Guide for Host Sites and Local Permitting Authorities

Author Organization: California Statewide Alternative Fuel and Fleets Project/ Clean Fuel Connection, Inc.

Web Link: <http://www.baaqmd.gov/~media/files/strategic-incentives/alt-fuels/cng-and-Ing-best-practices-9-30-14-final.pdf>

Geographic Focus: California

Date of Publication: 2014

Vehicle(s) of Focus: Natural Gas

General Overview: "The purpose of this Guide is to two-fold: 1. To provide those agencies and businesses considering natural gas fueling infrastructure the tools to plan, design, permit, build and operate a compressed natural gas fueling station. 2. To provide local authorities information to properly evaluate proposed CNG or LNG fueling installations."

Relevance and Overall Usefulness to North Jersey Municipalities: - Written for California development, but applicable to North Jersey municipalities as it includes a thorough description of the cost, technical, siting, and maintenance considerations that any developer would need to take into account.

- Case studies show how these concepts are transferrable beyond the California market.

Study Methodology: Information and technical background, as well as case studies.

Techniques for Market Assessment

Market Status Evaluation: Yes; summarizes the different applications of natural gas vehicles (NGVs) and explains the categories of vehicles offered in the U.S. market. Compares trends in the U.S. market over time, and describes differences with international markets.

Key Challenges Evaluation: Yes; considers cost challenges, understanding of local market demand, station design specifications, and code issues.

Benefits Evaluation: Yes; describes the benefits of transitioning to natural gas such as availability, cost, and environmental impacts.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; lists questions that developers may consider in the siting process for fueling stations, including availability of public fueling stations nearby, demand, and costs.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; gives examples of relevant regulations and practices for compliance.

Zoning: Yes; details major zoning considerations.

Parking Codes: No

Permitting: Yes; describes permitting process step-by-step, including certification by a national recognized test lab.

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Building Codes: Yes; describes major codes governing natural gas infrastructure development, including both national and state-specific codes.

Incentives: Yes; mentions availability of federal, state, and local grants, as well as tax credits. Initiatives receiving benefits include educational programs, research programs, and advocacy groups. Incentives include discounts on vehicle and infrastructure purchases.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; mentions funding partnerships, as well as incentives aimed at supporting advocacy, research, and education.

Corridor Planning: No

Procurement Practices: No

Education and Training: Provides information about first responder and technician training for emergency response, as well as regular maintenance and service procedures.

Other Strategies: No

Natural Gas Vehicles (NGVs) - The Here and Now Technology: A Workshop for New England

Author Organization: Clean Cities Coalitions of Northern New England

Web Link: http://web.uri.edu/ceoc/files/CNG_Workshop_GPCOG_for_USDOE_RI_11202014.pdf

Geographic Focus: New England

Date of Publication: November 2014

Vehicle(s) of Focus: Natural Gas

General Overview: This presentation was developed for a Clean Cities Coalition workshop, and covers a variety of natural gas-related topics, starting with basic compressed natural gas vehicle information and benefits, and progressing to an overview of the market and technology. Provides beneficial information about the specific types of vehicles available for each fleet, as well as a comparison of the types of fueling infrastructure available.

Relevance and Overall Usefulness to North Jersey Municipalities: - Regionally applicable.

- Provides thorough assessment of benefits of natural gas vehicles and practical considerations to take into account when incorporating vehicles into fleets.

Study Methodology: Slide format.

Techniques for Market Assessment

Market Status Evaluation: Yes; provides a market assessment for certain fleet types, and also offers overview of U.S. market and international market.

Key Challenges Evaluation: Yes; discusses funding, technology, and design challenges, among others.

Benefits Evaluation: Yes; discusses the safety benefits associated with natural gas, and provides examples of damage to vehicles that did not damage the natural gas system. Also mentions economic and environmental benefits.

Niche Applications Considered: Yes; identifies heavy-duty freight trucks, bus fleets, metro fleets, waste haulers, delivery trucks, taxis, and service fleets as the target markets. Considers dual fuel application for heavy-duty fleets.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; describes national public policy developments related to alternative vehicle deployment. Also lists relevant codes and standards.

Zoning: No

Parking Codes: No

Permitting: Yes

Building Codes: Yes; goes into detail about maintenance facility building considerations.

Incentives: Yes; most of the focus is on federal funding options, but mentions potential state incentives.

Utility and Grid Concerns: No

Strategies for Advancement

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Key Partnerships: Yes; provides information about industry support for NGVs, including from gas associations, governments, and transportation groups. Also introduces idea of convenience store partnerships.

Corridor Planning: No

Procurement Practices: Yes; goes into detail about the types/brands of vehicles available on the market.

Education and Training: No

Other Strategies: No

Experiences with Compressed Natural Gas (CNG) in Colorado Vehicle Fleets

Author Organization: Colorado Energy Office

Web Link: <https://www.colorado.gov/pacific/sites/default/files/atoms/files/CNG%20Case%20Studies.pdf>

Geographic Focus: Colorado

Date of Publication: August 2012

Vehicle(s) of Focus: Natural Gas

General Overview: This report is comprised of a series of case studies of diverse fleets that have successfully implemented natural gas vehicles (NGVs) and associated fueling infrastructure.

Relevance and Overall Usefulness to North Jersey Municipalities: Local focus; addresses fleet application.

Study Methodology: Fleet manager interviews, economic data analysis, and literature review.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; includes discussion of various challenges faced by each fleet in the process of implementing natural gas technology.

Benefits Evaluation: Yes; includes discussion of various benefits faced by each fleet in the process of implementing natural gas technology.

Niche Applications Considered: Yes; entire resource focuses on niche fleet applications, including refuse trucks, airport vehicles, and municipal vehicles.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; includes discussion of partnerships used by fleets to help implement natural gas technology successfully.

Corridor Planning: No

Procurement Practices: Yes; addresses procurement process and vehicle selection used by each fleet in each case study.

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Education and Training: Yes; addresses training requirements for each fleet in each case study to successfully implement natural gas technology.

Other Strategies: Yes; addresses vehicle maintenance and performance, as well as fueling experience.

Natural Gas Vehicle (NGV) Market Implementation Plan

Author Organization: Colorado Energy Office

Web Link: <https://www.codot.gov/programs/planning/documents/stac-archives/2013-stac/june-2013/ngv-implementation-plan-pres>

Geographic Focus: Colorado

Date of Publication: June 2013

Vehicle(s) of Focus: Natural Gas

General Overview: The Colorado Energy Office outlines its vision for implementing NGVs into fleets. The plan describes the diverse benefits of NGVs, and provides a step-by-step guide to implementation.

Relevance and Overall Usefulness to North Jersey Municipalities: Information is mostly presented at the state level, but some of the broader concepts may be applicable to municipalities.

Study Methodology: Plan and vision statement.

Techniques for Market Assessment

Market Status Evaluation: Yes; mentions relationships within the market and the conditions that make a market sustainable.

Key Challenges Evaluation: No

Benefits Evaluation: Yes; includes cost benefits, revenue, jobs, and environmental benefits.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; discusses incentives under Congestion Mitigation and Air Quality Improvement funding.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; emphasizes the importance of building relationships between stakeholders.

Corridor Planning: Yes

Procurement Practices: Yes; mentions including local governments in procurement.

Education and Training: No

Other Strategies: No

Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England

** Also classified under Other Natural Gas Vehicle Resources, Studies, and Analysis*

Author Organization: Hydrogen Energy Center

Web Link: <http://www.gpcog.org/wp-content/uploads/2015/03/Final-HEC-report.pdf>

Geographic Focus: New England

Date of Publication: January 2015

Vehicle(s) of Focus: Electric; Natural Gas

General Overview: This report seeks to answer the question: What regulatory, permitting, approval and administrative policies and procedures by governments and private standards organizations are creating impediments to the implementation of alternative fueling stations and what measures can be taken to minimize or remove these obstacles? It dives into permitting, zoning, codes, standards, regulations, utility rules, and incentives.

Relevance and Overall Usefulness to North Jersey Municipalities: Geographically relevant; up-to-date information.

Study Methodology: Interviews with supply companies, advocacy organizations and government agencies; interviews with other related entities; and data analysis.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; report focuses on challenges associated with alternative fueling infrastructure, including permitting and regulatory issues; zoning; fuel taxation; insurance policies; utility rules; federal rules; and lack of incentives.

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; addresses all components of regulatory framework necessary to facilitate alternative fuel vehicle and infrastructure deployment.

Zoning: Yes; discusses role local governments can play to adjust zoning to accommodate demand for plug-in electric vehicle (PEV) charging.

Parking Codes: No

Permitting: Yes; addresses issues with current permitting processes and recommendations to streamline process for electric vehicle supply equipment installations.

Building Codes: Yes; addresses issue of building codes applying to fueling systems when no buildings are involved; also notes that codes do not address needs of PEV charging station installation; provides recommendations to address these issues.

Incentives: Yes; provides recommendations on incentives to facilitate adoption of alternative fueling.

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Utility and Grid Concerns: Yes; addresses state-level public utilities policies and how they tie into infrastructure development.

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Planning and Installation Guide: North Carolina Compressed Natural Gas (CNG) Fueling Stations

Author Organization: North Carolina State University Clean Energy Technology Center

Web Link: <https://nccleantech.ncsu.edu/wp-content/uploads/CNG-Station-Installation-Guide.pdf>

Geographic Focus: North Carolina

Date of Publication: Unknown

Vehicle(s) of Focus: Natural Gas

General Overview: This document outlines the process for planning the installation of a new CNG station, from deciding if a station is needed for your fleet, to choosing a site and selecting a vendor. While the guidance only offers a brief overview and includes some details specific to North Carolina, it identifies questions and challenges that all CNG planners should consider. A planning checklist at the end of the document can help fleet managers track their progress towards installing a station.

Relevance and Overall Usefulness to North Jersey Municipalities: - Intended for planners in North Carolina, applicable to North Jersey municipalities.

- Checklist at the end of the document is useful to any municipality.

Study Methodology: Unknown.

Techniques for Market Assessment

Market Status Evaluation: Yes; mentions the U.S. Department of Energy's Alternative Fuel Station Locator to help planners determine whether or not an additional station is worth the investment.

Key Challenges Evaluation: Yes; touches on a number of challenges to consider, including selecting the appropriate site location and capacity and overcoming capital cost challenges. Does not go in depth about identifying or addressing challenges.

Benefits Evaluation: No

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; an overview of permitting steps is included in the checklist.

Building Codes: Yes; mentions that vendors should comply with local fire and building codes, as well as national codes.

Incentives: Yes; provides funding and incentive steps to consider in the checklist.

Utility and Grid Concerns: Yes; recommends contacting the local public utility when determining site specifications and suitability.

Strategies for Advancement

Key Partnerships: Yes; mentions public/private partnerships as a funding option.

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Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Alternative Fuel Corridor Plan

Author Organization: Weld County Natural Gas Coalition

Web Link: <http://www.weldsmartenergy.org/assets/805Bc45794c8C9B25272.pdf>

Geographic Focus: Weld County, CO

Date of Publication: Unknown, likely before 2011

Vehicle(s) of Focus: Natural Gas

General Overview: The county discusses its plan to create a comprehensive alternative fuel corridor between Colorado and Wyoming along the US-85 corridor. This plan also discusses the reasons natural gas would be beneficial to the region, including not only economic benefits, but also compliance with air quality standards as Weld County is located in an 8-Hour Ozone Non-Attainment zone.

Relevance and Overall Usefulness to North Jersey Municipalities: Focus on local government approach should be informative to North Jersey municipalities.

Study Methodology: Outside economic impact study that quantifies the benefits of natural gas on the U.S. economy.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; describes challenges that the county has faced.

Benefits Evaluation: Yes; discusses job creation potential, as well as environmental benefits and air pollution reduction. Cites economic impact study related to natural gas production in the United States.

Niche Applications Considered: No

Infrastructure Siting Vision and Goals: Yes; provides details about the corridor plan and the installation of new infrastructure. Includes a map of Weld County natural gas fueling stations.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; provides information about available grants offered by federal and local entities.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: Yes; includes letters of support from various community partners.

Corridor Planning: Yes

Procurement Practices: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
Appendix B: Literature Review Document Detail

Education and Training: Yes; discusses a training and development support plan that will be supported by a partnership between a local community college and the National Alternative Fuels Training Consortium.

Other Strategies: Yes; mentions vehicle conversion pilot program, which would launch during the initial phase of the project.

Other Natural Gas Vehicle Resources, Studies, and Analysis

Costs Associated With Compressed Natural Gas (CNG) Vehicle Fueling Infrastructure

Author Organization: National Renewable Energy Laboratory

Web Link: http://www.afdc.energy.gov/uploads/publication/cng_infrastructure_costs.pdf

Geographic Focus: United States

Date of Publication: September 2014

Vehicle(s) of Focus: Natural Gas

General Overview: By examining a variety of cost factors, this report provides fleet managers with tools for infrastructure-related decision making. The focus of this report is on CNG vehicle infrastructure, not the vehicles themselves. Factors considered in the development of a station cost estimate include demand for fuel, the fleet's main purpose and patterns of usage, installation, and permitting.

Relevance and Overall Usefulness to North Jersey Municipalities: The authors warn that this document should not be used to determine a cost estimate for any individual project; however, North Jersey municipalities may find the cost estimation process and the factors considered here useful for planning.

Study Methodology: General guidance document.

Techniques for Market Assessment

Market Status Evaluation: Yes; describes different types of fueling infrastructure available, and discusses the benefits and main uses of each.

Key Challenges Evaluation: Yes; challenges are evaluated to the extent that they affect costs. Challenges such as engineering concerns or weather risks are mentioned.

Benefits Evaluation: No

Niche Applications Considered: Yes; the focus is on fleets.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: Yes; briefly, in relation to cost.

Zoning: Yes; briefly, in relation to cost.

Parking Codes: No

Permitting: Yes; briefly, in relation to cost.

Building Codes: No

Incentives: No

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
Appendix B: Literature Review Document Detail

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Building a Business Case for Compressed Natural Gas (CNG) in Fleet Applications

Author Organization: National Renewable Energy Laboratory

Web Link: http://www.afdc.energy.gov/uploads/publication/business_case_cng_fleets.pdf

Geographic Focus: United States

Date of Publication: March 2015

Vehicle(s) of Focus: Natural Gas

General Overview: Using National Renewable Energy Laboratory's Vehicle Infrastructure and Cash Flow Evaluation (VICE) model, this report provides guidance to fleets and businesses determine the profitability of CNG projects, and describes how to use the model.

Relevance and Overall Usefulness to North Jersey Municipalities: Municipalities may choose to use this tool in determining the profitability of proposed CNG vehicle and infrastructure projects.

Study Methodology: Cost calculator.

Techniques for Market Assessment

Market Status Evaluation: Yes; the model parameters consider a variety of market factors, including fuel price, inflation, and taxes.

Key Challenges Evaluation: Yes; examines challenges such as payback period, financing structures, and rates of return for different types of vehicles.

Benefits Evaluation: Yes; provides data on payback periods, incremental costs per vehicle, and a number of comparisons that help decision makers evaluate the benefits of CNG.

Niche Applications Considered: Yes; presents some data for fleet vehicles like taxis, transit buses, school buses, and trash trucks.

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: No

Incentives: Yes; evaluates how subsidies and tax credits affect payback period for different types of fleets.

Utility and Grid Concerns: No

Strategies for Advancement

Key Partnerships: No

Corridor Planning: No

Procurement Practices: No

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
Appendix B: Literature Review Document Detail

Education and Training: No

Other Strategies: No

Various resources (e.g., Compressed Natural Gas (CNG) Station Business Models, CNG Station Construction and Economics, CNG Station Design, Vehicle Availability Page (including associated documents), Transit Page)

Author Organization: NGVAmerica

Web Link: <http://www.ngvamerica.org/stations/cng-station-business-models/>;
<http://www.ngvamerica.org/stations/cng-station-construction-and-economics/>;
<http://www.ngvamerica.org/stations/cng-station-design/>; <https://www.ngvamerica.org/vehicles/vehicle-availability/>;

Geographic Focus: United States

Date of Publication: Accessed August 2016

Vehicle(s) of Focus: Natural Gas

General Overview: Throughout a series of separate websites, NGVAmerica provides information and guidance about business models, construction, economics, fueling, and other aspects of planning for natural gas.

Relevance and Overall Usefulness to North Jersey Municipalities: This information is concise and easily accessible for North Jersey municipalities looking for guidance.

Study Methodology: Various.

Techniques for Market Assessment

Market Status Evaluation: Yes; one page is dedicated to vehicle availability, including mentioning some specific manufacturers, as well as a discussion of natural gas vehicle (NGV) economics. Topics mentioned include fuel savings and life cycle cost advantages. This page also includes information about aftermarket conversion systems.

Key Challenges Evaluation: Yes; Transit page examines challenges related to fueling infrastructure, such as choosing the appropriate type of station, deciding whether to use existing infrastructure or to construct a new station, and how best to obtain the natural gas supply.

Benefits Evaluation: Yes; the site promotes the benefit of using NGVs and provides some useful statistics on how communities could benefit from using NGVs.

Niche Applications Considered: Yes; describes NGV applications in different markets, including for transit fleets.

Infrastructure Siting Vision and Goals: Yes; addresses land and access considerations, such as the minimum area required to build a station, the importance of geological and geotechnical evaluation, and access to roadways.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; but not in very much detail. Combined with building codes section.

Interagency Collaboration on Alternative Fuel Vehicle Infrastructure: Literature Review
Appendix B: Literature Review Document Detail

Building Codes: Yes; provides list of codes for CNG stations and stresses the importance of understanding codes during the permitting and construction phase.

Incentives: No

Utility and Grid Concerns: Yes; CNG Station Construction and Economics page provides some information about the role of utilities in helping to ensure supply of both gas and electricity.

Strategies for Advancement

Key Partnerships: Yes; identifies options for ownership partnerships.

Corridor Planning: No

Procurement Practices: No

Education and Training: No

Other Strategies: No

Natural Gas Vehicle (NGV) Market Analysis

Author Organization: TIAX

Web Link: <https://www.aga.org/tiax-natural-gas-vehicle-market-analysis>

Geographic Focus: United States and Canada

Date of Publication: Unknown, likely 2012

Vehicle(s) of Focus: Natural Gas

General Overview: This report is presented in two separate parts: liquefied natural gas (LNG) and compressed natural gas (CNG). Production and distribution is emphasized in both of these reports, but both touch on the market conditions and opportunities necessary to facilitate NGV market growth.

Relevance and Overall Usefulness to North Jersey Municipalities: Municipalities can use the information about demand and supply, as well as the detailed information about the NG supply chain, to maximize the benefits realized in their town. This report provides specific information, such as company data and station design layouts, which can help communities determine what to look for and what questions to ask when they start developing infrastructure.

Study Methodology: This market analysis relies on "segmentation of the vehicle market, identification of market decision drivers, assessment of market development actions, analysis of competing technologies, analysis of market scenarios, and integration of overall market development opportunities."

Techniques for Market Assessment

Market Status Evaluation: Yes; "this assessment examines the key technical, economic, regulatory, social, and political drivers and challenges that shape this market" by looking at various market factors. Table 4.2-1 offers cost and return on investment values for a CNG station.

Key Challenges Evaluation: Yes; notes that costs must be minimized in at least one of the following categories for LNG infrastructure to be successful: feedgas cost, liquefaction and upgrade cost, and transportation cost. Discusses possible pathway supply options and other infrastr

Benefits Evaluation: Yes; identifies the emissions reduction and economic benefits associated with NGV use.

Niche Applications Considered: Yes, looks at heavy-duty and long-haul vehicle applications.

Infrastructure Siting Vision and Goals: Yes; addresses the need to site enough stations and enough infrastructure in accessible locations that people are willing to buy vehicles. A map showing predicted future major truck routes is included to highlight areas where investments in LNG infrastructure may have the highest impact. Explores the discrepancies and correlations between demand for NGVs and supply of fueling infrastructure. Discusses pros and cons of public and private stations.

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: No

Building Codes: Yes; lists codes covering safety standards, technology requirements, and fire protection (including for parking structures). Includes a sample safety data sheet. Also lists the code agencies administering the codes and their primary functions.

Incentives: Yes; recommends incentives that last five to ten years, which would help ensure market growth. Additionally, the report mentions excise and sales taxes as major contributors to customer cost, offsetting incentives for purchase. Gives examples of utilizing federal funding for infrastructure development.

Utility and Grid Concerns: Addresses supplier concerns.

Strategies for Advancement

Key Partnerships: Yes; identifies the major companies in the LNG station and fueling market. The CNG report lists stakeholders--including government, construction firms, and retailers--and offers actions and opportunities for stakeholder collaboration for infrastructure development. Also details the roles of the four primary company types involved in infrastructure development.

Corridor Planning: Yes; Figure ES-2 of the LNG report shows a map of the developing LNG corridor in the western United States.

Procurement Practices: Yes; the CNG report includes a section on the station procurement process and shows a flow chart of the various procurement pathway options based on the initial point of contact.

Education and Training: No

Other Strategies: No

American Recovery and Reinvestment Act: Clean Cities Project Awards

** Also classified under Other Plug-In Electric Vehicle Resources, Studies, and Analysis*

Author Organization: U.S. Department of Energy

Web Link: http://www.afdc.energy.gov/uploads/publication/arra_cc_project_awards.pdf

Geographic Focus: United States (various projects)

Date of Publication: August 2016

Vehicle(s) of Focus: Electric; Natural Gas

General Overview: This report provides a summary of the 25 cost-share projects under the Clean Cities program funded through the American Recovery and Reinvestment Act of 2009. These projects resulted in 542 fueling stations and more than 9,000 alternative fuel vehicles deployed nationwide. This includes 855 electric vehicle supply equipment stations, 143 compressed natural gas (CNG), and nine liquefied natural gas stations. The report provides brief project summaries and case studies, and includes a summary of the New Jersey Compressed Natural Gas Refuse Trucks, Shuttle Buses, and Infrastructure Project. This project was led by New Jersey Clean Cities with support from partners.

Relevance and Overall Usefulness to North Jersey Municipalities: - Locally relevant information, as well as national best practices.

- Recent data and lessons learned.

Study Methodology: Data collection, analysis, and case studies.

Techniques for Market Assessment

Market Status Evaluation: No

Key Challenges Evaluation: Yes; discusses individual project challenges, including management and vehicle conversion issues.

Benefits Evaluation: Yes; includes individual project metrics on emissions reductions, economics, and petroleum saved.

Niche Applications Considered: Yes; touches on a variety of niche markets, including heavy-duty drayage (CNG), heavy-duty trucks (CNG and plug-in electric), taxis (CNG and plug-in electric), refuse trucks (CNG), concrete mixers (CNG), and delivery trucks (CNG).

Infrastructure Siting Vision and Goals: No

Policy and Regulatory Frameworks

Regulatory Frameworks Considered: No

Zoning: No

Parking Codes: No

Permitting: Yes; discusses permitting plans for infrastructure and signage in one case study.

Building Codes: No; however, mentions maintenance facility upgrades.

Incentives: No; however, the entire report focuses on the result of grant projects.

Utility and Grid Concerns: No; however, mentions utility fleets that implemented vehicles as a result of the grants.

Strategies for Advancement

Key Partnerships: Yes; includes diverse lists of partners for all projects.

Corridor Planning: Yes; includes summaries of CNG corridors in Utah and Idaho, as well as the Midwest; and an LNG corridor in Nevada and California.

Procurement Practices: Yes; discusses incorporating hybrid buses into the Kentucky procurement contracts.

Education and Training: Yes; mentions several instances of driver and other training activities.

Other Strategies: No

Appendix C: Readiness Plans



Montclair Township



Alternative Fuel Vehicle

Readiness Plan

December 2017

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Disclaimer

This publication was prepared with funding from the North Jersey Transportation Planning Authority (NJTPA) and the Federal Highway Administration (FHWA). This document is disseminated under the sponsorship of NJTPA and FHWA in the interest of information exchange. The NJTPA and FHWA assume no liability for its contents or use thereof.

Acknowledgments

This plan was prepared for the NJTPA by a consultant team consisting of ICF, Greener by Design, and Fitzgerald & Halliday, Inc.

Executive Summary

Plan Overview

This Montclair Township Alternative Fuel Vehicle (AFV) Readiness Plan outlines actions that the township can take to reduce and resolve barriers to AFV usage. It includes 28 recommendations across five action areas for community leaders and other stakeholders interested in expanding the use of plug-in electric vehicles (PEVs) and natural gas vehicles (NGVs).

The North Jersey region, including Montclair Township in Essex County, stands to benefit from AFVs, specifically through reduced fuel costs, savings on maintenance, use of advanced technology, support of domestic industries, and promotion of environmental sustainability. The objective of readiness planning is to identify, prioritize, and implement strategies that unlock the potential for vehicle electrification and NGV deployment. If done thoroughly and thoughtfully, AFV readiness planning will set the course for municipalities to effectively accelerate the shift away from reliance on conventional vehicles to AFVs, both in the consumer and fleet markets.

The NJTPA project team, working closely with a stakeholder advisory committee (SAC) made up of municipal decision-makers, residents, and industry representatives, developed the Montclair Township Alternative Fuel Vehicle Readiness Plan. The readiness planning process includes data collection and analysis around the current and future market, barriers to increased adoption, regulatory framework, and existing and planned incentives and funding. The resulting recommendations focus on general plans and policies, zoning and parking codes, permitting and inspection, building codes, and fleet planning.

This study was conducted in keeping with the policies of Plan 2045: Connecting North Jersey to improve mobility, protect the environment, and take advantage of technology developments

Plug-in Electric Vehicle Readiness

As of July 2017, PEVs made up approximately 0.5 percent of all vehicles registered in the township. That is approximately 140 PEVs. Given the consumer focus, the opportunity for PEVs is closely linked to several socio-economic factors, including income, hybrid electric vehicle (HEV) ownership, home ownership, and housing type. While barriers to usage exist, the number of PEVs traveling in and around Montclair Township will continue to increase. Additional charging infrastructure will be needed to support this growing number of PEVs (see box).

Regulations, policies, and incentives at the municipal, state, and federal levels can play a role in facilitating PEV usage. The project team analyzed existing plans, codes, ordinances, and incentives to inform the recommendations below.

The project team organized both the charging demand analyses and readiness planning recommendations according to the charging infrastructure needs identified for Montclair Township:

- **Residential:** In general, Montclair ranks relatively high with regard to residential charging demand. The demographics associated with households in Upper Montclair, in particular, align very well with key PEV ownership indicators.
- **Multi-Unit Dwelling (MUD):** Focusing on residential buildings with 10 or more units, the greatest estimated demand for MUD charging correlates with the central neighborhoods where the majority of apartment and other multi-unit buildings are located.
- **Workplace:** Workplace charging demand is estimated to be highest in two distinct areas: within the commercial district along Bloomfield Avenue, and in the portions of Upper Montclair closest to Montclair State University.
- **Public:** The commercial districts around the Bay Street transit station and along Bloomfield Avenue ranked high and medium/high, respectively for public charging

Natural Gas Vehicle Readiness

Given that NGVs are typically medium- and heavy-duty vehicles, both market penetration and opportunities for municipal NGV readiness planning is more limited than for PEVs. Montclair Township has experience with NGVs in the municipal fleet, and owns and operates one private compressed natural gas (CNG) station, which is located at the Department of Community Services Yard on North Fullerton Avenue. The NGV market outlook in Montclair is tied to both national (e.g., price differential) and local (e.g., resource constraints) barriers.

Recommendations

The plan's recommendations correlate with goals set by the SAC, as well as the demand analysis, existing municipal plans and policies, and incentives. The recommendations are organized by the type of infrastructure demand (general, residential, MUD, workplace, and public). In addition, for each recommendation, a lead organization or stakeholder is identified. The time horizon for the actions is 10 years, with actions that may be ongoing, as well as those to be implemented in the near-term (1-2 years), medium-term (3-5 years), and long-term (6-10 years). Below is a summary of the recommendations for Montclair Township:

- **General Plans & Policies:** The township has two long-range plans that consider transportation. In addition to the Montclair Township Unified Land Use and Circulation Element, the proposed Sustainability Element to Master Plan is expected to include an AFV component. Also, recent redevelopment plans for discreet areas of the Township include requirements for accommodating PEVs. This readiness plan includes the following recommendations to further incorporate AFV preparedness into local plans and policies:

- Integrate AFV readiness into local planning efforts, including **general plans** and **climate action plans**
- Create **cross-jurisdictional opportunities** for sharing lessons learned
- Update the **PEV infrastructure demand analysis**
- Establish **design criteria** for AFV infrastructure
- Collaborate with **utilities** to share market information and facilitate necessary electricity distribution infrastructure upgrades
- Conduct **community education and outreach** to increase awareness about the benefits of AFVs and the role they can play in decreasing transportation costs and achieving environmental goals.
- Conduct **targeted outreach** to MUD managers, developers, employers, and other landowners to install chargers at high-priority locations.
- Collaborate with MUDs to create and implement policies that **allow residents to install** PEV charging infrastructure
- Identify **AFV grants and other funding opportunities** for workplace and public charging infrastructure development
- Pursue **public-private partnerships** to fund publicly accessible charger installations
- **Zoning & Parking Codes:** Montclair’s zoning code does not address PEV charging infrastructure. Yet, it does require more detailed site design review for all parking lots, decks, and garages. This gives the zoning authority the opportunity to examine any planned developments for inclusion of PEV parking spaces and charging stations. The township has several parking ordinances and codes that reference PEVs. Collaboration is ongoing with the Montclair Parking Utility to ensure adequate charging spaces for PEVs in the township. This readiness plan includes the following recommendations for zoning and parking codes:
 - Amend zoning codes to **require or incentivize PEV charging stations or pre-wiring** in new MUD and commercial developments
 - Establish **preferential parking policies** for PEVs, **amend parking codes** to regulate the use of PEV charging spaces, and allow PEV parking to **count towards minimum requirements** for developers
- **Permitting & Inspection:** Municipalities are responsible for administering and enforcing New Jersey codes through the state-mandated permitting and inspection processes. The New Jersey Department of Community Affairs (NJCA) has been working to streamline the installation of PEV charging stations, including developing guidance on when construction permits and inspections are required and expediting the permitting process. Montclair Township has not yet developed processes for administering building codes or electrical subcodes specific to the installation of PEV charging infrastructure. The plan includes the following recommendations for permitting and inspection:

- **Streamline and expedite** approval processes
- **Educate** permitting officials, inspection officials, and first responders in AFV station basics
- Produce **guidance documents outlining permitting requirements** for residential and commercial PEV charging station installations
- **Building Codes:** The NJDCA establishes and enforces statewide building codes — referred to as the Uniform Construction Code (UCC). Municipalities like Montclair Township are limited to the statewide UCC, and are therefore not in a position to take a more progressive approach to building codes as they are related to PEVs or other issues. To that end, the plan includes only one recommendation for building codes:
 - **Work with the state to amend the building code** to require PEV station readiness in new single-family developments
- **Fleet Planning:** While often overshadowed by the consumer focus for PEVs, fleet planning is important to AFV readiness, particularly for NGVs. The plan includes the following recommendations related to fleet planning:
 - Assess **the existing municipal fleet**, develop a **fleet management plan**, and **explore opportunities** for fleet AFVs
 - Provide **technical assistance, training, and educational resources** to local fleet managers regarding AFV and infrastructure deployment

Conclusions and Next Steps

By following the recommendations outlined here, Montclair Township will be well-equipped to support AFV use within the municipality, thereby reducing fossil fuel use, supporting a healthy environment, increasing economic development, attracting residents and businesses, and demonstrating leadership.

This is a comprehensive plan, but it only provides a snapshot in time. AFV readiness planning is an iterative and ongoing process. The alternative fuel industry is dynamic and this plan should be a “living” document that Montclair Township revisits and updates as goals are achieved, new challenges arise, or circumstances change. In order to accomplish this, Montclair Township should continue to engage stakeholders and solicit feedback on areas that may need additional attention.

There are numerous technical assistance resources available to provide Montclair Township with ongoing support and direction, including the NJTPA and other organizations. The NJTPA project team also developed an AFV readiness guidebook to assist Montclair and other municipalities with future planning efforts.

Introduction to Alternative Fuel Vehicle Readiness Planning

With the increased availability of and attention paid to AFVs in recent years, the NJTPA is supporting local and regional efforts to deploy these vehicles and related infrastructure for both the consumer and fleet markets. This report focuses on municipal readiness planning in Montclair Township in Essex County, New Jersey.

Municipalities can benefit from AFVs, particularly PEVs and NGVs. Benefits include reduced fuel costs for consumers, savings on maintenance, supporting domestic industries, and promoting environmental sustainability. The objective of readiness planning is to identify, prioritize, and implement strategies that unlock the potential of transportation electrification and NGV deployment. More specifically, AFV readiness planning lays out the path to make municipalities “AFV ready” by identifying the barriers to widespread deployment of infrastructure and vehicles, and outlining actions that will reduce and resolve these barriers. This plan also includes recommended actions community leaders and other stakeholders can take to help expand the use of PEVs and NGVs.

The value of AFV readiness planning is highlighted by work from the U.S. Department of Energy (DOE) and the International Council on Clean Transportation (ICCT). Researchers at DOE national laboratories demonstrated a correlation between higher PEV deployments and readiness planning, even after factoring in cold weather and incentive availability.¹ Meanwhile, the ICCT assessed actions taken at the municipal level and concluded that there is quantitative support for the “ecosystem approach” as a best practice, where many stakeholders (including local municipalities) have key roles in enabling PEV growth; and that “cities are focal points for collaboration among governments, the auto industry, utilities, and advocates on electric vehicles.”²

Most readiness planning to date has been focused at the regional or state level. For instance, DOE awarded 16 projects in 2011, referred to as the Clean Cities Community Readiness and Planning for Plug-in Electric Vehicles and Charging Infrastructure,³ at the multi-state, state, regional, and metropolitan levels. This plan takes readiness planning to the municipal level, in an effort to accelerate the shift away from reliance on conventional vehicles to AFVs. This plan focuses on PEVs and NGVs. Both plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) make up the broader PEV category.

To the extent practicable, this plan considers the unique attributes that influence AFV adoption in Montclair, providing customized insights and recommendations. This plan can help decision-makers in Montclair identify and prioritize the most effective ways to catalyze AFV deployment.

This effort was sponsored by the NJTPA, the Metropolitan Planning Organization (MPO) for the 13 counties of northern and central New Jersey. Working with local stakeholders and drawing on national examples, three readiness plans were developed to understand existing conditions and recommend

¹ DJ Santini, Electric Drive Technology Market Trends, 2015 Clean Cities Strategy,

http://www.eere.energy.gov/cleancities/pdfs/2015_strategic_planning_presentation_electric_drive.pdf

² ICCT White Paper, Assessment of leading electric vehicle promotion activities in United States cities, 2015,

http://theicct.org/sites/default/files/publications/ICCT_EV-promotion-US-cities_20150729.pdf

³ More information about these projects is available online at <https://cleancities.energy.gov/partnerships/projects#electric-vehicle-projects>.

implementation strategies related to AFV readiness. The other plans were developed for the Town of Secaucus and Woodbridge Township.

Relevant Regional Planning Efforts

The NJTPA has been involved in developing and implementing two related northern New Jersey plans that provide long-term, regional context to the development of local readiness plans for AFV infrastructure.

Together North Jersey Plan

The Together North Jersey (TNJ) Regional Plan for Sustainable Development, completed in 2015, is the result of three years of planning activities by a coalition of diverse partners. The Plan provides detailed strategies and specific actions, serving as a technical guide for implementation.

The TNJ plan has 15 focus areas, including *Focus Area 11: Transition to a clean energy economy*. Within Focus Area 11, there are four strategies, one of which is *Strategy 11.4: Reduce transportation petroleum use*, which in turn recommends actions in two categories: *travel optimization* and *advanced vehicles* actions. The advanced vehicles actions involve regional and local governments “...working with state officials and the private sector to speed the adoption of new vehicle technologies, especially electric, hybrid and other alternative fuel vehicles by implementing incentive programs, investments and other measures to encourage the purchase and use of these vehicles by individuals and fleet owners and significantly expanding the number public and private electric vehicle charging stations and alternative fuel vehicle refueling stations available in our region and statewide.”

There are nearly a dozen AFV related actions recommended. Of these, two are related directly to the development of AFV infrastructure and local readiness plans: (1) “Incentivize and support municipalities to develop and adopt alternative fuel readiness plans... Implement a variety of programs that encourage development of public charging infrastructure for electric vehicles across the region, with particular focus on the involvement of municipal governments...”; and (2) “Incentivize, support, and promote the development of private EV charging infrastructure at commercial (for employees or visitors), and residential properties...” The TNJ plan outlines several steps to implement these actions.

Source: togethernorthjersey.com

Plan 2045

Plan 2045: Connecting North Jersey is the NJTPA’s Regional Transportation Plan for northern New Jersey. The plan considers how AFVs, as well as other “game changing” technologies will shape transportation while offering a long-term vision to support the region’s economy and quality of life. Developed with extensive public and stakeholder input, the plan addresses infrastructure and transportation needs that ultimately will shape a positive, productive future for North Jersey.

Source: <https://apps.njtpa.org/plan2045>

Montclair Township

Located in Essex County, one of the 13 counties in the NJTPA region (see [Appendix G](#)), Montclair Township is home to more than 38,000 residents and spans 6.3 square miles (see Figure 1).⁴ Montclair is primarily a residential community with vibrant business districts and convenient commuter transit options.

The township includes several unofficial neighborhoods that are loosely based on transit stops and commercial areas: Montclair Heights, Upper Montclair, Watchung Plaza, Walnut Street/Montclair Center, Bay Street/Bloomfield Avenue, and South End District. Upper Montclair is comprised of all of Montclair north of Watchung Avenue and is its own Census Designated Place (CDP).

Approximately 75 percent of the land area in Montclair Township is residential, 15 percent is other uses such as civic and open space and just over 10 percent is commercial. Single-family houses make up 48 percent of the housing stock. While diverse in ethnicities and income levels, Montclair’s population is considered to be among the higher income and education levels in New Jersey.

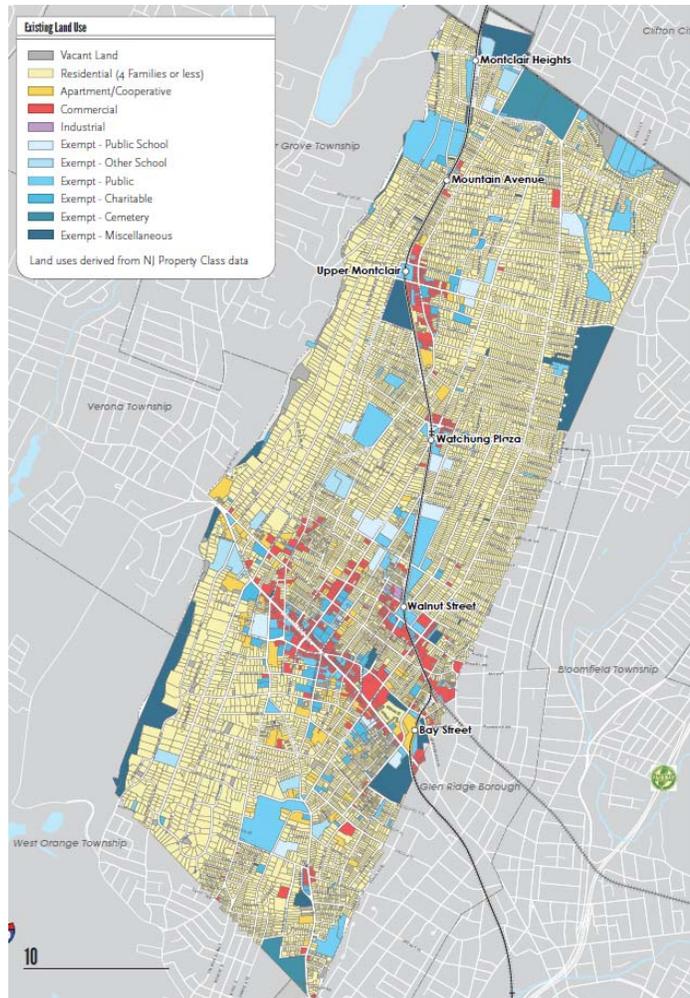


Figure 1. Map of Montclair Township with Existing Land Uses

There are more than 15,000 housing units within the township, 57 percent of which are owner-occupied. About half of the housing units are single-unit structures and the other half are multi-unit.⁵ The average commute time for Montclair residents is 36.6 minutes. The majority (62 percent) of commuters report driving to work and a quarter take public transit.⁶ The rate of car ownership has increased over the past 10 years in the township and there are more cars per household today.

⁴ U.S. Census Bureau (2011-2015), Total Population American Community Survey 5-year estimates, https://censusreporter.org/data/table/?table=B01003&geo_ids=06000US3401347500&primary_geo_id=06000US340134750. Accessed April 10, 2017.

⁵ U.S. Census Bureau (2011-2015), Units in Structure American Community Survey 5-year estimates, https://censusreporter.org/data/table/?table=B25024&primary_geo_id=06000US3401347500&geo_ids=06000US3401347500,05000US34013,04000US34,01000US. Accessed April 10, 2017.

⁶ U.S. Census Bureau (2011-2015), Means of Transportation to Work American Community Survey 5-year estimates, https://censusreporter.org/data/table/?table=B08006&primary_geo_id=06000US3401347500&geo_ids=06000US3401347500,05000US34013,04000US34,01000US. Accessed April 10, 2017.

A key component of Montclair’s 2015 Unified Land Use and Circulation Plan is to concentrate new mixed-use development in areas served by public transportation in the form of transit-oriented development, thereby preserving existing residential neighborhoods.⁷ The township is using redevelopment as a tool for revitalization and rehabilitation in many areas of Montclair. The objective of redevelopment is to allow for a flexible mix of commercial, retail, office, and residential use.

⁷ Montclair Township, *2016 Master Plan Reexamination Report*, <http://www.montclairnjusa.org/dmdocuments/Draft-Master-Plan-Reexam-2016.pdf>.

Alternative Fuel Vehicle Readiness Planning Goals

The project team and Montclair staff met throughout the course of the project. Municipal officials were key members of the stakeholder advisory committee (SAC), which also included representatives from the Montclair Parking Utility, Planning Board, Environmental Commission, Township Council, Montclair Center Business Improvement District, local businesses, Essex County, and EZ Ride Transportation Management Association (TMA). SAC members provided valuable background data and critical review throughout the project. SAC meetings helped to articulate Montclair's vision for AFV readiness, to provide sufficient background material to stakeholders, and to gather input about the challenges, barriers, and opportunities related to AFV readiness. Montclair considered stakeholder input and community priorities in developing the following goals:

- Facilitate increased public access to AFV infrastructure, as well as a balance of home, workplace, and public charging in Montclair.
- Encourage businesses to collaborate on providing infrastructure in commercial districts.
- Educate local officials and municipal staff to help inform the departmental purchasing process.
- Promote a positive mindset for AFV use and supporting infrastructure.
- Establish a benchmark for progress so the township can assess how AFV goals are being met.

Structure of the Readiness Plan

The Montclair Township readiness plan is structured as follows:

[Section 1. Plug-In Electric Vehicles and Charging Infrastructure](#): This section begins with an overview of the PEV market today, including the type and number of PEVs registered in Montclair Township; the location, quantity, and level of available charging infrastructure; a market outlook; a review of barriers to increased PEV adoption; a review of the regulatory framework in Montclair and the region that impacts PEVs and charging infrastructure deployment; and a review of the incentives available.

[Section 2. Natural Gas Vehicles and Fueling Infrastructure](#): This section provides an overview of the status of NGVs and natural gas fueling infrastructure in Montclair, a discussion of barriers to increased NGV adoption, and a natural gas market outlook.

[Section 3. Recommendations and Steps to Implementation](#): This section lays out the roadmap and recommended actions to achieve the township's AFV readiness goals. Recommendations are presented in a way that aligns with the types of infrastructure demand. Each recommendation references an entity or entities best suited to take responsibility for leading actions.

[Appendix A. Acronyms](#): This appendix lists the acronyms used in this document.

[Appendix B. Plug-in Electric Vehicle Forecasting Methodology](#): This appendix describes the methodology and assumptions used for the PEV forecasts presented in the plan.

[Appendix C. Charging Infrastructure Demand Forecasting Methodology](#): This appendix describes the methodology and assumptions used for the charging infrastructure siting analysis presented in the plan.

[Appendix D. Municipal Policy Examples](#): This appendix includes additional detail on policy examples mentioned in this plan.

[Appendix E. Plug-in Electric Vehicle Community Readiness Resources](#): This appendix is adapted from a compilation developed by the DOE and links to relevant documents, websites, case studies, and other resources.

[Appendix F. Additional Information on Parking](#): This appendix includes municipality-specific parking information beyond the scope of the main discussion.

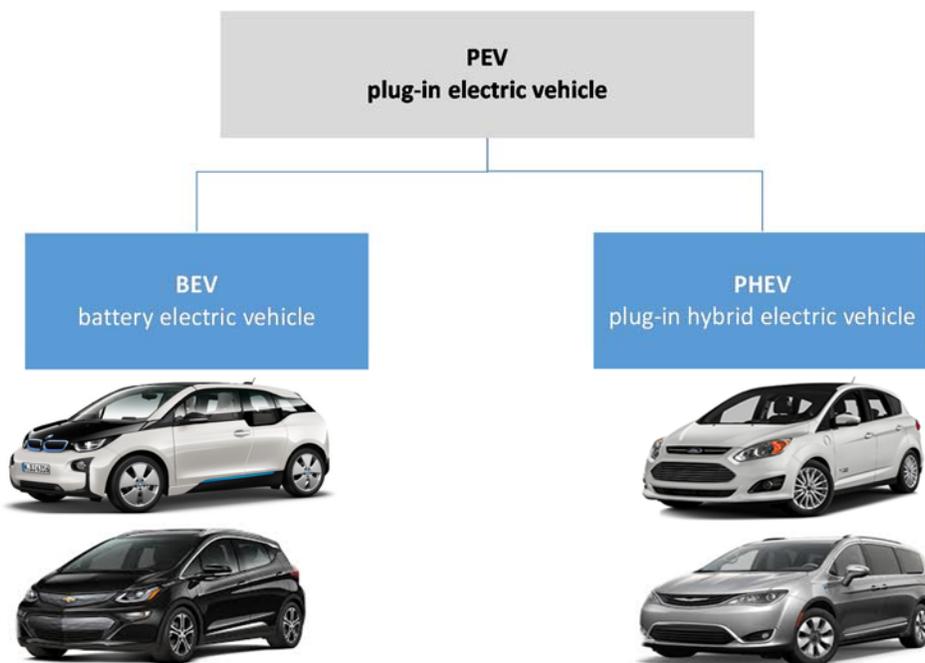
[Appendix G. Regional Planning Area](#): This appendix provides a description of the NJTPA region.

1 Plug-in Electric Vehicles and Charging Infrastructure

Overview

The national PEV market has expanded in scale, geography, and technology since manufacturers released the first modern PEVs in 2011. Driven by incentives, mandates, investment from industry, and enthusiasm from early adopters, new PEV sales in the United States grew from approximately 17,000 vehicles in 2011 to nearly 160,000 in 2016.⁸ Over that same period, charging infrastructure increased nearly 10 times.⁹ While California has historically led in PEV adoption, the Northeast and Mid-Atlantic regions are quickly becoming primary markets for PEVs. However, PEVs still account for less than 1 percent of the total light-duty vehicle market nationwide. There are many potential benefits associated with an increase in PEVs on the road, including lower operating and maintenance costs, improved air quality, and economic growth.

Both plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) make up the broader PEV category. PHEVs have both a battery-powered motor and an internal combustion engine (that uses gasoline) capable of powering the wheels; BEVs are powered exclusively by a battery-powered motor and do not use gasoline. The BMW i3 and Chevy Bolt (BEVs) and the Ford C-Max Energi and the Chrysler Pacifica (PHEVs), shown below, are examples of vehicles available to consumers.



⁸ Argonne National Laboratory, Light Duty Electric Drive Vehicles Monthly Sales Updates, <https://www.anl.gov/energy-systems/project/light-duty-electric-drive-vehicles-monthly-sales-updates>. Accessed April 3, 2017.

⁹ U.S. DOE, U.S. Alternative Fueling Stations by Fuel Type, <http://www.afdc.energy.gov/data/10332>. Accessed April 3, 2017.

In 2017, there were upwards of 25 light-duty PEVs to choose from, and the market continues to expand as automobile manufacturers roll out additional models. Longer range BEVs – such as Tesla models and the Chevy Bolt – can drive 200 miles or more on a single charge. Other BEV models, like the Nissan Leaf and Volkswagen eGolf, have an electric range of 80-100 miles. There are a variety of PHEVs available that can travel 13-50 miles (depending on the model) in all-electric mode, after which the gasoline engine kicks in to provide additional range. Over the past several years, technological advancements (largely in batteries) have extended the electric range significantly. Continued advancements are likely to result in longer vehicle ranges and reduced purchase prices.

PEV charging infrastructure is typically differentiated by the maximum amount of power that can be delivered to a vehicle's battery. This determines the time that it takes to fully charge. Three categories of charging stations are dominating the market:

- **Level 1** chargers consist of a standard 110-volt alternating current (AC) outlet that provides 2-5 miles of range per hour of charging, depending on the vehicle and other factors. Level 1 is most commonly found in residential applications but can be suitable for some fleet and workplace charging applications.
- **Level 2** is a 220 or 240-volt AC outlet, and provides 10-20 miles of range per hour of charging. Level 2 can also be used at the home and workplace.
- **Direct current (DC) fast chargers** are more in line with the typical gas station refueling model, and provide 50-70 miles of range per 20 minutes of charging through different types of connectors – J1772 combo, CHAdeMO, and Tesla. The connectors for DC fast charging units are not standardized across vehicle manufacturers in the same way that Level 2 charging hardware is (via the J1772 standard). Furthermore, there are no PHEVs on the market today that can use a DC fast charger.¹⁰ In other words, not all PEVs currently available can use DC fast chargers, and even those that are equipped for fast charging may not have on-vehicle hardware compatible with the charging unit.

Just as vehicle and battery technology is advancing, so is charging infrastructure technology. For example, wireless charging is gaining attention as an option in certain applications, like home and fleet charging. Higher powered DC fast charging technology, providing up to 20 miles of range per minute of charging, is also in the works.

¹⁰ A potential exception to this is the “range extender” or REX. For the sake of simplicity, this plan refers to BEVs and PHEVs; the REX is a kind of hybridized powertrain. Range extenders typically have an engine powered by gasoline that is used to drive an electric generator, which supplies the vehicle's motor with electricity.

Vehicles and Infrastructure in New Jersey and Montclair

Figure 2 shows PEV counts by county in New Jersey as of July 2017. Essex County is among the five leading counties, with more than 1,000 PEVs.

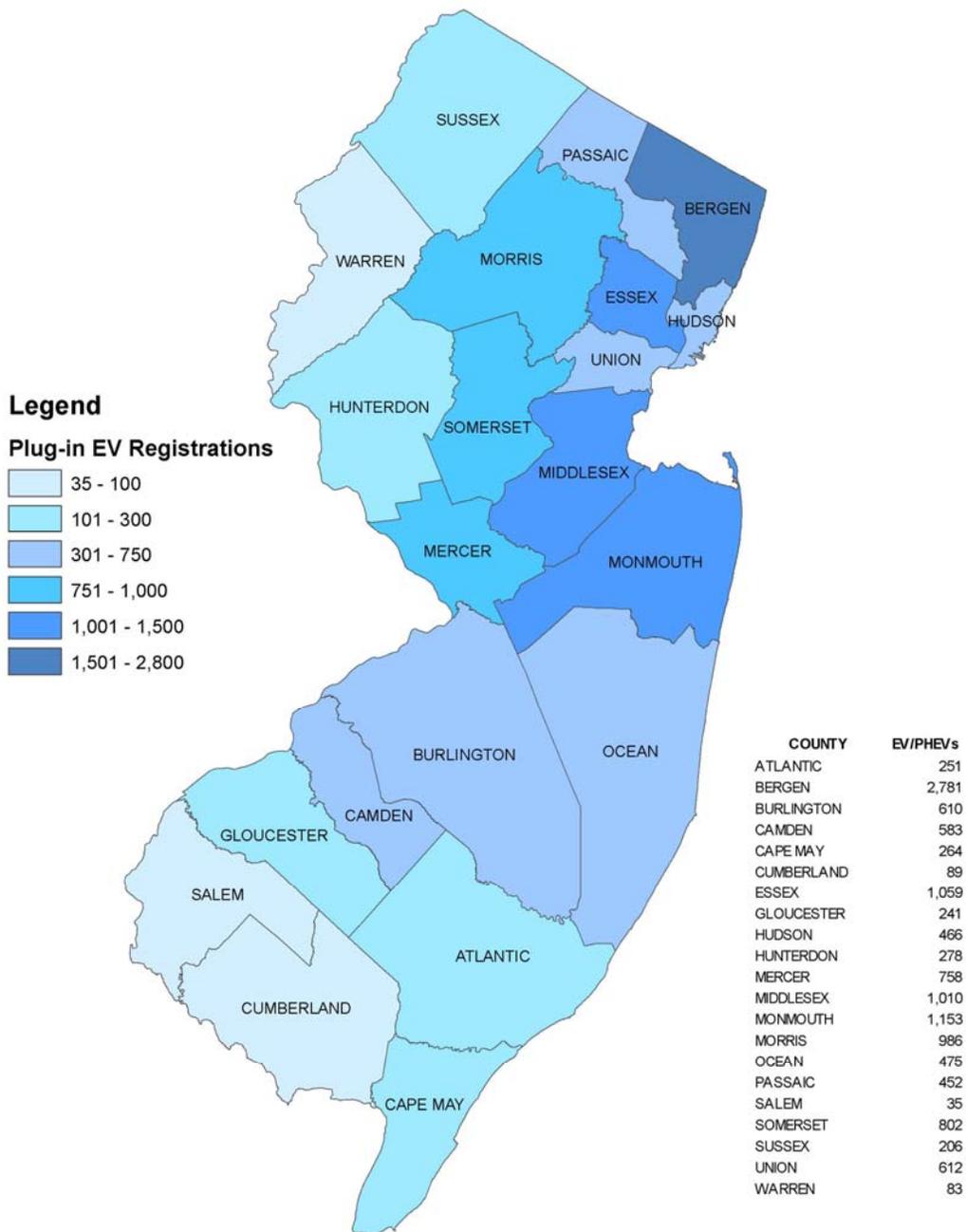


Figure 2. New Jersey PEV Registrations by County, July 2017¹¹

¹¹ Figure provided by the New Jersey Department of Environmental Protection (NJDEP) in August 2017. Data shown here may differ from the final version posted to the NJDEP Clean Vehicles website, <http://www.nj.gov/dep/cleanvehicles/>. Note that other PEV data sources exist, which may present different estimates.

Table 1 below provides data on the types of vehicles being used in Montclair Township, as of July 2017. This data serves as an important baseline both in terms of tracking growth in ownership and forecasting future PEV demand in the township.

Table 1. Vehicle Population in Montclair Township, July 2017¹²

	PHEV	BEV	Total Vehicles	PEV Percentage of Total
Montclair	86	53	26,320	0.53%

PEVs make up 0.53 percent of total vehicles registered in Montclair Township. This share is more than double the PEV percentage in Essex County (0.22 percent), and is not far off the national PEV penetration rate, which is less than 1 percent.

Providing adequate charging infrastructure can help accommodate and encourage increased use of PEVs. The DOE’s Alternative Fuels Data Center (AFDC) Station Locator¹³ provides data on charging infrastructure availability across the country.

As of October 2017, New Jersey had 216 public charging locations (14 Level 1, 186 Level 2, and 49 DC fast charging stations), with a combined total of 513 charging outlets (note that some locations have more than one charger type). There are an additional 45 private access locations with Level 2 charging stations, many of which are at Nissan dealership service departments.

Table 2 below includes the operational charging stations in Montclair, according to the AFDC Station Locator, as of October 2017. The stations are also shown on the demand maps beginning with [Figure 3](#). Montclair has one publicly available DC fast charger, which is an asset in terms of quick, public charging.

Table 2. Charging Infrastructure in Montclair, October 2017

Charging Station Host/Name	Address	Accessibility	Access Type	Charging Stations		
				L1	L2	DC Fast
Nauna’s Bella Casa	148 Valley Rd	Public	Public		1	1
ProPark - Crescent Parking Garage	13 The Crescent	Public	Public		2	
ProPark - Valley & Bloom Garage	34 Valley Rd	Public	Public		3	
Fullerton Parking Deck	20 Park St	Public	Public		2	
Upper Montclair Parking Plaza	580 Valley Rd	Public	Public		2	
Hillside Square	8 Hillside Ave	Private	Workplace		1	
Brassworks on Grove	105 Grove St	Private	Workplace/Fleet		1	

¹² PEV counts were provided by the NJDEP, based on registration data from the Motor Vehicle Commission (NJMVC).

¹³ U.S. DOE, Alternative Fueling Station Locator, <http://www.afdc.energy.gov/locator/stations/>.

Barriers to Increased Plug-in Electric Vehicle Use

While there are significant benefits to increased PEV use, certain barriers exist which could limit the market’s expansion.

- **Vehicle Cost** — Upfront vehicle cost is likely one of the largest barriers to widespread PEV use. Battery costs comprise the largest percentage of a PEV’s price; however, that cost has been decreasing per unit of energy and will continue to do so as manufacturers achieve additional technological breakthroughs and economies of scale in the future. Incentives are available at the federal and state levels to help reduce vehicle costs.

- **Charging Station Build-out and Range Anxiety** — The majority of PEV charging occurs at residential locations when drivers plug in their vehicles after finishing a trip. The distance of some trips require additional charging — either at work or around town when visiting shops, restaurants, and other destinations. While public charging station network development can help with this (particularly DC fast charging for long-distance trips), the perceived lack of charging infrastructure may contribute to “range anxiety,” the fear that a vehicle may leave a driver stranded because it runs out of charge before reaching the intended destination.

Key Consideration: Charging Infrastructure Costs

The high costs of the infrastructure to provide publicly accessible charging infrastructure make it difficult to earn a profit because the commodity (i.e., electricity) being sold is comparatively inexpensive. While highly dependent upon specific site conditions, publicly accessible installations of Level 2 charging infrastructure can cost in excess of \$10,000; whereas DC fast charger installations can cost more than \$150,000. A [2015 National Academies Consensus Study Report](#) states that the high cost of installing public charging stations and the minimal revenue obtained from providing electricity present challenges for developing business models for profitable charging stations.

There are several challenges associated with the deployment of publicly accessible charging infrastructure including funding, siting, permitting, and operational costs. On the municipal side, permitting and inspection processes can be a barrier. These issues are addressed further below and recommendations to overcome these barriers are included in [Section 3](#).

- **Consumer Awareness** — The introduction of new technologies such as PEVs requires continuous outreach to consumers to deliver messaging that highlights PEV availability and benefits, including long-term cost savings as well as environmental, health, and community benefits. Furthermore, it is important to communicate the direct financial and nonfinancial benefits to drivers including tax credits, grants, and the PEV driving experience (e.g., fast acceleration and quiet vehicle operation) and the differences associated with fueling from the grid rather than from a gas station.

Market Outlook in Montclair

As part of PEV readiness planning, it is important to understand the existing deployment of PEVs and charging infrastructure, as well as the market outlook, including factors such as who is buying PEVs, what type of PEVs are likely to be purchased, and projected market growth. Tracking the market using available data and through partnerships at the local, regional, and state level are means by which the township can stay informed and in touch. The type of PEVs that are on the roads and the locations in which they are registered can help characterize the demand for the different types of charging and applications (such as residential, workplace, and public charging). For instance, a market that is dominated by BEVs is likely to need more DC fast charging than a market that is dominated by PHEVs because BEV charging demands will likely be higher as a result of the larger batteries. This section provides a summary of the potential rate of PEV adoption in the township and areas within where PEV demand might be highest.

Forecasted Plug-in Electric Vehicle Populations in Montclair

For the purposes of this plan, residential PEV ownership forecasts in Montclair Township were projected over a planning horizon from 2016-2030. Projecting PEV ownership at a local level beyond 2030 is not practical given the rapidly changing nature of the technology, demographics, land use changes, and local economic conditions. The forecasts are meant to guide the planning process, to help support deployment of PEV infrastructure, and guide local policy and regulatory changes as appropriate.

Three PEV projections for Montclair Township were developed based on varying assumptions around adoption trends. Table 3 summarizes the approach used to forecast PEVs in low and high usage scenarios. It also includes a greenhouse gas (GHG) stretch scenario in which the state meets the emissions reductions set forth in the New Jersey Global Warming Response Act.¹⁴

Table 3. PEV Forecast Scenario Descriptions

Scenario	Description
Low	Reflects usage trends comparable to the Reference Case in the Energy Information Administration's (EIA) Annual Energy Outlook (AEO) 2016, ¹⁵ adjusted slightly for increased potential indicated in the Mid-Atlantic region.
High	Assumes that PEV usage rates in Montclair will be consistent with the Zero Emission Vehicle (ZEV) mandate in place for New Jersey, ¹⁶ with a fair-share assumption (i.e., that ZEV deployment will occur in the state on a population-weighted basis in the long-term).
GHG Stretch	The PEV strategy of the NJTPA Regional GHG Mitigation Plan calls for a 60 percent market share of PEVs by 2040. The GHG stretch scenario assumes that PEV adoption rates will be slightly lower than the plan, with a 50 percent market share by 2040.

¹⁴ Public Law 2007, c.112, N.J.S.A 26:2C-37

¹⁵ U.S. EIA, AEO 2016, [https://www.eia.gov/outlooks/aeo/pdf/0383\(2016\).pdf](https://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf), August 2016.

¹⁶ ZEV programs aim to increase sales of ZEVs, which include PEVs and fuel cell electric vehicles, by requiring that some portion of vehicle manufacturer sales in the state be ZEVs. More information on New Jersey's ZEV mandate is available on the NJDEP website at <http://www.nj.gov/dep/cleanvehicles/LEV.pdf>.

A more detailed description of the forecasting methodology, as well as corresponding graphs, are provided in [Appendix B](#). The results of these three forecast scenarios are as follows:

- Low Scenario: Approximately 875 PEVs on the road in Montclair in 2030 (400 PHEVs and 475 BEVs).
- High Scenario: 2,500 PEVs on the road in 2030 (1,750 PHEVs and 750 BEVs).
- GHG Stretch Scenario: About 15,000 EVs on the road in Montclair by 2040.

To provide context, forecasts project that total light-duty vehicles will increase by about 10-12 percent in Montclair by 2030, with about 29,000 vehicles of all types registered. The forecasts indicate that PEVs will comprise 6-17 percent of registered vehicles in Montclair by 2030, up from the current 0.53 percent. PEV market penetration will also increase across the region, with perhaps a larger number of PEVs driven by people working in and visiting the municipality. This will likely increase demand for charging infrastructure, positioning the township to be an important contributor to a regional network supporting and reinforcing PEV market growth opportunities.

It is worth noting that the AEO is the source of adoption trends for the low case. The EIA is generally conservative in its electrification outlook, and the outlook does not force compliance with regulations like the ZEV program. Despite these limitations, the AEO is a useful source because it is transparent and typically consistent with national-level assessments. Further, it is updated annually, allowing Montclair Township and others to review updates to the outlook from one year to the next. The EIA's 2017 AEO is considerably more bullish on BEVs than the 2016 version. This type of update and change to the forecast can help planning processes and reinforces the notion of a flexible planning process than a deterministic one.

Forecasted Charging Infrastructure Demand in Montclair

As part of this plan, a charging infrastructure demand analysis was conducted to broadly identify the areas within Montclair Township that are most likely to see an increased demand for charging infrastructure. This analysis complements the vehicle forecasting discussed above, and introduces an important geographic component that can guide municipal policy and investments to meet the increased demand for charging infrastructure. [Appendix C](#) includes a detailed methodology of the charging infrastructure demand analysis.

The analysis uses PEV ownership indicators and regional travel patterns to identify areas where there is potential demand for charging stations. Montclair Township can use these results to identify areas where charging station deployment is projected to have the greatest potential to be cost effective, as chargers located in areas where PEV drivers are most likely to travel will be utilized more. Recent research by Idaho National Laboratory demonstrates that charging equipment deployed as a result of a planning process, similar to this plan, experiences nearly 90 percent greater utilization (as measured by charging events per week) compared to charging equipment deployed in a sporadic, unplanned manner.¹⁷ However, it is important to note that the results of the demand analysis should not exclude areas from charging as their demographics evolve.

¹⁷ Idaho National Laboratory, *How Does Utilization of Non-Residential EVSE Compare Between those*

There are four primary types of charging to consider:

- Residential Charging – Highlights areas that will likely experience high demand for residential charging. Since residential charging takes place at home, these are locations in which likely PEV owners live. Residential charging is limited to Level 1 and Level 2 charging infrastructure. Today, the average PEV driver charges at home about 70-90 percent of the time. Most residential charging occurs at Level 1, as it typically does not require any additional investment on the part of the PEV owner. Level 2 charging is more common at residences for BEVs compared to PHEVs, especially those vehicles with ranges above 150 miles.
- Multi-Unit Dwelling Charging – Highlights areas in the region that will likely experience high demand for residential charging and have high incidence of multi-family units. Like residential charging, MUD charging is expected to be a combination of Level 1 and Level 2 charging. The market for MUD charging is in very early stages, and it is unclear which level of charging is most appropriate for this application.
- Workplace Charging – Highlights areas that will likely experience high demand for workplace charging, particularly areas where likely PEV owners work and vehicles are parked for several hours during the day. Level 1 and Level 2 charging are appropriate for workplace charging; ultimately, the appropriate level of charging is something that should be dictated by the facilities management, funding, and demand.
- Public Charging – Highlights areas that will likely experience high demand for public charging (i.e., other non-home or non-work charging), also referred to as opportunity charging. This includes areas where likely PEV owners shop, dine, and travel for recreational activities. Level 1, Level 2, and DC fast charging are all options for public charging, with dwell times (i.e., how long are drivers likely to be parked) and local site conditions (e.g., accessibility to sufficient electrical power) the most important factors in determining which strategy is appropriate.

The resulting analysis illustrates charging demand. Areas shown as warmer colors represent higher demand for charging while the cooler colored areas rank lower for charging demand. Each separate area is a traffic analysis zone (TAZ). The rankings and corresponding colors are based on the TAZ's demand score relative to the entire NJTPA region. For example, a TAZ ranked high (red) on the workplace charging demand map means that area scored in the top 5 percent for workplace charging demand across the NJTPA region. Similarly, a TAZ with a public/opportunity charging ranking of low (blue) scored among the bottom 40 percent for public charging in the region. Additional information about these percentiles can be found in [Appendix C](#).

Residential Charging

The infrastructure demand analysis is based on vehicle registration data and key socio-economic indicators that are positively correlated with PEV ownership, such as income, hybrid vehicle ownership rates, and property characteristics.

Figure 3 presents the results of the residential charging demand analysis. These areas will likely experience high demand for residential charging. Since most PEV charging takes place at home, the map indicates the areas where likely PEV adopters live. While most of Montclair ranks relatively high with regard to residential charging demand, the demographics associated with households in Upper Montclair, in particular, align very well with the key PEV ownership indicators mentioned above. The portion of the township directly south of Watchung Avenue also ranked in the high demand category.

Residential charging demand is the most market-driven of the four charging types, as the number of chargers installed at residences throughout Montclair Township will grow as more PEVs are purchased or leased. [Section 3](#) includes recommendations to support the growth of residential charging in Montclair, primarily through consumer education and outreach.

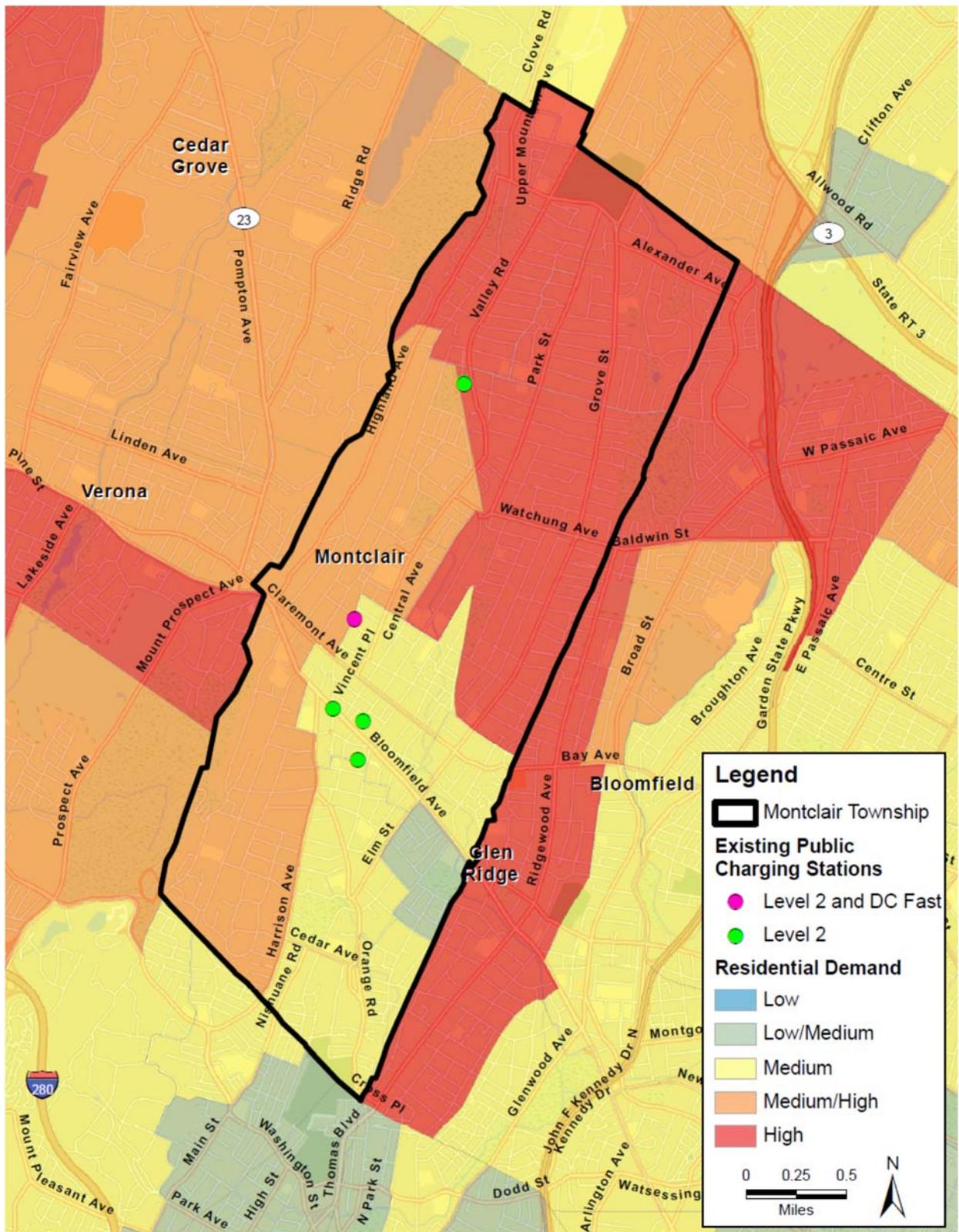


Figure 3. Residential Charging Demand Ranking

Multi-Unit Dwelling Charging

Given that roughly 50 percent of the housing stock in Montclair is multi-family, MUD charging is a key consideration for the township. While many of the MUDs are comprised of two and four units, this plan focuses on MUDs with 10 or more units. In Montclair, these developments house approximately 15 percent of residents.¹⁸

Figure 4 presents the results of the MUD charging demand analysis. These areas will likely experience high demand for individual or shared charging infrastructure in condominium and housing developments as well as apartment buildings. For Montclair, the greatest estimated demand for MUD charging correlates with the central neighborhoods where the majority of apartment and other multi-unit buildings are located.

Conversations with MUD management companies suggest there is limited demand for PEV charging at older, established buildings (e.g., garden-style apartments). Future demand for MUD charging will be driven by new developments and significantly renovated buildings that may draw higher income tenants who view PEV charging as an attractive amenity. [Section 3](#) includes recommendations specific to MUD charging, including outreach to property managers to gauge demand.

¹⁸ Graham Petto, Montclair Township, Stakeholder Advisory Committee meeting, September 12, 2017.

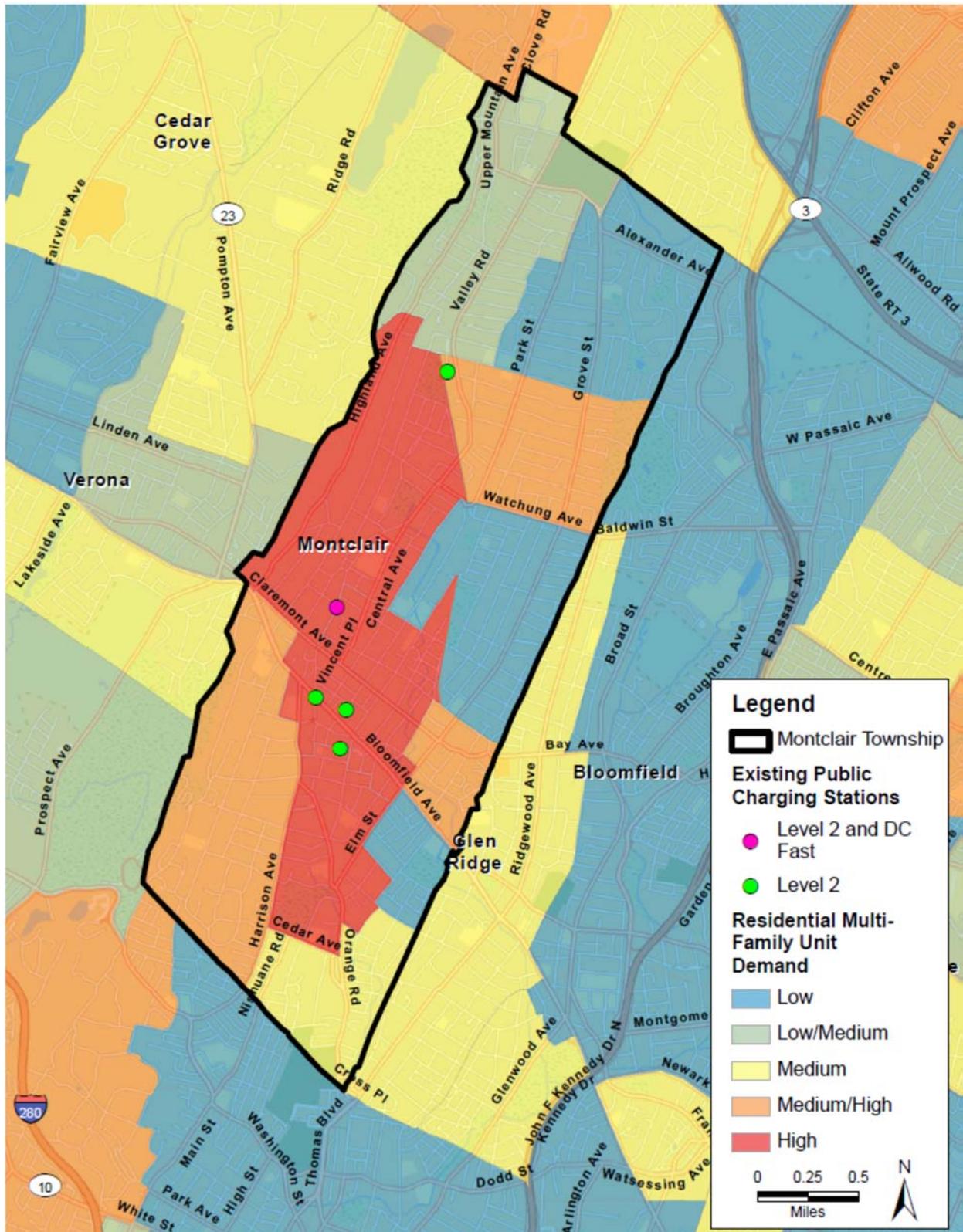


Figure 4. MUD Charging Demand Ranking

Workplace Charging

Figure 5 presents the results of the workplace charging demand analysis. Areas likely to experience high demand for workplace charging are typically found around employment clusters or centers. For Montclair, workplace charging demand is estimated to be highest in two distinct areas: the commercial district along Bloomfield Avenue, and in the portions of Upper Montclair closest to Montclair State University. The high opportunity zone analysis and resulting map (Figure 7) presented later in this section will be a useful tool to help the township target businesses and other organizations, including the university, with employee charging demand. [Section 3](#) includes specific recommendations to support workplace charging, primarily through employer outreach.

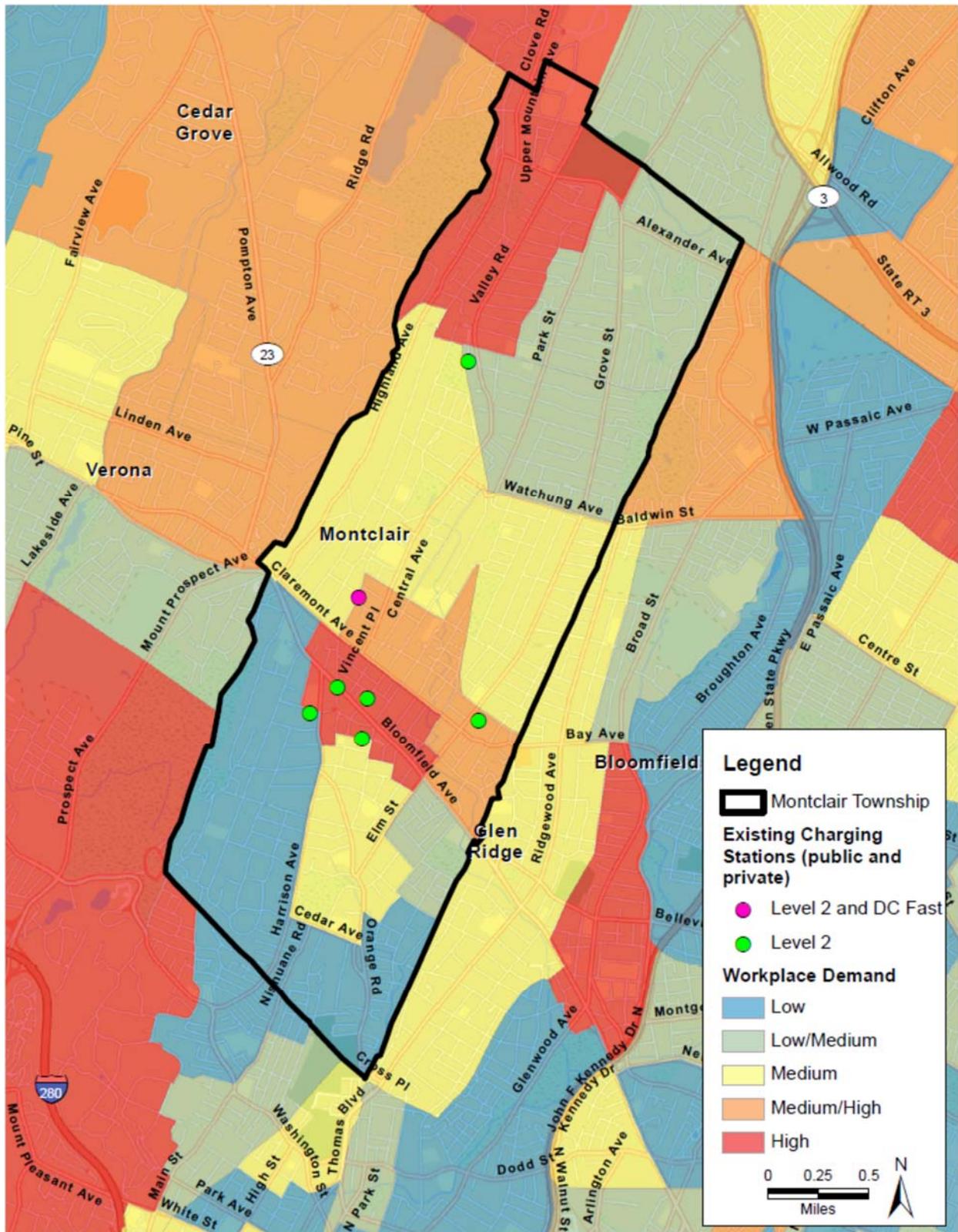


Figure 5. Workplace Charging Demand Ranking

Public Charging

Public charging, also referred to as opportunity charging, covers a wide range of potential charging situations (or opportunities) for a PEV driver away from home or work. Unlike residential and workplace charging, where vehicles are parked for long enough that they achieve a significant charge even with Level 1 charging, public charging will take place at locations where drivers are parked for varying times; therefore, it is important to consider the level of charging the stations offer. Table 4 shows the recommended charging method based on the available charging time at different venues.

Table 4. Available Charging Time and Recommended Charging Level for Different Venues¹⁹

Typical Venue	Available Charging Time	Charging Level (Primary/Secondary)
Shopping Centers	0.5–2 hours	Level 2/DC Fast
Other (e.g., stand-alone retail)	< 1 hour	Level 2/DC Fast
Street/Meters	1–2 hours	Level 1/Level 2
Parking Garages	2–10 hours	Level 2/Level 1
Hotels/Recreation Sites	8–72 hours	Level 2/Level 1

Public charging will consist of predominantly Level 2 and DC fast stations, as it is more convenient for drivers to spend less time charging their vehicles.²⁰ The Montclair public charging analysis focuses primarily on Level 2 charging infrastructure. Figure 6 shows the location of areas that are likely to experience high demand for public charging— these are locations where likely PEV owners shop, dine, and visit for recreational activities. In Montclair, the commercial districts around the Bay Street transit station and along Bloomfield Avenue ranked high and medium/high, respectively for public charging demand. Interestingly, the area north of Claremont Avenue ranked the lowest for public charging demand, which is likely because the majority of commercial parking is located to the south, along Bloomfield Avenue. The high opportunity zone analysis and resulting map (Figure 7) presented later in this section provides additional considerations for building out public charging infrastructure in Montclair. [Section 3](#) includes specific recommendations to support the deployment and use of public charging infrastructure.

¹⁹ Source: ICF

²⁰ The Association of Electrical and Medical Imaging Equipment Manufacturers (NEMA), “EVSE: Powering the Electric Vehicle.” <https://www.nema.org/Products/Documents/nema+evse+presentation+for+communities.pdf>. Accessed February 1, 2017.

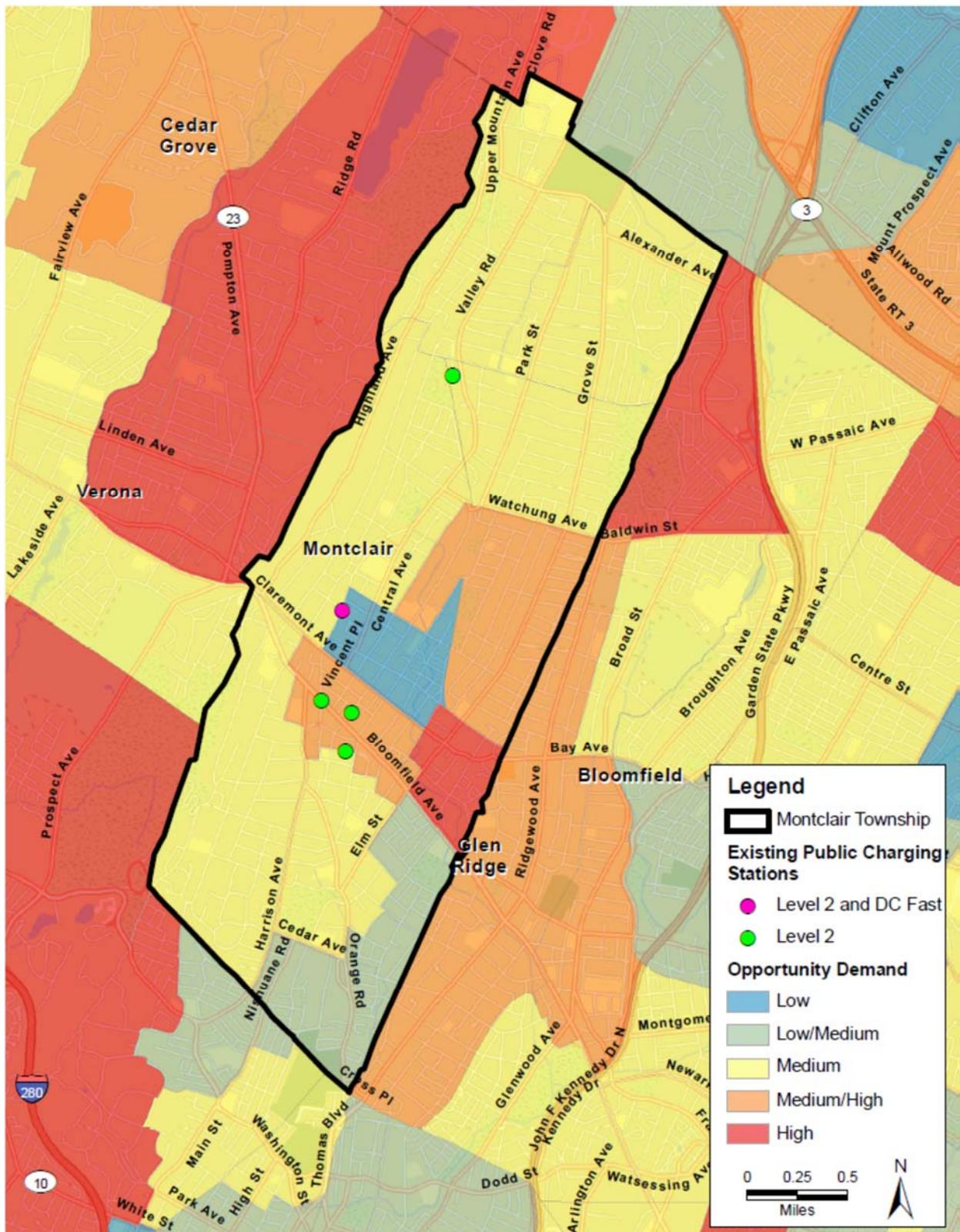


Figure 6. Public Charging Demand Ranking

While not a focus of the public charging analysis, DC fast charging is present in North Jersey and is seeing a great deal of growth in the Mid-Atlantic and across the country. DC fast charging is particularly well-suited for long-distance travel along corridors, as it provides a greater charge in a shorter period of time and correlates with the gas station way of fueling. This corridor approach has become the foundation of numerous infrastructure deployment efforts, such as the Express Charging Corridors Initiative,²¹ and other private partnerships.

High Opportunity Zones for Public and Workplace Charging

It can be challenging to select locations for public charging stations. Workplaces and homes typically have dedicated parking spaces for each worker or resident, vehicles spend the majority of time at work or at home, and commute trips are long, which means PEVs can often use a charge when they arrive at work or home. It is therefore easy to determine the right amount of charging stations at workplaces and homes; ideally these locations have at least one charger for every two PEVs. By contrast, demand for public charging, which currently accounts for less than 10 percent of all charging, is much more sporadic, and in locations where parking is either undersupplied (e.g., a bustling downtown commercial center) or oversupplied (e.g., a big-box retail store on a weekday morning). Furthermore, public charging can be expensive or labor-intensive to install, since charging stations may be in the public right-of-way, far from electrical panels, or in locations where adding a charging space means also adding a parking space in order to meet minimum parking requirements. Though public chargers can send a message to residents and others considering purchasing a PEV that charging is available, those charging stations can also end up as high-profile failures if they are underutilized or consistently occupied by non-charging vehicles.

Although public charging only accounts for a small share of the market today, this will likely change over time with increased access to DC fast charging. National and corridor-based infrastructure deployment efforts, such as Electrify America, are likely to increase opportunities for DC fast charging, or utilities may seek to support market expansion. Together, these types of market developments may help increase access to charging for MUD residents or enable more inter-regional travel, thereby increasing the share of public charging.

All that said, public charging is a key component to PEV readiness and deployment. For this reason, it is important to be thoughtful in placing charging infrastructure. In addition to looking at where demand for charging is likely to be located, an effective public charging analysis identifies high opportunity zones where the environment supports successful charging stations. These zones are often busy commercial areas with high demand for parking and ample turnover, which is conducive to well-utilized, highly-visible chargers. They can also be redevelopment areas or areas with public land uses where local governments have more control over development and therefore greater ability to place charging stations in the right location.

The high opportunity zone analysis for Montclair leveraged municipal zoning data to identify commercial areas, redevelopment areas, and public land uses that could serve as an initial set of high opportunity zones for public charging. The second step was to overlay the high opportunity zones with the demand maps for workplace and public charging, confirming that the zones aligned with the demand analysis.

²¹ For more information, see ChargePoint's press release at <https://www.chargepoint.com/about/news/bmw-volkswagen-and-chargepoint-announce-completion-electric-vehicle-express-charging/>, as well as various news articles.

Montclair Township staff reviewed the zones and provided input to help eliminate areas that may not be suitable, such as parks, schools, and other public spaces.

Figure 7 identifies the resulting high opportunity zones for public charging and workplace charging. The high opportunity zones for public charging generally correlate with Montclair's commercial districts and public parking lots meant for retail/commercial activity versus transit service. Note that some areas provide opportunities for both types of charging while others are more suitable for one or the other. The central business district along Bloomfield Avenue is a focus area for both public and workplace charging. Visitors and employees of the businesses located in Montclair Center would benefit from access to charging stations, and that area includes multiple municipal lots. Another more specific focus area is the Mountainside Hospital.²² The healthcare industry has been actively installing charging infrastructure that primarily serves employees, but may also be accessible to visitors. The high opportunity zone for workplace charging surrounds Montclair State University. Chargers installed here would primarily serve university employees, but could also be made available to students and visitors, providing some public charging.

Upper Montclair already has multiple public chargers, and parking is at a premium, so it is not identified as a high opportunity zone. [Section 3](#) notes the importance of gauging demand over time, as there will likely come a time when more chargers are needed in Upper Montclair.

[Section 3](#) includes specific recommendations for how the township can use this analysis to focus effort and investment in a way that will support public and workplace charging infrastructure.

²² The New Jersey Board of Public Utilities (NJBP) funded a microgrid feasibility study at the same location, see <http://www.state.nj.us/bpu/pdf/boardorders/2017/20170630/6-30-17-91.pdf>. According to Mike Hornsby, NJBP, the project may incorporate PEV charging (noted during the Technical Advisory Committee meeting held October 17, 2017).

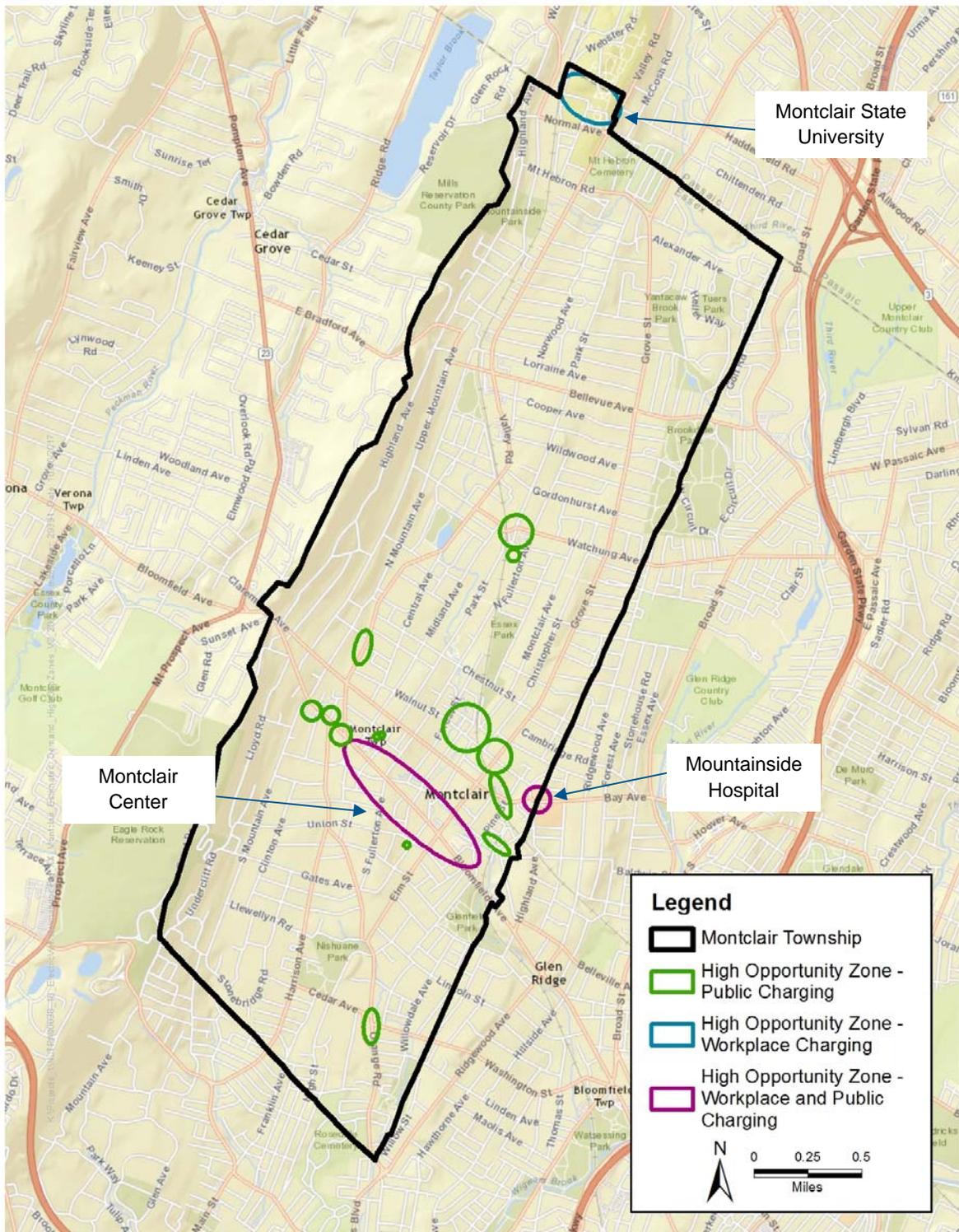


Figure 7. High Opportunity Zones – Public and Workplace

Regulations

Regulations and policies at the municipal, state, and federal levels can play a role in facilitating increased PEV use. Regulations that can support the deployment of PEV charging infrastructure include building, electrical, and zoning codes; parking rules; permitting processes; and incentives.²³ This section provides an overview of Montclair’s community plans as they relate to facilitating AFVs, PEVs in particular. It also addresses Montclair’s local zoning regulations and analyzes their potential to affect PEV charging station installation, including sections on parking, site plans and site development, and environmental performance standards (noise, air quality, etc.). The relevant language and provisions related primarily to PEVs are described below. Regulatory information specific to NGVs and natural gas fueling infrastructure can be found in [Section 2](#).

Local Community Plans

Local community plans are forward-looking documents that both define a community’s vision for the future and respond to anticipated future conditions with strategies and related actions. Community plans can proactively facilitate and encourage AFV use. They can do so by establishing policies that encourage inclusion of PEV charging infrastructure in new development or that support charging stations as a key element of the local transportation system.

Montclair Township has two relevant long-range plans that consider transportation, which contain some language supportive of AFV use:

Montclair Township Unified Land Use and Circulation Element (2015, Municipal Land Use Center at The College of New Jersey): This plan focuses, in large part, on ways to enhance non-automobile travel. It does, however, have the following relevant goals and policies:

- “Ensure that future growth and development in the township is met with supportive infrastructural (sic) improvements.”
- “Build on and expand transportation choices that ensure convenience, safety, and access.”

Proposed Sustainability Element to Master Plan: This document is being developed through the Montclair Township Environmental Affairs Office. It is expected to include an AFV component. The township has been active in promoting sustainability in the past and is looking to advance AFV use as part of its Master Plan and to reflect those efforts in the Sustainability Element.

Zoning and Parking Codes

Through zoning codes, design standards, and parking rules, local governments have the opportunity to ensure both that there are sufficient charging opportunities to meet projected PEV demand and that PEV parking spaces are effectively designed and regulated to accommodate charging vehicles. Zoning codes can allow, encourage, or require appropriate placement of charging infrastructure in certain land use designations. Zoning code provisions, design standards, and parking rules can also specify

²³ Note that incentives are addressed in more depth in the Incentives and Funding section below.

requirements for design and installation, signage, accessibility, fees, time limits, lighting, and maintenance.

Local zoning provides for the direct implementation of land use policy in a community by setting standards and guidelines for land development. While PEV charging stations are generally not considered independent land uses in and of themselves, they have implications for site function and character. In terms of site functionality, they are a distinct element of the parking supply, impacting site circulation, including pedestrian circulation and safety and handicap access. Infrastructure for charging PEVs is, therefore, an important element of site planning and design in terms of location, scale, and relationship to overall site use. Consequently, it is to a community’s advantage to address charging infrastructure in the course of zoning language in general and parking requirements and site plan review in particular. Zoning also offers an opportunity to include incentives for site design as a tool to encourage accommodations for PEV use.

The township’s forms for requesting a zoning permit and submitting a development application do not include any references or requirements to indicate the intent to provide PEV charging infrastructure. Zoning codes and related redevelopment plans are laid out below:

Montclair Zoning Code: The Montclair regulations have no specific language relative to charging infrastructure. Yet, they do require more detailed site design review for all parking lots, decks, and garages. This gives the zoning authority the opportunity to examine any planned developments for inclusion of PEV parking spaces and charging stations. More explicitly, when a site plan is submitted as part of a conditional use application, it requires that information on any planned parking facilities is shown in the plan. While proposed PEV charging stations are not specifically mentioned in the regulations, any plans for parking lots or facilities would need to identify them if the charging stations are intended to help meet parking supply requirements.

Chapter 281 for Site Plan Review in the Montclair zoning ordinance has a dedicated section for parking areas and driveways, which governs the requirements for such spaces. Additionally, Planning Board applications, under § 202-29.2 “Checklists” requires parking information for major site plan and subdivision applications.

Redevelopment Plans: There are three redevelopment plans for discreet areas of Montclair Township that include requirements for accommodating PEVs. Each does so in a somewhat different way with the distinctions among them noted below. As these plans serve as the zoning requirements for these areas, they directly affect efforts to incorporate PEV charging infrastructure in those areas. Each of these plans has similar parking requirements relative to PEVs:

- **Hackensack University Medical Center (HUMC)/Mountainside Hospital Redevelopment Plan (2016):** At least two spaces must be provided for PEV charging. It does not require that the charging stations be installed, just that the spaces be provided.
- **Seymour Street Redevelopment Plan (2016):** PEV charging stations are a stated permitted use. All parking facilities within the Redevelopment Area must include a minimum of two PEV charging stations as well as the infrastructure necessary to support additional charging facilities to accommodate future demand (e.g., conduit). The car-charging facilities are the responsibility of the redeveloper.

- **Montclair Center Gateway Phase 1 Redevelopment Plan (2011):** Public or private parking structures, owned or operated by a public agency or private entity, including parking, docking, and charging stations for PEVs or shared vehicles, are considered an accessory use and are regulated as such. This means they are a permitted land use in association with and in addition to the principal land use on a lot. There are development standards which apply to accessory uses, relative to size and location in relation to the principal use. In the case of this plan, a PEV charging station, as an accessory use, may be located on another lot separate from the lot where the principal use is situated; so a building may have its parking lot on a separate parcel and the PEV charging stations also are permitted to be located on that separate lot.

Parking Ordinances & Codes

Local parking ordinances and codes are used to regulate parking structures and parking behavior. Montclair has several parking ordinances and codes that reference PEVs. Chapter 230: Parking Lots (Montclair Township Code of Ordinances) governs parking lots overall, and Article I under this chapter governs parking permits, which are authorized by the Montclair Parking Utility. Sequential Articles under Chapter 230 addresses Crescent Deck, Church Street Parking Lot, and Lloyd Road Parking Lot, with no specific reference to PEVs for these lots.

However, Chapter 230 does specifically cite PEVs:

- The township, from time to time, shall set aside and designate for each said permit parking area in each of the respective parking lots such number of parking spaces as may be reasonably necessary to accommodate the needs of the public, with due regard for the requirements of the public for metered parking spaces and for recharging of PEVs. Reference: § 230-3 “Number of spaces.”
- Regulation regarding the use of PEV spaces and required signage. Reference: § 230-3.1 “Reserved parking for recharging electric vehicles.”
- A PEV is defined as “Any car, truck, or other vehicle that does not produce tailpipe or evaporative emissions or is a plug-in hybrid electric vehicle (PHEV).” Reference: § 230-9 “Definitions.”

There are several issues within these ordinances that may become obstacles in the future. The first is the restriction on accessory structures or any off-street parking area found in the zoning ordinances. This limits the location of structures or areas between the main building and the street, which may affect potential to provide charging infrastructure in the future. Additionally, the installation of PEV charging stations may fall under electrical fixtures and devices under § 121-4, Fee schedule. That said, if this does happen, the associated fees do not seem overly prohibitive.

As discussed later as part of the recommendations in [Section 3](#), there are a number of opportunities inherent in partnering with the Montclair Center Special Improvement District (Montclair Center Corporation). Similar to other improvement areas found throughout New Jersey, Montclair Center Corporation is a district management corporation. It has the power to undertake improvements for parking areas and facilities, as well as provide special parking arrangements for the district subject to prior Township Council approval.

Parking Authorities

Parking authorities are generally established to manage the public parking supply – set rates for parking space use and time limits – and conduct enforcement. Ideally, one municipal agency oversees the use of PEV parking and enforcement. The Montclair Parking Utility (Article XIVB – Montclair Township Code of Ordinances) could serve this role. The Montclair Parking Utility has been engaged in the readiness planning process and is committed to collaborating with the township and other stakeholders to enable additional charging stations within municipal parking lots.

Permitting and Inspection

Streamlined permitting and inspection processes are key to PEV planning. These processes can help expedite the installation of charging stations at appropriate locations, provide the service at a reasonable cost to consumers, and maintain the safety of consumers and the public.

The New Jersey Clean Cities Coalition (NJCCC) has worked with the New Jersey Department of Community Affairs (NJCA), the agency that oversees the statewide code, to clarify and, where possible, streamline the permitting process for PEV charging stations. In 2011-2012, NJCA published an article, *“Electric Vehicle Charging Stations – What you need to know,”* which is the most recent guidance available from the state on the installation of PEV charging stations at residential locations. The article includes Table 5 showing when construction permits and inspections are required for the installation of PEV charging infrastructure.

Table 5. New Jersey Permit Requirements for Charging Stations²⁴

Project	Permit Required	Inspection Required	Classification
Existing outlet is sized correctly but plug configuration is not compatible with equipment plug necessitating the replacement of the outlet to one with proper configuration.	No	No	Ordinary Maintenance NJAC 5:23-2.7(e)3 http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
Upgrade circuit breaker and wire to higher rating (15 amp to 20 amp)	Yes ¹	Yes ²	Minor Work NJAC 5:23-2.17A http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
Vehicle charging system being installed that requires new 120 or 240 volt outlet or an electrical line that will be directly connected to the system.	Yes ¹	Yes ²	Minor Work NJAC 5:23-2.17A http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
1 - The issuance of a construction permit is not required before the work may proceed. However, the owner or electrical contractor acting on behalf of the owner must notify the local code enforcing agency before the work begins. Also, a permit application must be filed and must be delivered in person or by mail within five business days from the date of oral notice.			
2 - An inspection must be performed within 30 days of the request for inspection and is based upon what is visible at the time of the inspection with the certificate of approval stating so.			

Another NJDCA article provides more detailed information on permitting for residential PEV charging stations: *“Electric Vehicle Charging Stations – Installation and Permit Requirements”* (in NJDCA’s Construction Code Communicator, Vol. 23, Number 1, Spring 2011). NJDCA provides contacts for additional information regarding the installation of PEV charging stations: NJDCA, Division of Codes and Standards, Code Assistance Unit at (609) 984-7609.

In June 2011, NJDCA announced the results of its review of applicable state codes and regulations and determined that installation of residential PEV charging equipment is considered “minor work”, i.e., the homeowner or contractor need only provide verbal notification to the local code enforcement agency prior to starting the installation and submit the permit application within five days of notification, so they do not have to wait up to three weeks for permit approval.

The challenges associated with local permitting and inspection of PEV charging infrastructure vary depending on the type of property at which the infrastructure will be located. For PEV charging, factors include whether it is at a single-family residence, at a MUD, or a commercial property. Since the majority of demand for PEV charging infrastructure is likely to be at privately owned residences and workplaces, local governments can support successful large-scale deployment of PEVs by being

²⁴ NJDCA, *Electric Vehicle Charging Stations – What you need to know*, http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

prepared to handle increased volumes of permit requests for charging infrastructure installations in an efficient and safe manner.

The main approval process applicable to AFV infrastructure installation is the issuance of permits relative to the building code, and sub-codes relating to electrical, fire, etc., whose application contents and process requirements are set out in state law. New Jersey municipalities are responsible for administering and enforcing the state codes through state-mandated permitting and inspection processes.

Montclair has not yet developed processes for administering building codes or electrical subcodes specific to the installation of PEV charging infrastructure. The list below summarizes key permitting process characteristics for Montclair Township:

- **Time to Issue Permit:** 20 business days, typically (which does not include necessary prior approvals)
- **Permit Fee:** Dependent on sub-code and installation type
- **Permit Availability:** Applications are online; must be accompanied by a construction permit folder, which is available over the counter only
- **Permit Staff Training:** Electrical Inspector is aware of the guidelines; no additional training specific to PEV charging infrastructure

Building Codes

Building codes contain safety standards and specifications that guide new construction and renovations. NJDCA, specifically the Division of Codes and Standards, establishes and enforces statewide building codes—referred to as the Uniform Construction Code (UCC). There are two major opportunities to create building codes that support PEV deployment. The first is to specify standards for PEV charging infrastructure in the building code to ensure that any charging station installations are safe and accessible. The second is to require pre-wiring for charging stations to lower the cost of future installations. Pre-wiring refers to the practice of providing sufficient basic infrastructure, such as conduits, junction boxes, outlets serving garages and parking spaces, adequate wall or lot space for future charging infrastructure, and adequate electrical panel and circuitry capacity, to meet anticipated future charging demand.

Municipalities like Montclair are limited to the statewide UCC, and are therefore not in a position to take a more progressive approach to building codes as they are related to PEVs or other issues. Some municipalities have taken steps to advocate for UCC updates that incorporate PEVs where appropriate and feasible.

Incentives and Funding

There is a variety of financial support at the federal, state, and local levels for individuals and local fleets interested in investing in PEVs and charging infrastructure. These include financial incentives, such as tax credits, vehicle rebates, and insurance discounts, as well as non-financial incentives, like high occupancy vehicle (HOV) lane access. This section provides an overview of each primary form of financial support as

well as who the funding is available for (consumers, businesses, non-profits, and/or public entities may be eligible for any given program).

Additional funding opportunities and incentives may emerge in the future, such as state-level programs funded through the Volkswagen Clean Air Act Settlement and auto manufacturer partnerships to offer vehicle purchase price discounts. The New Jersey Department of Environmental Protection (NJDEP) has established a website to provide more information for New Jersey.²⁵

Volkswagen Clean Air Act Settlement

The Volkswagen (VW) Settlement established two funding sources that may result in AFV deployment and infrastructure support in and around Montclair Township.

- ZEV Investment Plan: VW, through a newly formed entity called Electrify America, will install, operate, and maintain ZEV infrastructure nationwide, initially focusing on 11 major metropolitan areas. The New York City metro area, which includes Montclair Township, will receive the following benefits:
 - Level 2 charging installation at MUDs, workplaces, and public sites
 - DC fast charging facility installation on highway and other transportation corridors
 - Education and outreach that builds or increases public awareness of ZEVs
- Environmental Mitigation Trust: The State of New Jersey is eligible to receive and use approximately \$72 million in funding. While the specific program in New Jersey has yet to be established or implemented, these funds could be used to replace polluting diesel equipment with cleaner vehicles, including local freight trucks, transit buses, school buses, shuttle buses, and refuse trucks. A certain portion of these funds could also be used to install PEV charging stations.

For more information, see www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement.

Incentives for Vehicle Purchasers

Vehicle purchase incentives typically help to reduce the upfront cost of a qualified PEV, either at the point-of-sale or later. Other variations of vehicle purchase incentives include cost reductions, fee waivers, and other special privileges associated with the vehicle. Some utilities, for example, offer reduced charging rates for eligible PEV drivers. Table 6 provides an overview of the available incentives for PEV purchasers in New Jersey.

²⁵ See <http://www.state.nj.us/dep/vw/>.

Table 6. Incentives for PEVs

Type	Incentive/Program	Funder/Administrator	Eligible Entities	Timeline	Incentive Summary
Federal	Plug-In Electric Drive Vehicle Tax Credit	IRS	Individuals, businesses, government entities	Available, deadline not specified; phases out based on sales	\$2,500-7,500, depending upon battery capacity. Tax credit can be combined with state level rebates.
Federal	Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Federal Highway Administration	State DOTs, MPOs, local governments, transit agencies	As funds are available	The CMAQ program provides funding (via DOTs and MPOs, including the NJTPA) for eligible transportation projects that contribute to air quality improvement and congestion relief. Publicly owned AFVs, such as PEVs, are eligible for CMAQ funding; however, vehicles must provide a dominant transportation function.
State	ZEV Tax Exemption	NJ Division of Taxation	Individuals, businesses	Timeline not specified	ZEVs sold, rented, or leased in New Jersey are exempt from state sales and use tax. This exemption is not applicable to partial ZEVs, including HEVs.
State	HOV Lane Exemption and Toll Discount	NJ Turnpike Authority (NJTA)	Individuals, businesses, government entities	Expires September 30, 2019	The NJTA allows qualified PEVs to travel in the HOV lanes located between Interchange 11 and Interchange 14 on the New Jersey Turnpike. The NJTA offers a 10 percent discount on off-peak New Jersey Turnpike and Garden State Parkway toll rates through NJ EZ-Pass for drivers of vehicles that have a fuel economy of 45 miles per gallon or higher and meet the California Super Ultra Low Emission Vehicle standard.

Incentives for Charging Infrastructure Deployment

Incentives and financing options are available to help defray the costs of deploying charging infrastructure. Some programs aim to reduce or eliminate the cost of eligible equipment (e.g., Level 2 charging station) while others provide funding for equipment and installation costs. Table 7 includes an overview of the available incentives for PEV charging infrastructure deployment in New Jersey. In addition, programs such as the NJDEP NJ Charging Challenge provide special recognition to employers making their workplaces PEV ready.²⁶

²⁶ For more information, see www.drivegreen.nj.gov/programs.html.

Table 7. Incentives for PEV Charging Infrastructure

Type	Incentive/ Program	Funder/ Administrator	Eligible Entities	Timeline	Incentive Summary
Federal	Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Federal Highway Administration	State DOTs, MPOs, local governments, transit agencies	As funds are available	The CMAQ program provides funding (via DOTs and MPOs, including the NJTPA) for eligible transportation projects that contribute to air quality improvement and congestion relief. PEV charging infrastructure may be eligible for CMAQ funding.
Federal	Low and Zero Emission Vehicle Research, Demonstration, and Deployment Funding	Federal Transit Administration	Local, state, and federal government entities; public transportation providers; private and non-profit organizations; and higher education institutions	Not specified	Financial assistance is available for research, demonstration, and deployment projects involving low or zero emission public transportation vehicles. Funding may cover up to 80% of project costs, with a required 20% non-federal cost share requirement. Eligible vehicles must be designated for public transportation use and significantly reduce energy consumption or harmful emissions compared to a comparable standard vehicle.
State	Workplace Charging Station Grants	NJDEP and New Jersey Board of Public Utilities (NJBPU)	Businesses, nonprofits, government entities	As funds are available	Reimbursement grants are offered on a first-come, first-served basis for the cost and installation of eligible charging stations at workplaces, government and educational facilities, nonprofits, and parking facilities. Funding up to \$250 is available for each Level 1 charging stations installed and up to \$5,000 for each Level 2 charging stations installed. Current funding has been allocated as of January 2017, though interested applicants may be put on a waitlist in anticipation of additional funding.
Utility	Workplace Charging Station Incentives	PSE&G	Businesses, nonprofits, government entities	As funds are available	PSE&G provides free charging stations to companies in their service territory for the purpose of workplace charging. Chargers are available on a first-come, first-served basis to companies that secure a commitment from at least five employees who will use a PEV for their commute. PSE&G will own the chargers and collect usage data.
Nonprofit	Sustainable Jersey Small Grants	Sustainable Jersey	Municipal governments	As funds are available	Grants are available to help municipalities achieve progress toward Sustainable Jersey certification and general sustainability. Eligible projects must align with actions for which municipalities could score points toward certification, such as “Make Your Town Electric Vehicle Ready” and “Public Electric Vehicle Charging Infrastructure.”

2 Natural Gas Vehicles and Fueling Infrastructure

Overview

While PEVs primarily serve the light-duty consumer market, the NGV industry targets the medium- and heavy-duty fleet sectors. Following an initial surge in NGV interest in the mid- to late-1990s, natural gas fueling infrastructure increased steadily from approximately 750 stations across the country in 2007 to more than 1,800 in 2016.²⁷ The use of natural gas as a vehicle fuel grew by 75 percent in that same period.²⁸ Incentives and investment from industry have been important drivers for this growth. Natural gas only accounts for 3 percent of transportation fuel (based on energy content).²⁹ Additional development of this market is focused on strategic deployment of NGVs in appropriate fleets. For example, nationwide, CNG vehicles account for 35 percent and 55 percent of the transit bus and refuse truck markets, respectively.^{30,31}

The deployment potential for natural gas vehicles is mainly linked to the medium- and heavy-duty truck fleet market sectors. For instance, as part of the American Recovery and Reinvestment Act, the NJCCC led a statewide public/private partnership — including Clean Energy, Atlantic County Utilities Authority, Waste Management of New Jersey, Atlantic City Jitney Association, Central Jersey Waste & Recycling, and others — that put more than 300 NGVs on the road in refuse and shuttle bus applications, and included the development of six CNG fueling stations. There are significant market barriers to more widespread use of natural gas in the transportation sector. These are not unique to any particular township or municipality. Rather, they are a function of issues outside the purview of local governments.

Vehicles and Infrastructure in New Jersey and Montclair

Given that the primary market sectors for NGVs are medium- and heavy-duty vehicles, municipal NGV readiness planning is more limited than the consumer focus of PEVs. That said, NGV readiness involves close coordination with the gas utility; adopting policy language that will support natural gas (and, more broadly, alternative) fueling stations; creating a regulatory framework for NGV fueling infrastructure; and possibly incentivizing or requiring NGVs. Several locations across New Jersey, for example, have provided bid preferences for municipal contractors (e.g., trash collection) who use natural gas or other AFVs. Montclair Township has had light-duty CNG vehicles for use by traffic enforcement personnel, however those vehicles are no longer supported by the manufacturer and are being phased out of the municipal fleet.

²⁷ U.S. DOE, U.S. Alternative Fueling Stations by Fuel Type, <http://www.afdc.energy.gov/data/10332>. Accessed April 3, 2017.

²⁸ U.S. Energy Information Administration (EIA), U.S. Natural Gas Vehicle Fuel Consumption, <https://www.eia.gov/dnav/ng/hist/n3025us2m.htm>. Accessed April 3, 2017.

²⁹ U.S. EIA, Energy Use in Transportation, http://www.eia.gov/energyexplained/?page=us_energy_transportation. Accessed April 3, 2017.

³⁰ NGVAmerica, Transit, <http://www.ngvamerica.org/vehicles/for-fleets/transit/>. Accessed April 3, 2017.

³¹ NGVAmerica, Refuse, <http://www.ngvamerica.org/vehicles/for-fleets/refuse/>. Accessed April 3, 2017.

According to the most recent report by the NJCCC,³² there are just over 1,000 light- and heavy-duty NGVs in New Jersey. Although this list is not exhaustive, it represents a robust estimate of the NGVs registered statewide. As mentioned above, two of these NGVs are owned by Montclair Township, but are being phased out. Of the vehicles reported, more than 85 percent are heavy-duty vehicles; and of those heavy-duty vehicles, more than 50 percent are refuse or transit vehicles. More granular data, specifically at the municipal level, is not readily available. The NJDEP provides NGV estimates, but the counts are inclusive of propane vehicles.³³

Of the 28 CNG fueling stations in New Jersey as of October 2017, 13 are accessible to the public and 15 are meant for private (i.e., fleet only) use. There are no liquefied natural gas (LNG) fueling stations in New Jersey.³⁴

Montclair Township owns and operates one private CNG station at the Department of Community Services Yard on North Fullerton Avenue. This time-fill CNG station was used to fuel the township's two light-duty NGVs, which are now out of commission. It is the only natural gas fueling station in the township.

Barriers to Increased Natural Gas Vehicle Use

Deploying NGV technology offers numerous benefits as compared to gasoline and diesel vehicles, including emissions reductions and improved air quality. However, there are substantial barriers to NGV implementation that impede progress towards more significant deployment. Understanding the key barriers below can help municipalities and fleet owners plan wisely and act accordingly.

Low Gas Quality for Transportation Applications

Natural gas in common carrier pipelines has a variety of end uses — space heating, industrial processes, electricity generation, and as a transportation fuel (after compression). Natural gas quality in the pipeline transmission system can vary depending on a number of factors. In the northern PSE&G territory, including Montclair Township, there have been gas quality issues linked to the presence of refinery gas in the pipeline, a function of an agreement between PSE&G and the Bayway Refinery (Phillips 66) in Linden, New Jersey. Furthermore, during periods of peak gas demand (i.e., extremely cold winter days), PSE&G often supplements its natural gas supply by adding propane to the distribution system. Both of these issues hinder the use of pipeline natural gas as a transportation fuel since higher quality gas is required for combustion in heavy-duty CNG vehicles. Similarly, the combustion engines in CNG vehicles are not designed to manage the potential blend of propane and natural gas.

As of September 2017, PSE&G no longer accepts Bayway Refinery gas into its system.³⁵ However, it is unclear if this alone will resolve the gas quality issue hampering NGV adoption in the region.

³² U.S. DOE, 2016 Transportation Technology Deployment Report: NJCCC, March 2017.

³³ NJDEP, Natural Gas Vehicle Distribution, <http://www.nj.gov/dep/cleanvehicles/Alt-Fuel%20Vehicles%20&%20Stations%20-%20Natural%20Gas.pdf>. Accessed October 20, 2017.

³⁴ U.S. DOE, Alternative Fuels Data Center, Station Locator, <http://www.afdc.energy.gov/locator/stations/>.

³⁵ Kenny Esser, PSE&G, via email communication, September 6, 2017.

Lack of Incentives

Although there are certain applications of NGVs that provide attractive payback periods compared to their diesel counterparts (after accounting for fuel and operational savings), the incremental cost of purchasing an NGV compared to a diesel or gasoline vehicle remains an impediment to increased use. Part of this is due to the lack of sustained state incentives for the purchase of cleaner-burning NGVs. Across the country, states are encouraging increased use of AFVs and AFV infrastructure through incentives, such as vouchers, rebates, and grants. In addition, many jurisdictions allow preferences in public procurements for those bidders that use, or pledge to use, AFVs in executing their contract. Funding resulting from the VW Environmental Mitigation Trust mentioned previously may be used for NGVs and fueling infrastructure, depending on the state's implementation approach. The NJBPU has also provided grants for commercial NGVs in specific counties.³⁶

Fuel Price Differential

The increase in accessible supply of natural gas in the 2010-2011 timeframe contributed to a significant price differential between diesel and natural gas. Because NGVs have a higher incremental cost due to the expense of specialized fuel systems and fuel tanks, the payback period is greatly dependent upon the lower cost of natural gas relative to diesel and gasoline. While the low price of diesel has extended this payback period, as diesel prices rise, the price differential will help improve deployment potential. The diesel fuel tax increase in New Jersey, enacted in October 2016, gives a further advantage to NGVs. One clear economic advantage of natural gas is the relative price stability, which is an important factor to consider for a fleet manager or business owner. The commodity price for natural gas makes up a relatively small portion of the price for CNG at the pump. For example, an increase of \$1.50 per million British thermal units (MMBtu) in the cost of natural gas translates to only a \$0.25 increase per diesel gallon equivalent (DGE) at the pump. Diesel, on the other hand, suffers price spikes because the raw commodity makes up a much larger portion of the price at the pump. Although the price of natural gas is much more stable than that of petroleum fuels, the price differential is often not sufficient to offset the higher upfront cost. Absent incentives and improved accessibility to fueling infrastructure, truck owners and fleets have been reluctant to convert to CNG vehicles.

Market Outlook in Montclair

The NGV market outlook in Montclair is inextricably tied to the three barriers outlined above. Further, these three issues are linked to market forces beyond the purview of municipal governments: Local governments like Montclair have no control over gas quality (this is under the purview of the gas utility); resource constraints at the local level limit the ability of municipalities to incentivize NGVs to spur adoption; and lastly, local governments have no influence over commodity energy prices. Until these issues are addressed by other market actors, Montclair, and communities like it, will likely be best served by relying on local partners, such as the NJCCC, for relevant information and updates.

³⁶ NJBPU. CNG Vehicle Grant Program. <http://www.nj.gov/bpu/commercial/cng.html>. Accessed October 23, 2017.

Potential for Renewable Natural Gas

Renewable natural gas (RNG) is produced over a series of steps — namely collection of a feedstock (such as waste or manure), delivery to a processing facility for biomass-to-gas conversion, gas conditioning, compression, and injection into a common carrier pipeline. RNG can be combusted to generate on-site electricity and be used to fulfill renewable energy goals and requirements. Over the last several years, however, there has been considerable growth in the use of RNG in the transportation sector. This is linked in large part to the U.S. Environmental Protection Agency’s (EPA) determination in 2013 that RNG is an eligible fuel under the federal Renewable Fuel Standard (RFS).³⁷ Feedstocks for RNG include, but are not necessarily limited to landfill gas, municipal solid waste, animal manure, agricultural residue, and forestry or forest product residues.

The introduction of RNG into the transportation sector has the potential to allay some of the local and regional concerns linked to the GHG emissions and other potential environmental impacts from fossil natural gas use. The GHG footprint of RNG is linked to the feedstock, location of the facility relative to the end user, and the type of vehicle in which the fuel is used. RNG from landfill gas, for instance, reduces GHG emissions by about a factor of two to three when compared to conventional diesel fuel on a lifecycle basis. RNG from animal manure can reduce GHG emissions even more by capturing methane — a GHG pollutant with 25 times the global warming potential of carbon dioxide — that would have otherwise been vented into the atmosphere.

The NGV industry and the RNG industry are advocating around the prospects of pairing the low carbon fuel with a recently certified engine for medium- and heavy-duty vehicles from Cummins Westport, the ISL G 8.9 liter engine. This engine is appropriate for many applications in the goods movement sector, including short and regional haul applications, as well as in refuse hauling applications. This engine received certification from the EPA at levels 90 percent lower than the current standard for nitrogen oxide (NOx) emissions of 0.20 g/bhp-hr.³⁸ In other words, pairing RNG with the so-called low NOx engine has the potential to reduce criteria pollutant emission reductions, reduce GHG emissions, and decrease petroleum consumption.

Regulations

This section provides an overview of Montclair’s community plans as they relate to facilitating AFVs in the community and to identify any language that supports the use of AFVs – NGVs in particular. It also reviews provisions in Montclair’s local zoning regulations for their potential to affect installation of AFV infrastructure, such as parking, site plans and site development, and environmental performance standards (noise, air quality, etc.). While most of the relevant language and provisions are related primarily to PEVs (described in [Section 1](#)), there is also some regulatory language that applies more broadly to AFVs, including NGVs and natural gas fueling infrastructure.

³⁷ In 2015 the EPA determined that RNG from landfill gas (LFG) is eligible to generate renewable identification numbers (RINs; the currency of the federal RFS program) in the category labeled as cellulosic biofuels or D3 RINs. These are the highest value RINs in the RFS market.

³⁸ The NOx emission standards for engines are established in units of grams of pollutant per brake horsepower hour (g/bhp-hr).

Local Community Plans

Local community plans are forward-looking documents that both define a community's vision for the future and respond to anticipated future conditions with strategies and related actions. Community plans can proactively facilitate and encourage AFV use. They can do so by establishing policies that support AFV fueling stations as a key element of the local transportation system.

Montclair Township has two relevant long-range plans that consider transportation, which contain some language supportive of AFV use:

Montclair Township Unified Land Use and Circulation Element (2015, Municipal Land Use Center at the College of New Jersey): This plan focuses, in large part, on ways to enhance non-automobile travel. It does, however, have the following relevant goals and policies:

- “Ensure that future growth and development in the Township is met with supportive infrastructural (sic) improvements.”
- “Ensure a variety of land uses and transportation modes that pursue a balanced mix of activities and vibrancy.”
- “Build on and expand transportation choices that ensure convenience, safety, and access.”
- “Advance an interconnected travel system utilizing all forms and combinations of travel to access key destinations in and outside the community.”

Proposed Sustainability Element to Master Plan: This document is being developed through the Montclair Township Environmental Affairs Office. It is expected to include an AFV component. The Township has been active in promoting sustainability in the past and is looking to advance AFV use as part of its Master Plan and to reflect those efforts in the Sustainability Element.

Zoning Codes

Local zoning provides for the direct implementation of land use policy in a community by setting standards and guidelines for land development. Fueling stations for NGVs can be complex, particularly those with public accessibility. Natural gas fueling stations are often included with other large scale fueling facilities or complexes in terms of defined land uses and would be considered part of both allowable uses and site design for those facilities. Infrastructure for fueling NGVs is, therefore, an important element of site planning and design in terms of location, scale, and relationship to overall site use. Consequently, it is to a community's advantage to address AFV infrastructure in the course of zoning language in general and parking requirements and site plan review in particular. Zoning also offers an opportunity to include incentives for site design as a tool to encourage accommodations for AFV use.

The township's forms for requesting a zoning permit and submitting a development application do not include any references or requirements to indicate the intent to provide AFV infrastructure. The zoning code is as follows:

Montclair Zoning Code: The Montclair regulations have no specific language relative to AFV infrastructure. Yet, they do require more detailed site design review for all parking lots, decks, and garages. This gives the zoning authority the opportunity to examine any planned developments for

inclusion of AFV parking spaces and fueling or charging stations. More explicitly, when a site plan is submitted as part of a conditional use application, information on any planned parking facilities is required to be shown on the plan.

Chapter 281 for Site Plan Review in the Montclair zoning ordinance has a dedicated section for parking areas and driveways, which governs the requirements for such spaces. Additionally, Planning Board applications, under § 202-29.2 “Checklists” requires parking information for major site plan and subdivision applications.

3 Recommendations and Steps to Implementation

This section recommends actions Montclair Township can take in order to facilitate AFV use and meet the future infrastructure demands.

Each recommendation correlates with the demand for charging or fueling infrastructure discussed throughout the previous sections of this plan. In the case of PEVs, recommendations are distinguished by their role in residential charging, MUD charging, workplace charging, and public charging. The recommendations are similarly distinguished by planning areas — general plans and policies, building codes, zoning and parking codes, permitting and inspection, and fleet planning. Furthermore, for each recommendation, a lead organization or stakeholder has been identified, distinguishing largely between local government, regional agencies, and utilities.

The time horizon for the recommended actions is 10 years, with actions that may be ongoing, as well as those to be implemented in the near-term (1-2 years), medium-term (3-5 years), and long-term (6-10 years). Montclair Township and its stakeholders should refer to their AFV readiness goals as they determine which activities are priorities now and in the future.

Several recommendations appear multiple times, though with different steps to implementation depending on the targeted infrastructure. These recommendations include the identification of grants and other funding opportunities, and conducting targeted outreach to install charging infrastructure at high-priority locations.

Stakeholder input has helped to shape the recommendations in this section. During the interactive portion of Montclair’s second SAC meeting, participants provided input on and discussed a series of strategies that could be included in the readiness plan. This exercise aimed to:

- Broaden stakeholders’ understanding of the strategies available to enhance AFV readiness;
- Gather feedback on the AFV strategies that may be best suited to the community; and
- Help determine priority areas and areas of emphasis to be highlighted in the Montclair readiness plan.

Technical Assistance Resources

New Jersey is home to several established organizations that are well-versed in AFVs, community planning, sustainability, and other topics relevant to AFV readiness. These groups can provide technical assistance to support many of the recommended activities. They include:

New Jersey Clean Cities Coalition – a fuel neutral, nonprofit organization promoting partnerships that advance the use of alternative fuels. See www.njcleancities.com.

Sustainable Jersey – a nonprofit organization supporting community sustainability efforts through tools, training, and incentives. See www.sustainablejersey.com.

Stakeholders considered five groups of strategies, described in detail below. Prior to voting, participants were asked to briefly evaluate the strategies based on the following three criteria as they pertained to Montclair:

- The strategy is/strategies are feasible.
- The strategy/strategies could be implemented in a timely fashion.
- The strategy/strategies could be effective at increasing AFV opportunities in the community.

The Montclair SAC input can be summarized as follows:

1. Conduct Community Education and Outreach – Stakeholders thought these strategies met all three criteria. Education and outreach would likely target MUD owners/managers and employers.
2. Adopt Community-wide Policies – Stakeholders agreed these strategies met all three criteria, and the Township is already implementing some of the recommended policies, or planning to do so.
3. Facilitate Municipal Infrastructure and/or Public-Private Collaboration – Stakeholders thought these strategies met all three criteria, and that the business improvement district would need to play a central coordination role.
4. Amend the Zoning Code to Include Requirements or Incentives for AFV Infrastructure – Stakeholder responses indicated these strategies would meet all three criteria, depending on the strategy and implementation. The Township is supportive of zoning code amendments that encourage AFV infrastructure.
5. Modify Approval Processes – Stakeholders indicated these strategies could meet multiple criteria, though streamlining processes for multi-family buildings would take priority over single-family residences.

The priorities, opportunities, and challenges identified and discussed helped determine the recommendations presented in this section.

Whenever possible, recommendations point to specific resources that are available to help guide and assist the township's implementation. See the examples mentioned throughout this section, as well as [Appendix E](#), which is a collection of PEV readiness resources developed by or in partnership with the DOE. The forthcoming NJTPA guidebook on AFV readiness will serve as a key resource for Montclair Township and other municipalities throughout North Jersey.

General Market Support

Due to the myriad considerations involved in PEV adoption — consumer behavior, gasoline pricing, vehicle pricing, etc. — deployment will be linked to factors beyond the purview of local and regional governments, utilities, and other stakeholders. Similarly, NGV adoption is closely linked to fuel prices and vehicle cost. However, Montclair Township has an opportunity to support infrastructure development through planning, coordinating education and outreach efforts, collaborating with utilities, and leading by example. Table 8 highlights the recommendations that will provide general market support to AFVs.

Table 8. General Recommendations to Support the Market for Montclair AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Create cross-jurisdictional opportunities for sharing lessons learned	Ongoing	Montclair Township in partnership with neighboring municipalities
	Update the PEV infrastructure demand analysis	Ongoing	Montclair Township
	Collaborate with PSE&G to share market information	Ongoing	Montclair Township, PSE&G
	Conduct community education and outreach to increase awareness about the benefits of AFVs and the role they can play in decreasing transportation costs and achieving environmental goals	Near-term	Montclair Township
	Establish design criteria for AFV infrastructure	Near-term	Montclair Township
	Integrate AFV readiness into local planning efforts, including general plans and climate action plans, to support AFV infrastructure development	Near- to medium-term	Montclair Township
Permitting & Inspection	Streamline and expedite approval processes	Near-term	Montclair Township
	Educate permitting, inspection, and first responders in AFV station basics	Near-term	Montclair Township
Fleet Planning	Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities for fleet AFVs	Medium-term	Montclair Township
	Provide technical assistance and training to local fleet managers	Medium-term	Montclair Township

General Plans & Policies

Create cross-jurisdictional opportunities for sharing lessons learned

The NJTPA region encompasses many local governments, each with its own challenges and experiences with AFV adoption. Montclair stands to benefit from sharing best practices and lessons learned from stakeholders. Successful collaboration and information-sharing will require Montclair to invest the time and resources necessary to actively engage with its neighbors, and creating and sustaining a network of stakeholders who work on AFV-related issues will help strengthen AFV readiness in both the municipality and throughout the region. Sustainable Jersey provides one such forum, and Montclair is already a leader in their participation. The township can leverage Sustainable Jersey’s network and engage with the Essex County Hub, a group of green team and environmental commission members, as

well as government, business, and community leaders. This group and Montclair Township can potentially learn from each other and support efforts going forward.

There are two broader initiatives of which Montclair and its partners should be aware related to AFVs and AFV readiness, namely:

- At the state level, ChargeVC was recently formed as a coalition of car manufacturers, technology companies, utilities, consumer advocates and non-governmental organizations to promote PEV use in New Jersey.
- The NJCCC formed the New Jersey Natural Gas Vehicle Workgroup committee. Participating members include representatives from gas distribution utilities; vehicle and engine manufacturers; fuel infrastructure providers; transit, refuse haulers and other fleet users of natural gas; and others interested in increasing and strengthening the deployment of low-emission NGVs throughout New Jersey.

Both initiatives provide Montclair with a means to stay updated on developments and opportunities related to complementary activities at the state and regional level, such as alternative fuel corridor planning and utility rate filings.

Update the PEV infrastructure demand analysis

The goal of a demand analysis is to help guide and coordinate future PEV charging infrastructure placement efforts based on anticipated or projected demand for charging infrastructure. The demand analysis included in this plan combines various parameters such as characteristics of PEV ownership and usage, land use, and regional travel patterns. As these characteristics change over time, Montclair Township can work with the NJTPA, the NJDEP, and other stakeholders to regularly update (every three to five years) the analysis with the latest vehicle registration, demographic, and travel demand data so the results remain current and relevant in the context of the likely demand for residential charging, workplace charging, MUD charging, and public charging.

Redevelopment and other projects may result in new parking facilities, so this development should also be considered as part of the ongoing analysis and planning process. Montclair Township's requirement to include PEV charging in redevelopment plans will result in additional infrastructure that will help meet demand for multiple charging demand types.

AFV Registration Data

The NJDEP maintains AFV registration data, coordinating with the NJMVC to provide updated statistics twice a year (January and July). A spreadsheet containing this data is available upon request by sending an email to drivegreen@dep.nj.gov, using the subject line "Vehicle Registration Data Request."

Collaborate with PSE&G to share market information

Montclair Township can take a leading role in the support of PEVs and charging infrastructure by collaborating with the local utility to share relevant market information. This can occur in a variety of ways. For instance, Montclair could integrate the permitting system with a notification protocol for PSE&G. This would help the utility understand where PEVs are being deployed and how they are being charged and plan accordingly.

Moving forward, Montclair Township can seek more proactive ways to engage and collaborate with PSE&G. The regional impacts on the electrical grid (in terms of greater demand for electricity as more vehicles are charging) will likely be negligible for many years. However, unmanaged charging station installations and increased regional PEV ownership in specific areas could negatively affect local electrical distribution systems. One of the primary causes of concern for PEVs is clustering of the load associated with vehicle charging. Utilities generally have a transformer replacement program to regularly target transformers that have reached the end of their useful life or have been identified as grossly overloaded. However, the adoption of PEVs may occur faster in some areas, such as Upper Montclair, thereby potentially altering the utility's transformer replacement program target areas and schedule.

Montclair Township should maintain open lines of communication with the utility as it evaluates its electricity distribution infrastructure and provide insights wherever helpful. When PSE&G upgrades or adds distribution infrastructure, it should consider potential PEV charging demand impacts as part of the analysis and, where possible, make strategic and cost-effective investments. The township can assist in this process by providing valuable perspective and advanced notice regarding anticipated PEV clustering, new construction, and DC fast charging corridors along the way.

Conduct community education and outreach to increase awareness about the benefits of AFVs, PEVs in particular, and the role they can play in decreasing transportation costs and achieving environmental goals

Montclair should develop and distribute educational resources that target the range of relevant audiences: residents, multi-family building owners, employers, fleet owners and managers, and commercial and other developers. Residents of multi-family units are often overlooked for targeted awareness and education activities related to PEVs because it is not often within a resident's power to install charging infrastructure. The township should therefore consider creating materials to inform developers and property managers about the benefits and costs of installing AFV fueling infrastructure during construction as well as the overall benefit of providing the spaces. Additionally, Montclair should consider developing resources that target younger residents, such as student drivers, to teach them about AFV options, particularly PEVs. Even basic information about how much it costs to fuel a PEV can be helpful to start the conversation with any audience.³⁹ Housing all of these resources in one place online will also enable residents to seek out the information on demand beyond active outreach events. While there are no vehicle dealerships located within Montclair Township, those in neighboring communities are likely to serve Montclair residents and would benefit from basic education.

Executing this recommendation would require some financial resources and staff time to prepare materials and conduct outreach, and to maintain the online resource database, but it would be relatively low cost to build upon existing outreach efforts and could be highly impactful over the long-term.

³⁹ One simple yet useful tool is the U.S. DOE's eGallon calculator, which shows the cost of fueling a PEV compared to a similar gasoline vehicle. See <https://energy.gov/maps/egallon>.

Separate recommendations introduced later in this section provide additional detail about more targeted education and outreach specific to MUD, workplace, and public charging.

Establish design criteria for AFV Infrastructure

Adopting AFV infrastructure design guidelines that address the many unique considerations associated with them can go a long way to help charging station and fueling station hosts determine the best configuration for their installations and ensure that installations are safe, follow industry-recommended standards, and are consistent with other community development goals.

Montclair is considering a more specific definition for “electric vehicle charging station” in its regulations in order to be more explicit and informative for developers and others including charging infrastructure in redevelopment plans.⁴⁰ The New Jersey code includes a streamlined permitting process and definitions for PEV charging stations, which Montclair could adapt based on local conditions. Design guidelines will likely vary depending upon the configuration of parking and upon the context in which parking is located, so Montclair will likely need to create multiple sets of PEV parking guidelines that apply to a variety of scenarios.

At a minimum, charging station design criteria should address the following issues:

- Minimum dimensions of PEV parking spaces
- Parking configurations, including guidance on whether it is preferable to locate chargers in perpendicular, parallel, or angled parking spaces, and on the location of wheel stops, guard posts, and signage
- Adopted technical standards that apply to PEV charging stations
- Regulatory signage and signs directing drivers to available PEV parking
- Area lighting
- Clearances, including minimum clearances around chargers to maintain access to controls, as well as on adjacent walkways to maintain pedestrian access. Pedestrian clearance guidelines should include recommendations for keeping sidewalks and walkways clear of cords and cables. Clearance recommendations should also address needs for snow plowing during the winter months.
- Landscaping
- Location relative to other spaces, adjacent land uses, and electrical infrastructure. For example, guidance on locating on-street parking could include language such as “the last space on the block in the direction of travel will usually minimize cord management issues, and places user closer to crosswalks and curb ramps.”
- Additional considerations that apply in overlay zones, such as flood control zones
- Design of disabled access spaces, including requirements for the number of spaces in areas that must be accessible in areas with multiple PEV parking spaces and design standards for accessible spaces.

⁴⁰ Montclair SAC Meeting Minutes. March 7, 2017.

Integrate AFV readiness into local planning efforts, including general plans and climate action plans, to support AFV infrastructure development

Montclair Township should integrate AFV readiness policies and goals into local planning efforts, including general plans, transportation plans, sustainable community strategies, or similar documents. These plans are broader and less detailed than building codes and zoning ordinances, so policies calling for increased charging opportunities typically do not contain specific details on where chargers are needed or on how much charging should be provided. However, even voluntary or broad policies can provide a basis for local governments to negotiate with developers to install chargers during discretionary review, as well as set the stage for more detailed implementation through building codes or zoning ordinances. One example is Woodbridge Township's *Sustainable Community Plan and Climate Action Plan*, included in [Appendix D](#), which could serve as a model for Montclair to develop its own action plan. The township should also consider incorporating this readiness plan and follow-up efforts into its Sustainable Jersey participation, both for recognition and to provide an example to other municipalities.

Taking steps to amend municipal general plans and codes to encourage PEV deployment can be an important step in building consensus among policymakers and the public to support more specific PEV readiness implementation measures. The exact policies that local governments choose to include can range from broadly encouraging increased adoption of PEVs to requiring charging stations at specific land uses or sites where local agencies see development opportunities or anticipate high demand for charging. These policies can also help pave the way to fund plans and capital projects that accelerate the deployment of PEVs. The incremental cost of PEV readiness planning is lower if it is part of a larger-scale effort. For example, tying PEV readiness to local policies can make it easier to allocate different funding streams toward PEV plans and projects. Montclair is already a leader in this regard given the requirements the township has incorporated into redevelopment plans. The township should continue to move in the direction of incorporating explicit language that encourages PEV and charging infrastructure deployment, as well as natural gas. Refer to [Appendix D](#) for example language related to pre-wiring.

Permitting & Inspection

Streamline and expedite approval processes

To remove barriers to charging station installation, Montclair Township should create approval processes that are easy to navigate, fast, and affordable. In the case of commercial and workplace charging stations, reducing permitting fees is particularly effective to incentivize installations by property owners and employers. For both residential and non-residential installations, minimizing permit requirements will reduce the amount of staff time devoted to permit review, which will enable the township to expedite processing and levy lower fees to recover costs.

In particular, the following actions will streamline and expedite the charging station approval process:

- Make permits available online or have copies out and available for people to take;
- Issue required permits within 48 hours;
- Reduce fees for both residential and non-residential installations;

- Issue supplementary guidance, such as residential and non-residential-specific permitting checklists, to help applicants through the permitting process, and post it online for easy access;
- Limit the number of required inspections to one;
- Focus requirements for supporting materials that provide information about the PEV charging system itself (i.e., level of charger, compliance with national standards, proposed location) and electrical service (i.e., existing electrical panel service information, load calculations, whether panel upgrades or a new meter installation are required);
- Do not require site plans for PEV charging station installations in single-family residences;
- Integrate permits with a utility notification protocol to help PSE&G understand where PEVs are being deployed and how they are being charged.

Where possible, Montclair Township should work together with neighboring municipalities to make their processes, fees, and requirements consistent with the rest of the region. Consistency between municipalities will also make it easier and faster for electrical contractors who work throughout the region to permit and install charging stations.

Educate permitting officials, inspection officials, and first responders on the basics of AFV station installation

Providing permitting staff with basic information about PEV charging stations and installations will help them process permits more efficiently and ensure staff can provide property owners with additional information about safety practices and other requirements. Similarly, inspectors would benefit from access to factual information and relevant details specific to Montclair (e.g., public charging locations) since they interface with residents, businesses, and others. The township may consider organizing an educational session focused on codes, safety, standards, site assessments, electric load calculations, permitting processes, and utility notification. Training first responders will ensure that safety procedures are in place in the case of any AFV or fueling/charging station-related emergencies.

The township could work with organizations such as the Electric Vehicle Infrastructure Training Program (EVITP)⁴¹ to organize training sessions on charging station installations and outreach to share local best practices among staff. Montclair Township should also collaborate with neighboring communities, the county, the NJTPA, and others to create an ongoing region-wide schedule of training and outreach events so that stakeholders can stay informed on educational opportunities across the region.

Fleet Planning

Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities for fleet AFVs

Montclair’s municipal fleet included NGVs for many years and, while these vehicles have been phased out, the township has an interest in continuing to support AFVs in its fleet.

Montclair Township should develop a comprehensive fleet management plan that can provide a framework for decision making and investments. The fleet management plan should pull together

⁴¹ Electric Vehicle Infrastructure Training Program. See <http://evitp.org/training/>.

relevant goals and activities (e.g., Sustainable Jersey Green Fleet actions) and include meaningful metrics for measuring progress toward goals. If the township decides to procure vehicles, it should be aware of aggregated purchase options for both vehicles and infrastructure, including the Mid-Atlantic Region initiative under Fleets for the Future as well as EV Smart Fleets.⁴²

Provide technical assistance and training to local fleet managers

Fleet managers often require assistance navigating and weighing the various considerations associated with AFV ownership as compared to conventional vehicle ownership. Local governments can take part in trainings offered by Clean Cities coalitions such as the NJCCC. Beyond providing educational materials, Montclair Township could also organize technical assistance and training workshops in collaboration with the NJTPA and other partners.

Residential Charging

In the near- to mid-term, most PEV charging will occur at drivers’ residences. Today, for instance, about 70-90 percent of charging occurs at home. Furthermore, the majority of residential charging occurs at Level 1 charging, which is particularly attractive because it requires little to no consumer investment. However, as the market evolves, there are a variety of factors that will likely increase the need for more investments in residential charging. For instance, as batteries in vehicles become larger and as utilities seek to play an increased role in managed charging, higher level charging equipment will likely be required. As a result, Montclair Township should monitor and coordinate with PSE&G and other relevant agencies on the electricity demands and potential impacts to the local grid. Table 9 includes this and other key actions the township can take to help support the expansion of residential charging.

It is worth restating that residential charging demand is very market-driven, so Montclair Township’s role in increasing this demand will be limited, allowing the township to focus its efforts on MUD, workplace, and public charging.

Table 9. Recommendations to Support Residential Charging for Montclair AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
Permitting & Inspection	Produce guidance documents outlining permitting requirements for residential PEV charging station installations	Near-term	Montclair Township
Building Codes	Work with the state to amend the building code to require PEV station readiness in new single-family developments	Medium-term	Montclair Township
General Plans & Policies	Collaborate with PSE&G to facilitate necessary electricity distribution infrastructure upgrades	Ongoing	Montclair Township

⁴² For more information see <http://www.fleetsforthefuture.org/> and <http://evsmartfleets.com/>.

Permitting & Inspection

Produce guidance documents outlining permitting requirements for residential PEV charging station installations

Providing information to local residents about the requirements to permit their residential charging station installation will both make the installation/permitting process more accessible and streamline the process. Montclair Township should consider developing a permitting checklist that helps applicants through the process and post it online for easy access. While this will require some staff time and resources up front, the time savings down the road will be significant, and NJDCA's "Electric Vehicle Charging Stations – What you need to know" can serve as a starting point for the checklist.⁴³

Building Codes

Work with the state to amend the building code to require PEV station readiness in new single-family developments

Amendments to the UCC can only be made at the state level. Therefore, Montclair Township should consider coordinating with other municipalities to work with the state to amend the building code to require that new single-family residential developments with off-street parking include pre-wiring for PEV charging station installations. The township should also collaborate with its neighboring municipalities to work with the state to amend the New Jersey State Residential Site Improvement Standards (RSIS) to apply this requirement to property redevelopment.

General Plans & Policies

Collaborate with PSE&G to facilitate necessary electricity distribution infrastructure upgrades

Although sales of PEVs are forecasted to grow, regional impacts on the electrical grid (in terms of greater demand for electricity as more vehicles are charging) will likely be negligible for many years. However, unmanaged charging station installations and increased regional PEV ownership in specific areas could negatively affect local electrical distribution systems.

One of the primary causes of concern for PEVs is clustering of the load associated with vehicle charging. Utilities generally have a transformer replacement program to regularly target transformers that have reached the end of their useful life or have been identified as grossly overloaded. However, the adoption of PEVs may occur faster in some areas, thereby causing gaps in the information that utilities would generally use to inform their replacement programs. Utilities need to know where the vehicles are being used and how they are being charged (e.g., Level 1 vs. Level 2) so that they can evaluate whether the local distribution system is adequate to serve PEV charging needs. One simple, but not always utilized, solution to this potential challenge is for utilities to establish a clear notification protocol so that utilities are aware of new chargers being added to the grid. There may be unique grid impacts in Montclair because of the older homes in the area, even more reason for communication with PSE&G.

⁴³ NJDCA, *Electric Vehicle Charging Stations – What you need to know*, http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

Multi-Unit Dwelling Charging

Most PEV charging is likely to occur at home. However, with a large portion of Montclair residents living in MUDs without dedicated garages like single-family homes, the purchase of a PEV may not make sense. Further, MUD owners and management companies will need to respond to tenant interest as the number of PEVs on the road increases. The recommendations in Table 10 represent the key actions Montclair can take to help address current and future demands for MUD charging.

As noted in [Section 1](#), much of the opportunity to expand charging infrastructure at MUDs will be through new developments or possibly as part of renovations to upgrade existing buildings. The established garden-style apartment complexes, for example, are less likely to have demand for charging given the socio-economic characteristics of the average tenant. MUD decision makers are not likely to pursue PEV charging infrastructure unless residents express an interest or the management company recognizes charging as an amenity to attract tenants. Therefore, it will be necessary for Montclair to be proactive with regard to targeted outreach and education.

Table 10. Recommendations to Support MUD Charging for Montclair AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Conduct targeted outreach to MUD managers and developers to install chargers at high-priority locations	Near-term	Montclair Township
	Collaborate with MUDs to create and implement policies that allow residents to install PEV charging infrastructure	Medium-term	Montclair Township
Zoning & Parking Ordinances	Amend zoning codes to require or incentivize PEV charging stations or pre-wiring in new MUD developments	Medium-term	Montclair Township

General Plans & Policies

Conduct targeted outreach to MUD managers and developers to install chargers at high-priority locations

Property owners and developers, and home owner associations (HOA) can have a tangible impact on PEV deployment in the region by providing charging for multi-family housing residents. In the case of MUDs, decision makers will need to consider the logistics of providing charging equipment, including who pays for the electricity and charging station upkeep, how to determine resident access/parking space sharing between resident PEV owners, and particular zoning and permitting considerations. They will also need to understand the approval process for new development versus existing development installations, and what activities would require a permit/approval from the Montclair Planning Board versus being done independently. Montclair Township can facilitate this discussion by providing targeted outreach and educational materials that address the specific questions and challenges these communities will face in the context of PEV and charging station deployment.

Montclair Township is proactive in its environmental and sustainability outreach, so it would be feasible and require little additional cost to build upon that foundation by developing a variety of situation- or user-specific PEV materials for distribution. Strategic outreach can take additional time, but it can also

be highly impactful, particularly given the presence of existing MUDs and new developments. The MUD demand map provided in [Section 1](#) (Figure 4) will be helpful as Montclair Township prioritizes target developments and areas. The township should also make educational information available to companies developing new or enhancing existing MUDs. See the resources in [Appendix E](#), particularly the link to an AFDC web page providing case studies, guidelines, and other information.

Collaborate with MUDs to create and implement policies that allow residents to install PEV charging infrastructure

Montclair Township has many residents that own or rent property in MUDs, where they might have a dedicated parking space but do not technically own the property on which they park. This presents unique challenges for PEV owners seeking to access a charging station at their home. Given the proportion of Montclair’s population that might face such issues, the township can have a very tangible impact on PEV deployment by working with multi-family developments to develop policies that allow residents to install PEV charging infrastructure or provide shared charging for residents. Refer to [Appendix D](#) for an example of “right to charge” language. The township might also consider accompanying these policies with education materials for landlords about the benefits (i.e., added property value) of providing PEV charging infrastructure for tenants.

Zoning & Parking Ordinances

Amend zoning codes to require or incentivize PEV charging stations in new MUD developments

Zoning codes, if developed thoughtfully, can facilitate PEV and charging infrastructure deployment. Montclair Township should consider amending zoning codes to require or incentivize pre-wiring or charging station installations at new MUD developments, including guidance on locating and installing PEV charging stations in such settings. Ideally, requirements should specify the number of chargers or pre-wired spaces to be provided at developments of different sizes. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed. While Montclair Township has implemented a requirement for redevelopment plans to include PEV charging stations and their necessary infrastructure, there is opportunity to strengthen the language to ensure that the requirements are more comprehensive, consistent across all redevelopment areas, and will not unintentionally impede charging station installations.

Workplace Charging

The PEV charging infrastructure market has focused considerable attention on workplace charging—through funding, outreach, and pilot programs. Although most PEV charging occurs at home, and is expected to for the next several years, PEVs are still parked for many hours as part of regular commuting. The availability of charging as part of a regular commute can help increase the electric vehicle miles traveled by PHEVs, while also helping demonstrate to potential drivers that there is sufficient infrastructure to maintain driving habits in a BEV (i.e., overcome range anxiety). Table 11 highlights the key recommendations to help meet the demand for workplace charging, as well as private fleet AFV adoption, as part of Montclair’s AFV readiness planning.

Table 11. Recommendations to Support Workplace Charging for Montclair AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Identify AFV grants and other funding opportunities for workplace charging infrastructure development	Ongoing	Montclair Township
	Conduct targeted outreach to employers to install chargers at high-priority locations	Near-term	Montclair Township, EZ Ride
Fleet Planning	Provide educational resources to local fleet managers regarding AFV and infrastructure deployment	Near-term	Montclair Township, EZ Ride
Permitting & Inspection	Produce guidance documents outlining permitting requirements for commercial PEV charging station installations	Near-term	Montclair Township
Zoning & Parking Ordinances	Amend zoning codes to require or incentivize PEV charging stations or pre-wiring in new commercial developments	Medium-term	Montclair Township

General Plans & Policies

Identify AFV grants and other funding opportunities for workplace charging infrastructure development and other opportunities

Montclair Township can play an important role in accelerating regional AFV adoption by helping stakeholders identify and pursue grant funding, both for AFVs and for workplace and fleet fueling/charging infrastructure. Table 6 and Table 7 (in [Section 1](#)) summarize available incentives for PEVs and charging infrastructure, respectively. Each opportunity varies in terms of eligibility and timelines, though several are suitable for employers and fleets in Montclair.

Montclair can maximize the number of electric miles traveled by supporting charging for those commuting to and working in the township. Montclair is a particularly strong candidate for grant funding if it can show that it has identified particular areas or facilities that are well suited for charging stations. The high opportunity zone map in [Section 1](#) (Figure 7) provides a starting point to identify specific areas best suited for workplace charging. This analysis is backed by the workplace charging demand illustrated in Figure 5.

While PEVs and charging infrastructure apply to the broader population, natural gas technology is still predominantly applicable only to fleets since commercially available vehicles are medium- to heavy-

duty. Fleets operating in and around Montclair may be interested in funding for NGVs and natural gas fueling stations, should it become available in the future. Montclair Township can point fleet managers and other stakeholders to the NJCCC and other organizations closely tracking funding solicitations and other incentives.

Funding could also be used for workshops, trainings, outreach campaigns and events. These may be specific to Montclair, or coordinated with other municipalities in the region to conserve costs and increase the reach and impact. Depending on resource availability, Montclair might also consider participating in an information sharing process in order to assist – and receive assistance from – neighboring municipalities in these efforts. Organizations such as Sustainable Jersey are in an ideal position to facilitate information sharing among engaged municipalities.

Conduct targeted outreach to employers and commercial developers to install chargers at high-priority locations

Building on the previous recommendation, Montclair Township should leverage the high opportunity zones and workplace charging demand maps in [Section 1](#) (Figure 7 and Figure 5, respectively) as resources to target workplace charging station development outreach. Commercial property owners and developers can have a tangible impact on PEV deployment in the region by providing charging for employees. Employers will need to gauge demand (current and future) and consider the logistics of providing charging equipment, including the etiquette for moving vehicles once the charging session is complete. They will also need to understand the approval process for new development versus existing development installations, and what activities would require a permit/approval from the Montclair Planning Board. The township can facilitate this discussion by providing targeted outreach and educational materials that address the specific questions and challenges employers may face in the context of PEV and charging station deployment.

Montclair Township has already been proactive in its environmental and sustainability outreach, so it would be very feasible and require little additional cost to build upon that foundation by developing a variety of situation- or user-specific PEV materials for distribution. Strategic outreach can take additional time, but it can also be highly impactful. This is an area in which EZ Ride can serve a key role, reaching out to its network of employers to provide factual and relevant information. The workplace charging demand map provided in [Section 1](#) (Figure 5) will be helpful as Montclair Township prioritizes target employers and areas. An obvious potential workplace charging location is Montclair State University, where PEV chargers could serve university employees, students, and visitors. Given the township's relationship with the university, this may be a natural partnership and area of focus. Primary education schools may be good candidates for workplace charging to serve teachers and other staff, particularly if they can leverage grant funding to offset costs.

Fleet Planning

Provide educational resources to fleet managers

Public and private fleets can provide opportunities for AFV introduction. However, fleets often require assistance navigating and weighing the various considerations associated with AFV ownership as

compared to conventional vehicle ownership. For this reason, information sharing can encourage investment in AFVs among corporate and government fleets alike.

Montclair Township should consider providing educational resources (e.g., toolkits or guidebooks) to fleet managers and employers to educate them regarding the total cost of AFV ownership, operating considerations, and fueling/charging station installation costs and guidelines. In particular, Montclair will need to educate the purchasing officer and should consider developing a comprehensive fleet management plan that incorporates AFV technology. It can also work with EZ Ride to effectively reach employers in the area.

In the case of electrification, since most PEVs available today are passenger cars, Montclair’s near-term focus should include fleets with light-duty vehicle applications. As more medium and heavy-duty PEV technology develops, Montclair can provide additional resources that draw upon best practices and lessons learned from local and regional case studies of fleets deploying such vehicle models. The opposite is true with NGVs: most natural gas technology is available for medium- and heavy-duty vehicles. Montclair should therefore focus on fleets with these applications in the near-term, which may include shuttle buses/vans and trash collection and recycling fleets that serve commercial entities throughout the municipality. Should light-duty NGVs become more readily available in the future, the township can provide additional resources that draw upon best practices and lessons learned in light-duty scenarios in order to support further expansion of the technology.

Permitting & Inspection

Produce guidance documents outlining permitting requirements for commercial PEV charging station installations

Providing information to employers and other site hosts about the requirements to permit charging station installation will streamline the process. Montclair Township should consider developing a permitting checklist that details the process and post it online for easy access. While this will require some staff time and resources up front, the time savings down the road will be significant, and NJDCA’s “Electric Vehicle Charging Stations – What you need to know” can serve as a starting point for the checklist.⁴⁴ The NJTPA could also provide support in this area by creating a template for municipalities to use.

Zoning & Parking Ordinances

Amend zoning codes to require or incentivize PEV charging stations in new commercial developments

Zoning codes, if developed thoughtfully, can facilitate PEV and charging infrastructure deployment. Montclair Township should consider amending zoning codes to require or incentivize pre-wiring or charging station installations at new commercial developments (e.g., office buildings serving multiple employers), including guidance on identifying locations for and installing charging stations in such

⁴⁴ NJDCA, *Electric Vehicle Charging Stations – What you need to know*, http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

settings. Ideally, requirements should specify the number of chargers or pre-wired spaces to be provided at new developments of different sizes. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed.

Incentives may include density or floor-to-area ratio bonuses or reduced application/design review fees. While Montclair Township has implemented a requirement for redevelopment plans to include PEV charging stations and their necessary infrastructure, there is opportunity to strengthen the language to ensure that the requirements are more comprehensive, consistent across all redevelopment areas, and will not unintentionally impede charging station installations.

Public Charging

Public charging refers to away-from-home charging that does not occur at the workplace, and is part of a non-work trip. These stations are typically accessible to the public or specific drivers, and as noted previously can include Level 1, Level 2, and DC fast charging. Public charging typically takes place at locations where drivers are parked for varying times; the actual demand for public charging is difficult to predict. In some regards, the likely utilization of public charging infrastructure will vary considerably depending on factors including but not limited to driving patterns and the fee charged. Although there is an opportunity for public entities to provide public charging at recreational and other sites, this plan assumes that site hosts will generally be private or commercial entities working with a PEV charging infrastructure provider. Site hosts may be keen to support public charging infrastructure for a variety of reasons, including demonstrating a commitment to sustainability, attracting new visitors to a site, or increasing the time that visitors spend at a site.

Montclair Township is becoming more of a destination and will draw visitors that include PEV drivers. As the demand for public charging becomes clearer, it is important that Montclair Township provide technical and policy support where possible, and seek opportunities to conduct targeted education and outreach. Table 12 below highlights the key recommendations for consideration by Montclair as they relate to public charging.

Table 12. Recommendations to Support Public Charging for Montclair AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Identify AFV grants and other funding opportunities for infrastructure development	Ongoing	Montclair Township
	Conduct targeted outreach to landowners to install chargers at high-priority locations	Near-term	Montclair Township, EZ Ride
	Pursue public-private partnerships to fund publicly accessible charger installations	Near-term	Montclair Township
Zoning & Parking Codes	Establish preferential parking policies for PEVs	Medium-term	Montclair Township
	Amend parking codes to regulate the use of PEV charging spaces	Medium-term	Montclair Township
	Amend zoning codes to require or incentivize PEV charging stations or pre-wiring in new commercial developments	Medium-term	Montclair Township
	Allow PEV parking to count towards minimum requirements	Medium-term	Montclair Township

General Plans & Policies

Identify AFV grants and other funding opportunities for fueling infrastructure development

Montclair Township can play an important role in accelerating regional AFV adoption by helping to identify grant funding, including for the purchase and installation of public fueling infrastructure. Table 6 and Table 7 (in [Section 1](#)) summarize the available incentives for PEVs and charging infrastructure, respectively. Each opportunity varies in terms of eligibility and timelines. Some are opportunities Montclair Township can apply for to fund public charging infrastructure or to purchase AFVs for the municipal fleet. Others are more suitable for private businesses in Montclair to expand the use of AFVs and the network of supporting infrastructure.

Montclair and its businesses should actively seek support in developing a robust charging station network that will ensure visitors and residents can access nearby charging options. This will both ease range anxiety and maximize the number of miles driven in electric mode. The high opportunity zone map in [Section 1](#) (Figure 7) provides Montclair Township with a starting point to identify specific areas of the best suited for public charging. This analysis is backed by the public charging demand illustrated in Figure 6.

The Montclair Parking Utility has indicated a willingness to explore charging infrastructure installation at public parking lots, and may be in a position to apply for grant funding. There are several municipal lots that would provide highly visible, centralized locations serving both visitors and residents. These include multiple lots in and around Montclair Center, the Grove Street lot, and the two lots in Watchung Plaza not specifically intended for train service parking. To help prioritize locations, the Montclair Parking Utility should consider the average dwell time, split between metered and permit spaces, and whether a lot is already at capacity on a regular basis.

Conduct targeted outreach to landowners to install chargers at high-priority locations

Building on the previous recommendation, Montclair Township should leverage the high opportunity zone and public charging demand maps in [Section 1](#) (Figure 7 and Figure 6, respectively) as resources to target outreach. Local landowners should contribute to the charging network, as the local economy will benefit from increased visitation and longer stays. In Montclair, retailers, in addition to workplaces and MUDs, are particularly high-priority targets. Property owners, developers, and other decision makers at these locales can have a tangible impact on PEV deployment in the region by providing charging for visitors, in addition to residents. EZ Ride is in a position to bring businesses to the table, leveraging their regional network. PEV charging stations can be amenities that help draw customers, and ultimately, pose opportunities to grow the local economy through increased visitor traffic and community spending.

It is important for businesses interested in hosting public stations to have a sense of the demand for charging before they pursue installation. Several of the existing charging stations in Montclair are networked and site hosts have access to data on usage over time. The township is in a position to collect and compile usage information, including data from its chargers, and make it available in summary form. This will supplement the public charging demand map in [Section 1](#) (Figure 6), helping to illustrate how often chargers in certain parts of the township (e.g., Upper Montclair) are being used and where there may be opportunities to serve high demand areas with additional charging stations.

Montclair Township has already been proactive in its environmental and sustainability outreach, so it would be very feasible and require little additional cost to build upon that foundation by developing a variety of situation- or user-specific PEV materials for distribution. Strategic outreach can take additional time, but it can also be highly impactful. Montclair Township could share this information using a combination of print materials (to be distributed at events, in local venues like business improvement district offices, and other destinations around town) and digital materials that people can access online or via email newsletters.

Pursue public-private partnerships to fund publicly accessible charger installations

There are various opportunities for Montclair Township to help facilitate funding for public charging station installations outside of grants. The Township should consider fostering public-private partnerships and working with business improvement districts (e.g., Montclair Center Corporation) to finance such installations. In the realm of public-private partnerships, there are display advertising opportunities for companies that sponsor charging stations. In both this case and that of partnerships with business improvement districts, the township will need to provide information supporting the business case for installing PEV charging stations, including customer attraction, dwell time, etc. Prospective station hosts should consider the potential increased revenue, as well as upfront costs.

Montclair Center Corporation has the authority to undertake improvements for parking areas and facilities, as well as provide special parking arrangements subject to Township Council approval. As such, Montclair Center Corporation could serve as a focal point and convener for discussions around PEV charging infrastructure in that particular commercial district. Businesses will need to be educated about the benefits of PEV charging, including increased customer interest and dwell times, and the township's targeted outreach efforts noted above should address this need.

Zoning & Parking Codes

Establish preferential parking policies for PEVs

Montclair Township should consider offering additional incentives for drivers to purchase PEVs, by creating dedicated parking spaces or waiving parking fees for these vehicles. If Montclair provides PEV parking that exceeds immediate demand, the township can consider specifying interim regulations that allow conventional vehicles to use these spaces in order to avoid under-utilization. The Montclair Parking Utility would provide leadership on this action and may look at adjusting existing parking permit requirements, as well as metered parking regulations, to benefit PEVs and other AFVs.

Amend parking codes to regulate the use of PEV charging spaces

After establishing policies and strategies to encourage the deployment of PEVs, the next step for Montclair Township is to amend parking ordinances to specify the regulations that apply to parking spaces designated for PEVs. The goal of these amendments is to ensure that PEVs have unobstructed access to PEV charging and to ensure the township can recoup the costs of public charging at the stations it owns and operates.

When designating PEV parking, Montclair should consider applicable definitions, restrictions, enforcement policies, time limits, and fees. In general, it is a best practice to restrict the use of PEV charging stations to vehicles that are actively charging to ensure that the equipment is available for drivers who need them. For example, the City of Raleigh's Code of General Ordinances requires that vehicles parked in designated PEV spaces be connected to the charging station or be subject to a \$50 fine.⁴⁵

While Montclair has taken a positive step by developing regulations to govern the use of PEV charging spaces, the ordinances may actually pose barriers to some charging station installations. The township should consider amending such regulations to include time limits for PEVs, restrictions for PEVs while not charging, and partnering with the Montclair Parking Utility to enforce these rules.

Amend zoning codes to require or incentivize PEV charging stations in new commercial developments

Zoning codes, if developed thoughtfully, can facilitate PEV and charging infrastructure deployment. Montclair Township should consider amending zoning codes to require or incentivize pre-wiring or charging station installations at new commercial developments, including guidance on identifying locations for and installing EV charging stations in such settings. Ideally, requirements should specify the number of chargers or pre-wired spaces to be provided at new developments of different sizes and land-use types. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed.

Incentives may include density or floor-to-area ratio bonuses or reduced application/design review fees. While Montclair Township has implemented a requirement for redevelopment plans to include PEV charging stations and their necessary infrastructure, there is opportunity to strengthen the language to

⁴⁵ City of Raleigh, NC, *Raleigh City Ordinance 11-2174(c) Electric Vehicle Parking FAQs*, <http://www.raleighnc.gov/content/PWksParkingMgmt/Documents/EVParkingFAQ's.pdf>. Accessed April 10, 2017.

ensure that the requirements are more comprehensive, consistent across all redevelopment areas, and will not unintentionally impede charging station installations.

Allow PEV parking to count towards minimum requirements

Montclair has minimum parking requirements specifying the number of spaces that developers must provide for new construction in different land uses. If PEV parking is not counted toward these requirements, it can discourage developers from installing charging infrastructure, because developers must either build more structured parking or reduce the amount of developed space to accommodate PEV charging. By amending the zoning or parking code to allow PEV parking to count toward parking requirements, Montclair could encourage PEV deployment. This is similar to the way that many local governments treat handicapped accessible parking, allowing it to count toward minimum requirements even though it has additional design requirements and is restricted to certain users.

Appendix A. Acronyms

Acronym	Stands For
AC	alternating current
AFV	alternative fuel vehicle
AEO	Annual Energy Outlook
AFDC	Alternative Fuels Data Center
BEV	battery electric vehicle or all-electric vehicle
CNG	compressed natural gas
DC	direct current
EIA	U.S. Energy Information Administration
EVSE	electric vehicle supply equipment
GHG	greenhouse gas
HEV	hybrid electric vehicle
MUD	multi-unit dwelling
NGV	natural gas vehicle
NJBPU	New Jersey Board of Public Utilities
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJTPA	North Jersey Transportation Planning Authority
PEV	plug-in electric vehicle
PHEV	plug-in hybrid electric vehicle
SAC	stakeholder advisory committee
TAZ	traffic analysis zone
TMA	Transportation Management Association
UCC	Uniform Construction Code
ZEV	zero emission vehicle

Appendix B. Plug-in Electric Vehicle Forecasting Methodology

For the purposes of this plan, residential PEV ownership forecasts for Montclair were projected over a planning horizon from 2016-2030. PEV projections for Montclair were developed as a range based on varying assumptions around adoption trends. Estimates of new vehicle sales included in this plan were developed using the following assumptions:

- The total annual sales of light-duty vehicles in New Jersey has been about 550,000 to 600,000 over the last several years, based on data from the National Automobile Dealers Association.
- New sales in Montclair are proportional to the share of total vehicles in Montclair relative to the entire state.
- New vehicle sales increase at a rate similar to the forecasted new vehicle sales reported by the Energy Information Administration (EIA) in the Reference Case of the Annual Energy Outlook (AEO) 2016, for the Middle Atlantic Region.⁴⁶

The increased deployment of PEVs coincides with increased deployment of more efficient conventional vehicles, driven largely by federal fuel economy and tailpipe greenhouse gas (GHG) emissions standards. Broadly speaking, the total stock of vehicles on the road is forecast to increase by about 10-12 percent between 2015 and 2030, and the stock of conventional vehicles is going to become more efficient, with efficiencies ranging from 40-50 miles per gallon (up from an average of around 25-30 miles per gallon today).

The table below summarizes the approach used to forecast PEVs in Montclair in low and high adoption scenarios. It also includes a GHG stretch scenario in which New Jersey meets the emissions reductions set forth in the New Jersey Global Warming Response Act.

Scenario	Description
Low	Reflects adoption trends comparable to the Reference Case in the EIA’s AEO 2016, adjusted slightly for increased potential indicated in the Middle Atlantic region. ⁴⁷
High	Assumes that PEV adoption rates in Montclair will be consistent with the ZEV mandate in place for New Jersey, ⁴⁸ with a fair-share assumption (i.e., that ZEV deployment will occur in the state on a population-weighted basis in the long-term).
GHG Stretch	The PEV strategy of the NJTPA Regional GHG Mitigation Plan calls for a 60 percent market share of PEVs by 2040 to meet state goals. The GHG stretch scenario assumes that PEV adoption rates will be slightly lower than the plan, with a 50 percent market share by 2040.

⁴⁶ U.S. DOE Energy Information Administration, *Annual Energy Outlook: 2016*, [http://www.eia.gov/outlooks/aeo/pdf/0383\(2016\).pdf](http://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf). August 2016.

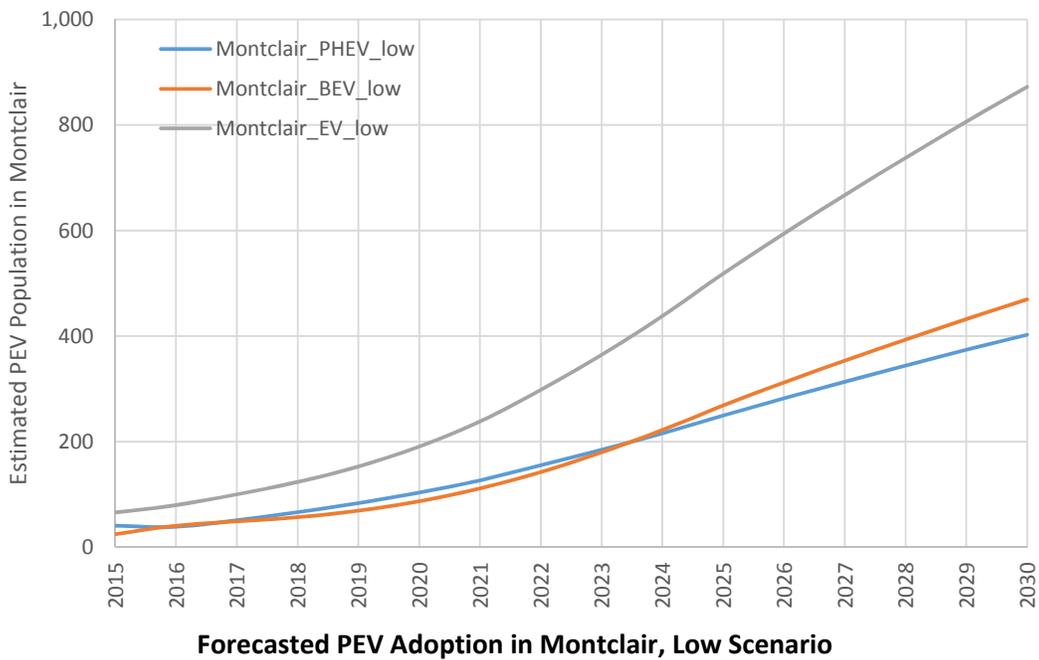
⁴⁷ AEO forecasting is typically used as a base for forecasts because it provides the benefit of transparency and consistency with national-level assessments. Further, the amount of data that is required to conduct a locally specific forecasting exercise is generally prohibitive. Lastly, the data are something that can be updated annually and modified by stakeholders easily, rather than relying on some proprietary methodology.

⁴⁸ ZEV programs aim to increase sales of ZEVs, which include PEVs and fuel cell electric vehicles, by requiring that some portion of vehicle manufacturer sales in the state be ZEVs. More information on New Jersey’s ZEV mandate is available online at <http://www.nj.gov/dep/cleanvehicles/LEV.pdf>.

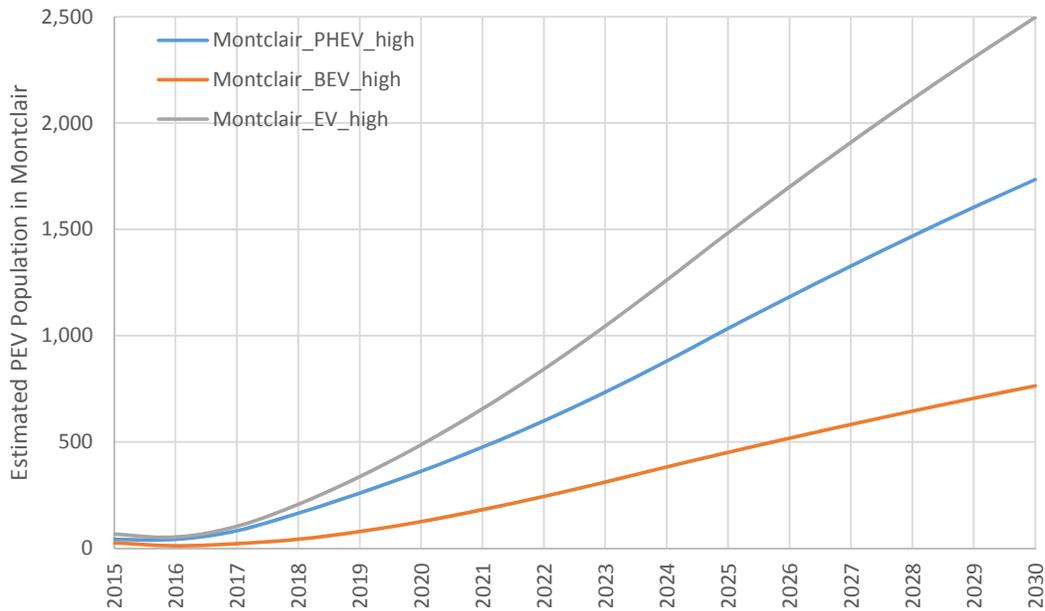
The figures that follow present the three PEV demand scenarios for Montclair based on the forecast descriptions in the table above. In the low scenario, the forecast is for approximately 875 PEVs (400 PHEVs and 475 BEVs) to be on the road in Montclair in 2030. In the high scenario, the forecast is for approximately 2,500 PEVs on the road (1,750 PHEVs and 750 BEVs). The GHG stretch scenario yields about 15,000 EVs on the road by 2040 in Montclair. To provide context, total light-duty vehicles are expected to increase by about 10-12 percent in Montclair by 2030, with a population of about 29,200 vehicles. The forecasts indicate that PEVs will make up to 6-17 percent of the vehicle fleet by 2030.

Additionally, note that the shape of each of the curves in the low scenarios and the shape of each of the curves in the high scenarios are similar. This is because both scenarios come from the same root functions, modified slightly based on the characteristics assumed in each case.

Low Scenario



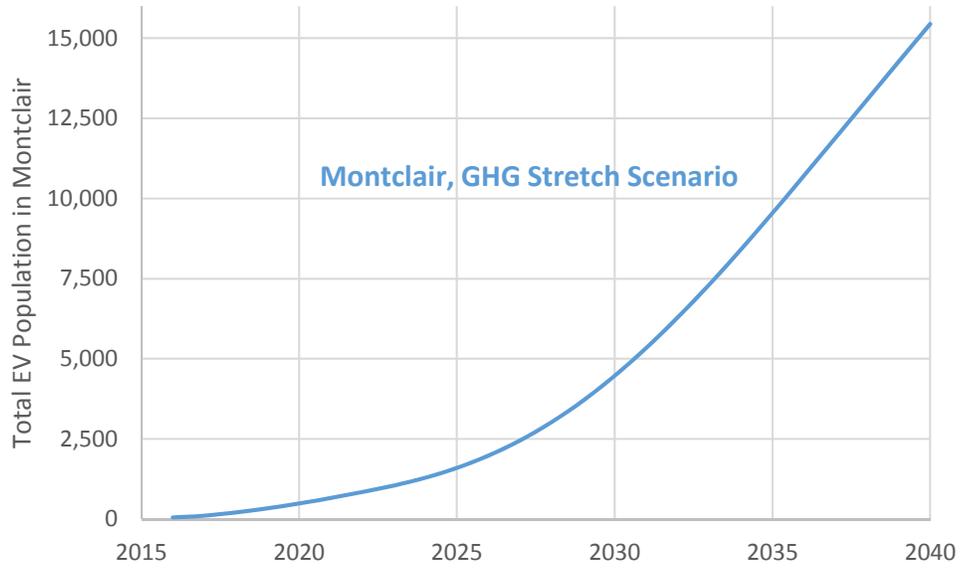
High Scenario



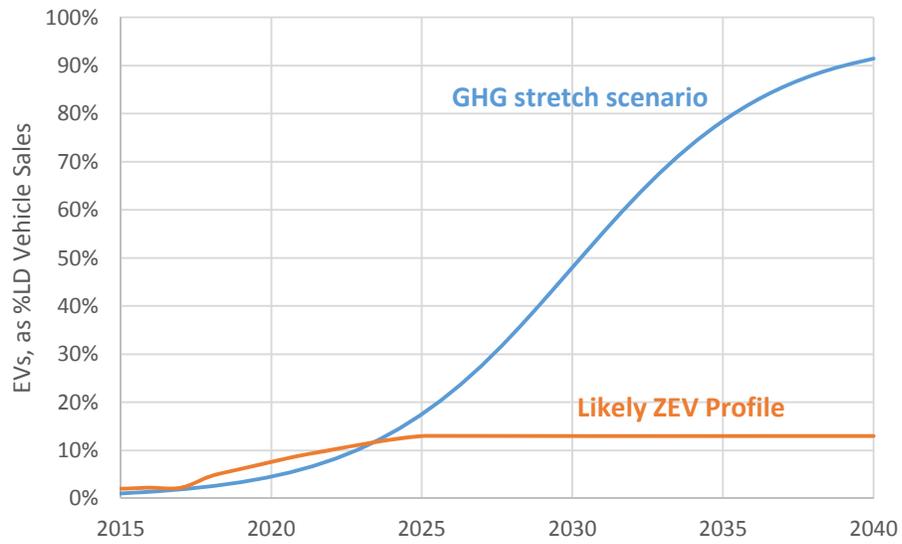
Forecasted PEV Adoption in Montclair, High Scenario

GHG Stretch Scenario

The New Jersey Global Warming Response Act requires a statewide reduction in emissions of 80 percent from a 2006 emissions baseline by 2050. In the NJTPA Regional GHG Mitigation Plan, a PEV strategy is included with the myriad strategies designed to reduce GHG emissions from on-road transportation. The EV Plan Implementation and Clean Fuels strategy calls for a 60 percent market share of PEVs by 2040. This level of penetration of PEVs by 2040 would effectively require PEVs to capture 50 percent of all new vehicle sales by 2028, and increase rapidly to greater than 90 percent of new vehicle sales by 2040. The GHG stretch scenario assumes PEVs will capture 50 percent of the light-duty market by 2040. The first figure below compares the GHG stretch scenario with the likely compliance outlook for the ZEV program, which plateaus post-2025. As shown in the second figure below, the ZEV program will help PEVs with an initial trajectory, but much higher sale volumes will be needed post-2025 to achieve a 50 percent market share by 2040. In fact, in order to achieve the 50 percent market share by 2040, PEVs will have to make up 80 percent of new sales by 2035 and 90 percent by 2040.



Forecasted PEV Adoption in Montclair, GHG Stretch Scenario



GHG Stretch Scenario vs Likely ZEV Profile

Appendix C. Charging Infrastructure Demand Forecasting Methodology

Overview

The infrastructure demand analyses are largely based upon the foundational data points of the NJTPA region's current and likely PEV ownership.⁴⁹ Socio-economic data were extracted from the 2014 American Community Survey (five year estimates). These data are available at the Census Block Group (CBG) level and include income, tenure or property ownership, and dwelling type. The analysis also relies on vehicle registration, particularly of HEVs.⁵⁰ The key socio-economic indicators used to develop the charging infrastructure siting analysis were:

- **Income.** Market research on early adopters of PEVs suggests that households with higher incomes are more likely to purchase a PEV. Because these vehicles tend to have higher upfront costs, income can be a limiting factor and individuals with a low income might not be able to afford the upfront cost of a PEV. Furthermore, higher income households generally buy a disproportionate share of new vehicles across all market segments and vehicle types.
- **HEV Ownership.** There can be long-term fuel savings associated with HEV (and PEV) ownership, which is one of the main reasons some might invest in such a vehicle. However, research shows that households who value the non-economic (e.g., environmental) benefits of HEVs are more likely to purchase PEVs, particularly in the early adoption phases. Many HEV owners have shown a willingness to pay to reduce gasoline use that goes beyond the economic benefits of using an HEV. A Ford Motors representative noted that typical Focus Electric buyers have purchased HEVs in the past.⁵¹ Research from the University of California, Davis (UC-Davis) supports this assumption: 68.3 percent of PEV owners surveyed either own or have owned an HEV and locations of HEV owners correlate with locations of PEV owners.⁵²
- **Property Ownership.** Households who own their property are more likely to purchase a PEV than those who rent, according to market research by Nissan and Chevrolet and surveys by UC-Davis and California's Clean Vehicle Rebate Project recipients. Home ownership reduces both financial and non-financial barriers to charging infrastructure deployment.

⁴⁹ There are multiple overlapping geographies considered in the charging infrastructure siting analysis. For instance, vehicle ownership data are provided at the ZIP code level; socio-economic indicators are provided at the CBG level; and trip data are generated for TAZs. These overlapping geographies can lead to uncertainty in the analysis; however, the analysis typically relies on values as percentages rather than absolute numbers. Through iterative analyses in other jurisdictions, the ICF team has found that this approach minimizes uncertainty. Furthermore, this makes the analysis less sensitive to changes on a time scale less than a year. For instance, if a municipality obtains PEV ownership at six-month intervals, and seeks to update the analysis, it is unlikely it will observe substantive changes in the results.

⁵⁰ Data provided by the NJDEP, based on NJMVC registration data.

⁵¹ Mike Tinsky, Associate Director, Sustainability and Vehicle Environmental Matters, Vehicle Electrification and Infrastructure, Ford Motor Company. Phone interview, April 9, 2012.

⁵² Gil Tal, Michael Nicholas, Justin Woodjack, Daniel Scrivano, Tom Turrentine, Plug-in Hybrid and Electric Vehicle Research Center of the Institute of Transportation Studies, University of California, Davis. Plug-In Vehicles in the San-Diego Region: A Spatial Analysis of the Demand for Plug-In Vehicles. Presented by Gil Tal, May 9, 2012, at EVS 26, Los Angeles, CA.

- Dwelling Type.** Dwelling type (e.g., single-family detached, single-family attached, or multi-unit dwelling) can help indicate PEV ownership. Consumers with a single-family detached home generally have fewer barriers to PEV adoption as they usually have access to a garage or driveway. Consumers living in MUDs are more likely to encounter barriers to installing chargers (e.g., limited space for infrastructure installation, home owners’ association restrictions, installation costs for trenching, additional metering requirements, power availability).⁵³

The charging infrastructure demand analysis leverages origin-destination trip tables from the NJTPA, which indicate the number of trips from an origin traffic analysis zone (TAZ) to a destination TAZ.⁵⁴ Trip types include home-based work (HBW), home-based other (HBO), and non-home non-work (NHNW) trips.

The readiness plan includes the mapped results of each infrastructure demand analysis – residential, MUD, workplace, and public/opportunity charging. Each map includes five levels of shading, based on the percentile of each TAZ’s score relative to the entire NJTPA region, and ranked as shown in the table below.

Scoring	Percentile	Demand
1	0—40%	Low
2	40—60%	Low/Medium
3	60—80%	Medium
4	80—95%	Medium/High
5	95—100%	High

Residential Charging

The residential charging demand analysis (associated with both HBW and HBO trips) relies exclusively upon socio-economic data for each TAZ. This data determined a General Residential Charging (ResGeneral) Score, which is directly correlated with residential charging infrastructure demand. As such, no trip data was incorporated into this assessment.

The socio-economic indicators explained above were scored with different weighting factors, which were linked to survey and market research of PEV owners and based heavily on California’s extensive PEV ownership data. These factors contributed to a ResGeneral Score:

$$ResGeneral\ Score = \sum \alpha Income, \beta HEV_Ownership, \gamma Tenure, \delta DwellingType,$$

where

$$\alpha + \beta + \gamma + \delta = 1.$$

Each weighting factor was based on the level of correlation associated with PEV ownership to date, and each factor is skewed towards the first two parameters: income and HEV ownership. The latter two factors — tenure and dwelling type — were used to differentiate amongst areas with higher potential.

⁵³ Graham, R.L., J. Lieb, J. Sarnecki, R. Almazan, B. Neaman. Wise Investment in Electric Vehicle Charging Infrastructure through Regional Planning. EVS26 International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium, 2012.

⁵⁴ The socio-economic data are scored at the CBG-level and the trip data are available at the TAZ level. NJTPA staff provided a look-up table linking each CBG with a TAZ.

The most critical parameter in this infrastructure demand analysis is income, which accounts for 60 percent of the scoring. To integrate this factor, CBGs were scored against one another by comparing the share of different income groups. This provides more granularity to the analysis than simply comparing median incomes.

The second most prominent parameter in the analysis is HEV ownership, which accounts for 30 percent of the scoring. This analysis compared the percent of HEVs owned in each CBG against the percent of HEV ownership in that CBG's municipality and against the entire state of New Jersey. CBGs scored higher in the analysis if they had HEV ownership higher than the state median.

The tenure parameter represents the rate of home ownership relative to the median rate of home ownership for the state of New Jersey. Based on survey data and PEV market research, home ownership as a percent of the number of residential units available in a given area are short- to mid-term indicators for PEV ownership but are less effective indicators over the long-term. For this reason, the tenure parameter accounts for 5 percent of the total score. Additionally, these parameters were used exclusively to differentiate amongst areas with better than median income and HEV ownership profiles. In other words, if an area did not have a higher than median income but did have a higher than median rate of home ownership, the home ownership factor would not impact the ResGeneral Score. However, for areas with a similar median income or HEV ownership profile, a higher rate of home ownership would yield a higher ResGeneral Score.

For the final parameter, dwelling type, areas were scored based on the rate of single-family units relative to the median rate of single-family units. This parameter also accounts for 5 percent of the total score and a higher rate of single-family units yields a higher ResGeneral Score.

Multi-Unit Dwelling Charging

This analysis includes a new metric to estimate the likely demand for charging at MUDs. This metric was developed by using the same approach as outlined previously for the residential charging estimates, however, the value of the weighting factor for dwelling type, δ ,⁵⁵ and the structure of the scoring were modified to favor areas with above median income, above median hybrid ownership, and a high share of MUDs (instead of a higher rate of single family units).

Workplace Charging

To forecast the likely demand for workplace charging infrastructure, the results of the residential demand analysis were combined with regional travel demand data to determine the TAZs within Montclair that have the highest number of trips originating from TAZs with the highest likelihood of PEV ownership. The analysis relied upon an output matrix from the NJTPA's travel model, referred to as origin-destination trip tables for home-based work trips. The trip originating from TAZ_o was multiplied by the score determined in the residential analysis, *ResGeneral Score_o*. The likelihood of workplace

⁵⁵ The weighting factor for dwelling type was increased to 25 percent from 5 percent, and the weighting factors for income and hybrid ownership were decreased to 50 percent and 20 percent, respectively. These changes are more subjective than the analysis behind the residential siting analysis, and it is important to update these values as the demand for charging at MUDs is better understood.

charging is simply correlated with the number of trips concluding at the workplace destination TAZ_D. The letters O and D represent origin and destination.

Public Charging

In the long run, public charging will consist of predominantly Level 2 and DC Fast charging, with Level 2 being the charging type most feasible for Montclair Township to install and support. For this reason, the forecast for public charging focuses on Level 2 charging, using a methodology similar to the workplace charging analysis. However, instead of multiplying the ResGeneral Score by HBW trips, it is multiplied by HBO trips, which served as a proxy for public charging.

Appendix D. Municipal Policy Examples

Sustainability/Climate Action Plan

Woodbridge *Sustainable Community Plan and Climate Action Plan*,
<http://www.twp.woodbridge.nj.us/DocumentCenter/Home/View/2813>

- Transportation and Circulation objectives include:
 - “Use fuel-efficient and alternative-fuel vehicles to reduce energy consumption, fossil fuel use, and associated air pollution emissions, including greenhouse gas emissions”
 - Continue to track alternative technologies such as electric, CNG or hybrid.”
- Includes indicators and targets specific to AFVs in the municipal fleet:
 - “Year 1 target: add at least five alternative fuel or high efficiency vehicles to the fleet
 - Further target: at least 25% of fleet using alternative fuels and/or high efficiency vehicles within 10 years.”
- Energy Conservation and Green Buildings action steps include:
 - “Adopt ordinances to change zoning to become electric vehicle friendly
 - Create a program that encourages work place and multifamily charging
 - Hold an event that promotes electric vehicle awareness”
- Other specific actions outlined in detail include:
 - “Create a Carpool Board for Municipal Employees and Promote Carpooling/Alternative Fuel Vehicles,” which seeks to provide information resources and explore the possibility of extending incentives to municipal employees.
 - “Create and Implement “Anything But Cars” (ABC) Program,” which aims to “provide choice and interconnectivity among sustainable transport modes and measures.”

New Construction Pre-Wire Requirement

New York City requires that newly constructed and upgraded parking garages and open lots include the necessary hardware for charging infrastructure in at least 20 percent of the parking spaces. See the General Administrative Provisions for Construction Codes, Section 28-101.4.3, as well as the Building Code, Sections 406.2.11 and 406.7.11 (<https://www1.nyc.gov/site/buildings/codes/2014-construction-codes.page>).

“Right to Charge” Language

While it exists at the state level, rather than as a municipal ordinance, California’s “right to charge” policy is summarized as follows:

A common interest development, including a community apartment, condominium, and cooperative development, may not prohibit or restrict the installation or use of electric vehicle supply equipment (EVSE) in a homeowner's designated parking space. These entities may put reasonable restrictions on EVSE, but the policies may not significantly increase the cost of the EVSE or significantly decrease its efficiency or performance. If installation in the homeowner's

designated parking space is not possible, with authorization, the homeowner may add EVSE in a common area for their use. The homeowner must obtain appropriate approvals from the common interest development association and agree in writing to comply with applicable architectural standards, engage a licensed installation contractor, provide a certificate of insurance, and pay for the electricity usage associated with the EVSE. Any application for approval should be processed by the common interest development association without willful avoidance or delay. The homeowner and each successive homeowner of the parking space equipped with EVSE is responsible for the cost of the installation, maintenance, repair, removal, or replacement of the station, as well as any resulting damage to the EVSE or surrounding area. The homeowner must also maintain a \$1 million umbrella liability coverage policy and name the common interest development as an additional insured entity under the policy. If EVSE is installed in a common area for use by all members of the association, the common interest development must develop terms for use of the EVSE. (Reference [California Civil Code](#) 4745 and 6713)

Source: <http://www.afdc.energy.gov/laws/9579>

Appendix E. Plug-in Electric Vehicle Community Readiness Resources

This information was adapted from a collection of resources compiled by the DOE's Clean Cities program, focusing on tools, documents, websites, and other information available via DOE's Office of Energy Efficiency and Renewable Energy.

[DOE EV Everywhere Electric Vehicles: Stakeholder Solution Center](#)

States and Municipalities

States and municipalities are key players in increasing PEV readiness. The best way for states and municipalities to improve their PEV readiness is to partner with their [local Clean Cities coalition](#), which can connect them to specific regional resources and other relevant stakeholders.

- [Plug-in Electric Vehicle Readiness Scorecard](#): Hosted on the DOE's Alternative Fuels Data Center, the Scorecard allows communities to assess their readiness, receive feedback about ways to improve, read about best practices, and record progress.
- [Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects](#): This guide, which is on the DOE Clean Cities' website, summarizes the best practices in streamlining permitting processes, revising codes, training emergency personnel, developing incentives, and educating the public based on the experiences of 16 PEV readiness projects across the country.
- [Reports from the Clean Cities' EV Community Readiness Projects](#): These are individual reports and community readiness plans from each of the projects, hosted on the Clean Cities' website. (See list of projects in chart, below).
- [Zoning, Codes and Parking Ordinances](#): This page on the DOE's Alternative Fuels Data Center links to relevant NIST codes for electric vehicle charging.
- [Handbook for Public Charging Station Hosts](#): This handbook on the DOE's Alternative Fuels Data Center provides an overview for what cities hosting public charging stations need to know before installation.
- [Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools](#): Published by the Transportation and Climate Initiative, this guide provides information on the steps to create, administer, and amend planning processes, rules and regulations, including in zoning, parking, and permitting.
- [EV-Ready Codes for the Built Environment](#): This guide, published by the Transportation and Climate Initiative, provides an overview of building and electrical codes as relating to PEVs, as well as providing recommendations specific to jurisdictions in the Northeast and Mid-Atlantic.
- Training on PEVs for First Responders through the [National Alternative Fuels Training Consortium](#) and the [National Fire Protection Association](#) provides essential education to firefighters, police officers, EMTs and others that may need to respond to accidents involving PEVs.
- [Drive Electric Vermont Case Study](#): This case study examines the opportunities and barriers to enabling small and midsize communities to partake in the PEV market and benefit from the economic and environmental advantages of the vehicles.

Employers

Providing charging at the workplace can encourage employees to purchase PEVs, be an attractive employee benefit, and maximize all-electric miles driven by PEV owners. The EV Everywhere [Workplace Charging Challenge](#) was a DOE program to encourage and recognize employers providing workplace charging.

- [Resources to Install and Manage Workplace Charging](#)
- [Handbook for Workplace Charging Hosts](#)

Fleets

Like consumers, fleets can benefit from the low operating costs and other benefits associated with PEVs. [Local Clean Cities coalitions](#) can help fleets decide which technologies and models will be most appropriate to meet their needs.

- [Handbook for Fleet Managers](#): This handbook on the DOE's Alternative Fuels Data Center provides fleet-specific information on the basics of PEVs, including issues like maintenance and charging.
- [Plug-in Electric Light, Medium and Heavy-Duty Vehicle Search](#): This tool on DOE's Alternative Fuels Data Center provides information on PEVs that can be filtered by class/type and manufacturer.
- [AFLEET Tool](#): Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation Tool allows fleet managers to calculate the cost of ownership, petroleum use, greenhouse gas emissions, and air pollutant emissions of alternative fuel vehicles.

Electrical Contractors and Inspectors

The installation of residential, workplace and public charging is essential to establishing a PEV market.

- [Electric Vehicle Infrastructure Training Program](#): This program provides training and certification at community colleges and electrical training centers across the U.S. for people installing electric vehicle supply equipment for residential and commercial markets.
- [EVSE Residential Charging Installation Video](#): A series of segments on the Clean Cities TV YouTube channel walk electricians through the basics of installing PEV charging infrastructure in homes, including an overview of the equipment, the relevant National Electrical Codes, inspection, and best practices.

Utilities

Through a partnership with the Edison Electric Institute, DOE is developing a suite of tools for utilities to support the use of PEVs.

- [The Utility Guide to Plug-in Electric Vehicle Readiness](#): A guide from the Edison Electric Institute, this document covers structuring your company to support PEVs, adding PEVs to utility fleets, enhancing the customer experience, working with state and local governments, and managing the electrical grid with PEVs.
- [Utilities Power Change](#) – This case study showcases how New Jersey's Public Service Electric and Gas Company, and Southern Company's unit Georgia Power are launching workplace charging programs for their commercial customers.

Additional Resources

[At A Glance: Electric-Drive Vehicles](#)

[Charging Plug-In Electric Vehicles in Public](#)

[Charging Plug-In Electric Vehicles at Home](#)

[Resources for Electrical Contractors and Inspectors](#)

[Developing Infrastructure to Charge Plug-In Electric Vehicles](#)

[Plug-In Electric Vehicle Deployment Policy Tools: Zoning, Codes, and Parking Ordinances](#)

[Signage for Plug-In Electric Vehicle Charging Stations](#)

[Plug-In Electric Vehicle Handbook for Consumers](#)

[Workplace Charging: Charging Up University Campuses](#)

[Electric Vehicle Charging for Multi-Unit Dwellings](#) (webpage with links to resources and case studies)

[Massachusetts Plug-in Electric Vehicle and Charging Infrastructure Case Study](#)

[Rolling Down the Arizona EV Highway](#) (case study)

[San Diego Prepares for Electric Vehicles in Multi-Unit Dwelling Communities](#) (text version and video)

[Houston Energizes Deployment of Plug-In Electric Vehicles](#) (case study)

[Seattle Rideshare Fleet Adds EVs, Enjoys Success](#) (case study)

[Alternative Fuels Data Center Publications](#) (search by keyword for additional resources)

Appendix F. Additional Information on Parking

Montclair's Parking Utility is governed by Chapter 3, Article XIVB of the Montclair Code of Ordinances (<http://ecode360.com/MO0769>). This states that the "Montclair Parking Utility shall be responsible for the administration, operation, and maintenance of all parking facilities owned by or under the control of the Township, including but not limited to parking lots, parking decks and structures, and regulated street parking." The Montclair Parking Utility is also responsible for the oversight of parking operations within the Township and is continuously working to improve parking conditions throughout Montclair. The Parking Utility is responsible for the implementation of PEV infrastructure on township property.

Another department with responsibilities related to municipal infrastructure (and thus, AFV infrastructure) is the Montclair Department of Community Services. This department performs the functions of maintenance, construction and reconstruction of streets, roads, storm sewers, drainage and parking facilities under Chapter 3, Article XI (Montclair Code of Ordinances), and may relate to management of alternative fuel equipment and infrastructure. Additionally, Chapter 44, Article VI (Montclair Code of Ordinances) creates the position of Parking Enforcement Officer, and covers powers, duties, qualifications, and compliance, specifically under § 44-23:26. This position is responsible for proper parking of AFVs as in the ordinances below.

Parking permits, limitations, and restrictions are covered extensively in the Montclair Code of Ordinances under Chapter 327, "Vehicles and Traffic." Article V under this chapter covers Metered Parking, but does not address charging for electric vehicles, which should be considered for the future. Chapter 347 governs zoning within the Township. The following are relevant definitions found within the zoning ordinances that may relate to AFVs:

- **Off-Street Parking** – Surfaced areas, not including driveways, designed for the parking of motor vehicles.
- **Parking Deck** – A deck, building or structure or part thereof used or intended to be used for the parking and storage of vehicles.
- **Structure** – Anything constructed, the use of which requires permanent location on the ground or attachment to something having permanent location on the ground, including central air-conditioning units, stationary and portable carports, but excluding paved parking areas, driveways, and walkways.

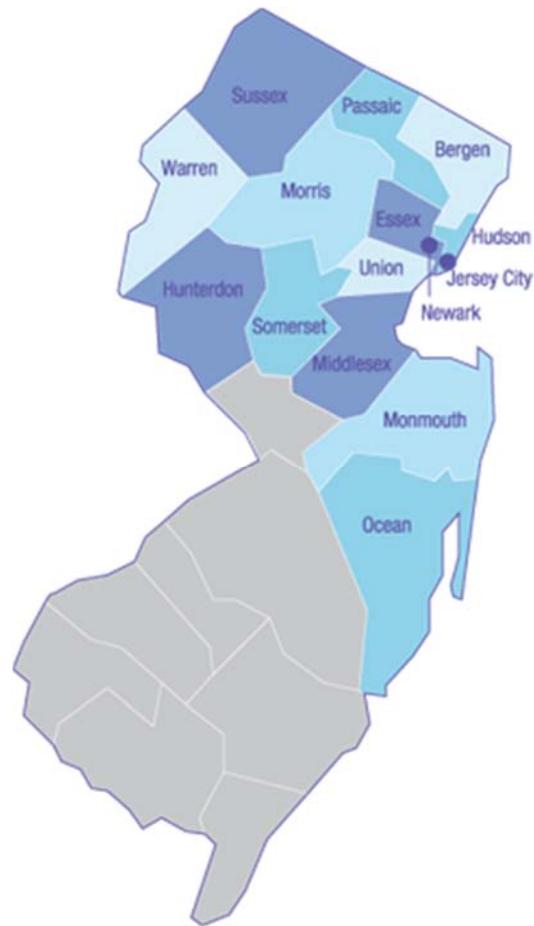
Appendix G. Regional Planning Area

The NJTPA regional planning area consists of 13 counties within North New Jersey; Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, and Warren; and its two largest cities, Newark and Jersey City. The region spans 4,200 square miles, about half of the state's land area. It is the fourth largest MPO in the nation in terms of population, serving more than 6.7 million people and over 3.1 million jobs.⁵⁶

The region has a robust multi-modal transportation network, including 26,000 miles of roads, 255 local and express bus routes, and 13 commuter/light rail lines with 228 stations, and 18 ferry routes from 19 piers.⁵⁷ Situated between New York and Philadelphia, the area is a regional corridor for both intra- and inter-state transportation. According to the American Community Survey (ACS), 34 percent of regional residents work outside their county of residence and 14 percent work outside of the state. The ACS found that the majority (70 percent) of commuters report driving alone, a rate that is significant but lower than most major metropolitan areas. In 2015, the region had 149.1 million miles of vehicle travel.⁵⁸

The NJTPA's regional transportation plan – Plan 2045: Connecting North Jersey – outlines the principles that guide project selection and provide policy and planning direction.⁵⁹ These include:

- **Help Northern New Jersey Grow Wisely** — Transportation investments should encourage economic growth while protecting the environment and minimizing sprawl in accordance with the state's Smart Growth plan, Energy Master Plan, and environmental plans.
- **Make Travel Safer** — Improving safety and security should be explicitly incorporated in the planning, design, and implementation of all investments.
- **Fix It First** — The existing transportation system requires large expenditures for maintenance, preservation, and repair, and its stewardship should be the region's highest priority.



NJTPA Region

⁵⁶ NJTPA, Plan 2045: Connecting North Jersey, <https://apps.nitpa.org/plan2045/>.

⁵⁷ New Jersey Transit, *Facts at a Glance – Fiscal Year 2016*, <http://www.njtransit.com/pdf/FactsAtAGlance.pdf>.

⁵⁸ New Jersey Department of Transportation, *New Jersey's Roadway Mileage and Daily VMT by Functional Classification Distributed by County*, http://www.state.nj.us/transportation/refdata/roadway/pdf/hpms2015/VMTFCC_15.pdf.

⁵⁹ NJTPA, Plan 2045: Connecting North Jersey, <https://apps.nitpa.org/plan2045/>.

- Expand Public Transit — Investment to improve the region’s extensive transit network should be a high priority, including strategic expansions to serve new markets.
- Improve Roads but Add Few — Road investments should focus on making the existing system work better and road expansion should be very limited without compromising the tremendous accessibility provided by the existing highway system.
- Move Freight More Efficiently — Investments should be made to improve the efficiency of goods movement because of its importance to the region’s economy and quality of life.
- Manage Incidents and Apply Transportation Technology — Investments should be made to improve information flow, operational coordination, and other technological advances that can make the transportation system work smarter and more efficiently.
- Support Walking and Bicycling — All transportation projects should promote walking and bicycling wherever possible.
- Increase Regional Resiliency — Investments should be made to mitigate risks associated with sea level rise, extreme weather, homeland security, and other potential threats. Investments should consider criticality of infrastructure, vulnerability, and level of risk.

While the expansion of transit and smart land-use planning work to reduce single occupant travel, the adoption of AFVs within the region will help reduce the environmental impact of the remaining vehicle trips by reducing oil consumption and transportation-related emissions, thus supporting the NJTPA’s goal of protecting the environment.



Town of Secaucus



Alternative Fuel Vehicle

Readiness Plan

December 2017

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Disclaimer

This publication was prepared with funding from the North Jersey Transportation Planning Authority (NJTPA) and the Federal Highway Administration (FHWA). This document is disseminated under the sponsorship of NJTPA and FHWA in the interest of information exchange. The NJTPA and FHWA assume no liability for its contents or use thereof.

Acknowledgments

This plan was prepared for the NJTPA by a consultant team consisting of ICF, Greener by Design, and Fitzgerald & Halliday, Inc.

Image Credits

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¹ From the New Jersey Sports and Exposition Authority's (NJSEA) Municipal Map at <http://arcgis5.njmeadowlands.gov/municipal/v31/>.

Executive Summary

Plan Overview

This Town of Secaucus Alternative Fuel Vehicle Readiness Plan outlines actions that the town can take to reduce and resolve barriers to alternative fuel vehicle (AFV) usage. It includes 27 recommendations across five action areas for community leaders and other stakeholders interested in expanding the use of plug-in electric vehicles (PEVs) and natural gas vehicles (NGVs).

The North Jersey region, including the Town of Secaucus in Hudson County, stands to benefit from AFVs, specifically through reduced fuel costs, savings on maintenance, use of advanced technology, support of domestic industries, and promotion of environmental sustainability. The objective of readiness planning is to identify, prioritize, and implement strategies that unlock the potential for vehicle electrification and NGV deployment. If done thoroughly and thoughtfully, AFV readiness planning will set the course for municipalities to effectively accelerate the shift away from reliance on conventional vehicles to AFVs, both in the consumer and fleet markets.

The NJTPA project team, working closely with a stakeholder advisory committee (SAC) made up of municipal decision-makers, residents, and industry representatives, developed the Town of Secaucus Alternative Fuel Vehicle Readiness Plan. The readiness planning process includes data collection and analysis around the current and future market, barriers to increased adoption, regulatory framework, and existing and planned incentives and funding. The resulting recommendations focus on general plans and policies, zoning and parking codes, permitting and inspection, building codes, and fleet planning.

This study was conducted in keeping with the policies of Plan 2045: Connecting North Jersey to improve mobility, protect the environment, and take advantage of technology developments

Plug-in Electric Vehicle Readiness

As of July 2017, PEVs made up approximately 0.38 percent of all vehicles registered in Secaucus. That is approximately 50 PEVs. Given the consumer focus, the opportunity for PEVs is closely linked to several socio-economic factors, including income, hybrid electric vehicle (HEV) ownership, home ownership, and housing type. While barriers to usage exist, the number of PEVs traveling in and around Secaucus will continue to increase. Additional charging infrastructure will be needed to support this growing number of PEVs (see box).

Regulations, policies, and incentives at the municipal, state, and federal levels can play a role in facilitating PEV usage. The project team analyzed existing plans, codes, ordinances, and incentives to inform the recommendations below.

The project team organized both the charging demand analyses and readiness planning recommendations according to the charging infrastructure needs identified for Secaucus:

- **Residential:** The majority of Secaucus ranks in the medium category for residential charging demand. While the current socio-economic characteristics of households in Secaucus do not align closely with likely PEV adoption, this will change over time.
- **Multi-Unit Dwelling (MUD):** Additional and future demand for MUD charging will be driven by new developments, of which there are several in Secaucus, that may draw higher income tenants, as PEV charging may be an attractive amenity to future tenants.
- **Workplace:** Workplace charging demand is high throughout the town, which is expected given the prevalent commercial and industrial land uses.
- **Public:** Public charging is predicted to be the highest within the commercial district near Harmon Meadow and the Mall at Mill Creek. This is expected given the retail centers and other destinations, including restaurants, located in those parts of Secaucus.

Natural Gas Vehicle Readiness

Given that NGVs are typically medium- and heavy-duty vehicles, both market penetration and opportunities for municipal NGV readiness planning are more limited than for PEVs. The NGV market outlook in Secaucus is tied to both national (e.g., price differential) and local (e.g., resource constraints) barriers.

Recommendations

The plan's recommendations correlate with goals set by the SAC, as well as the demand analysis, existing municipal plans and policies, and incentives. The recommendations are organized by the type of infrastructure demand (general, residential, MUD, workplace, and public). In addition, for each recommendation, a lead organization or stakeholder is identified. The time horizon for the actions is 10 years, with actions that may be ongoing, as well as those to be implemented in the near-term (1-3 years) and medium- to long-term (4-10 years). Below is a summary of the recommendations for Secaucus:

- **General Plans & Policies:** Approximately 90 percent of Secaucus is within the New Jersey Sports and Exposition Authority (NJSEA) Meadowlands District.² Consequently, the town adopts and abides by the plans the NJSEA prepares for properties within the district. The NJSEA's Meadowlands District Master Plan addresses transportation issues in Secaucus. The master plan does not directly address AFVs, but does indirectly support the concept. This readiness plan includes the following recommendations to purposefully integrate AFV preparedness into local plans and policies:

² For more information about the district, see <http://www.njsea.com/njmc/about/meadowlands-district.html>.

- Integrate AFV readiness into local planning efforts, including **general plans** and **climate action plans**
- Create **cross-jurisdictional opportunities** for sharing lessons learned
- Update the **PEV infrastructure demand analysis**
- Establish **design criteria** for AFV infrastructure
- Collaborate with **utilities** to share market information and facilitate necessary electricity distribution infrastructure upgrades
- Conduct **community education and outreach** to increase awareness about the benefits of AFVs and the role they can play in decreasing transportation costs and achieving environmental goals
- Conduct **targeted outreach** to MUD managers, developers, employers, and other landowners to install chargers at high-priority locations
- Collaborate with MUDs to create and implement policies that **allow residents to install** PEV charging infrastructure
- Identify **AFV grants and other funding opportunities** for workplace and public charging infrastructure development
- Pursue **public-private partnerships** to fund publicly accessible charger installations
- **Zoning & Parking Codes:** Neither the municipal site development requirements nor Meadowlands zoning requirements directly address AFVs. However, any Special Exception use is subject to a public hearing and a more detailed site design review. This gives the NJSEA zoning authority the opportunity to examine any planned developments for inclusion of PEV parking spaces and charging stations. The plan includes the following recommendations for zoning and parking codes:
 - Amend zoning codes to **require or incentivize PEV charging stations or pre-wiring** in new MUD and commercial developments
 - Establish **preferential parking policies** for PEVs and **amend parking codes** to regulate the use of PEV charging spaces
- **Permitting & Inspection:** Municipalities are responsible for administering and enforcing New Jersey codes through the state-mandated permitting and inspection processes. The New Jersey Department of Community Affairs (NJDEA) has been working to streamline the installation of PEV charging stations, including developing guidance on when construction permits and inspections are required and expediting the permitting process. Secaucus has not yet developed processes for administering building codes or electrical subcodes specific to the installation of PEV charging infrastructure. The plan includes the following recommendations for permitting and inspection:

- **Streamline and expedite** approval processes
- **Educate** permitting officials, inspection officials, and first responders in AFV station basics
- Produce **guidance documents outlining permitting requirements** for residential and commercial PEV charging station installations
- **Building Codes:** The NJDCA establishes and enforces statewide building codes — referred to as the Uniform Construction Code (UCC). Municipalities like Secaucus are limited to the statewide UCC, and are therefore not in a position to take a more progressive approach to building codes as they are related to PEVs or other issues. To that end, the plan includes only one recommendation for building codes:
 - **Work with the state to amend the building code** to require PEV station readiness in new single-family developments
- **Fleet Planning:** While often overshadowed by the consumer focus for PEVs, fleet planning is important to AFV readiness, particularly for NGVs. The plan includes the following recommendations related to fleet planning:
 - Assess **the existing municipal fleet**, develop a **fleet management plan**, and **explore opportunities** for fleet AFVs
 - Provide **technical assistance, training, and educational resources** to local fleet managers regarding AFV and infrastructure deployment

Conclusions and Next Steps

By following the recommendations outlined here, Secaucus will be well-equipped to support AFV use within the municipality, thereby reducing fossil fuel use, supporting a healthy environment, increasing economic development, attracting residents and businesses, and demonstrating leadership.

This is a comprehensive plan, but it only provides a snapshot in time. AFV readiness planning is an iterative and ongoing process. The alternative fuel industry is dynamic and this plan should be a “living” document that the Town of Secaucus revisits and updates as goals are achieved, new challenges arise, or circumstances change. In order to accomplish this, the Town of Secaucus should continue to engage stakeholders and solicit feedback on areas that may need additional attention.

There are numerous technical assistance resources available to provide the Town of Secaucus with ongoing support and direction, including the NJTPA and other organizations. The NJTPA project team also developed an AFV readiness guidebook to assist Secaucus and other municipalities with future planning efforts.

Introduction to Alternative Fuel Vehicle Readiness Planning

With the increased availability of and attention paid to AFVs in recent years, the NJTPA is supporting local and regional efforts to deploy these vehicles and related infrastructure for both the consumer and fleet markets. This report focuses on municipal readiness planning in the Town of Secaucus in Hudson County, New Jersey.

Municipalities can benefit from AFVs, particularly PEVs and NGVs. Benefits include reduced fuel costs for consumers, savings on maintenance, supporting domestic industries, and promoting environmental sustainability. The objective of readiness planning is to identify, prioritize, and implement strategies that unlock the potential of transportation electrification and NGV deployment. More specifically, AFV readiness planning lays out the path to make municipalities “AFV ready” by identifying the barriers to widespread deployment of infrastructure and vehicles, and outlining actions that will reduce and resolve these barriers. This plan also includes recommended actions community leaders and other stakeholders can take to help expand the use of PEVs and NGVs.

The value of AFV readiness planning is highlighted by work from the U.S. Department of Energy (DOE) and the International Council on Clean Transportation (ICCT). Researchers at DOE national laboratories demonstrated a correlation between higher PEV deployments and readiness planning, even after factoring in cold weather and incentive availability.³ Meanwhile, the ICCT assessed actions taken at the municipal level and concluded that there is quantitative support for the “ecosystem approach” as a best practice, where many stakeholders (including local municipalities) have key roles in enabling PEV growth; and that “cities are focal points for collaboration among governments, the auto industry, utilities, and advocates on electric vehicles.”⁴

Most readiness planning to date has been focused at the regional or state level. For instance, DOE awarded 16 projects in 2011, referred to as the Clean Cities Community Readiness and Planning for Plug-in Electric Vehicles and Charging Infrastructure,⁵ at the multi-state, state, regional, and metropolitan levels. This plan takes readiness planning to the municipal level, in an effort to accelerate the shift away from reliance on conventional vehicles to AFVs. This plan focuses on PEVs and NGVs. Both plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) make up the broader PEV category.

To the extent practicable, this plan considers the unique attributes that influence AFV usage in Secaucus, providing customized insights and recommendations. This plan can help decision-makers in Secaucus identify and prioritize the most effective ways to catalyze AFV deployment.

³ DJ Santini, Electric Drive Technology Market Trends, 2015 Clean Cities Strategy,

http://www.eere.energy.gov/cleancities/pdfs/2015_strategic_planning_presentation_electric_drive.pdf.

⁴ ICCT White Paper, Assessment of leading electric vehicle promotion activities in United States cities, 2015,

http://theicct.org/sites/default/files/publications/ICCT_EV-promotion-US-cities_20150729.pdf.

⁵ More information about these projects is available online at <https://cleancities.energy.gov/partnerships/projects#electric-vehicle-projects>.

This effort was sponsored by the NJTPA, the Metropolitan Planning Organization (MPO) for the 13 counties of northern and central New Jersey. Working with local stakeholders and drawing on national examples, three readiness plans were developed to understand existing conditions and recommend implementation strategies related to AFV readiness. The other plans were developed for Montclair Township and Woodbridge Township.

Relevant Regional Planning Efforts

The NJTPA has been involved in developing and implementing two related northern New Jersey plans that provide long-term, regional context to the development of local readiness plans for AFV infrastructure.

Together North Jersey Plan

The Together North Jersey (TNJ) Regional Plan for Sustainable Development, completed in 2015, is the result of three years of planning activities by a coalition of diverse partners. The Plan provides detailed strategies and specific actions, serving as a technical guide for implementation.

The TNJ plan has 15 focus areas, including *Focus Area 11: Transition to a clean energy economy*. Within Focus Area 11, there are four strategies, one of which is *Strategy 11.4: Reduce transportation petroleum use*, which in turn recommends actions in two categories: *travel optimization* and *advanced vehicles* actions. The advanced vehicles actions involve regional and local governments “...working with state officials and the private sector to speed the adoption of new vehicle technologies, especially electric, hybrid and other alternative fuel vehicles by implementing incentive programs, investments and other measures to encourage the purchase and use of these vehicles by individuals and fleet owners and significantly expanding the number public and private electric vehicle charging stations and alternative fuel vehicle refueling stations available in our region and statewide.”

There are nearly a dozen AFV related actions recommended. Of these, two are related directly to the development of AFV infrastructure and local readiness plans: (1) “Incentivize and support municipalities to develop and adopt alternative fuel readiness plans... Implement a variety of programs that encourage development of public charging infrastructure for electric vehicles across the region, with particular focus on the involvement of municipal governments...”; and (2) “Incentivize, support, and promote the development of private EV charging infrastructure at commercial (for employees or visitors), and residential properties...” The TNJ plan outlines several steps to implement these actions.

Source: togethernorthjersey.com

Plan 2045

Plan 2045: Connecting North Jersey is the NJTPA’s Regional Transportation Plan for northern New Jersey. The plan considers how AFVs, as well as other “game changing” technologies will shape transportation while offering a long-term vision to support the region’s economy and quality of life. Developed with extensive public and stakeholder input, the plan addresses infrastructure and transportation needs that ultimately will shape a positive, productive future for North Jersey.

Source: <https://apps.njtpa.org/plan2045>

Town of Secaucus

Located in northeastern Hudson County, one of 13 counties in the NJTPA region (see [Appendix G](#)), the Town of Secaucus is home to more than 18,170 residents and spans 5.8 square miles (see **Error! Reference source not found.**).⁶ The majority (90 percent) of Secaucus lies within the Hackensack Meadowlands district, while the remaining 10 percent is primarily residential development. The New Jersey Sports and Exposition Authority (NJSEA) serves as the planning and zoning agency for the Meadowlands District. The Town of Secaucus has adopted NJSEA's master plan, zoning regulations, codes and standards; however, the town reviews and approves applications for development, construction, and redevelopment on land in the district.

The town is divided into four sections: the downtown/residential portion in the north, the commercial/office space to the east of the New Jersey Turnpike, the industrial area in the central section, and the Secaucus Junction Station and adjacent residential apartment complexes in the south. A large portion of land on the edge of Secaucus is open space/marsh, which constitutes the majority of the land area. Approximately 40 percent is open space and other related uses, 30 percent is industrial, 20 percent of the land is residential, and 10 percent is commercial.

There are nearly 7,400 housing units within Secaucus, 59 percent of which are owner-occupied.⁷ Over half (57 percent) of the housing units are multi-unit structures, and 43 percent are single-unit.⁸ Harmon Cove, a high rise and townhouse development with more than 1,300 units, accounts for large portion of

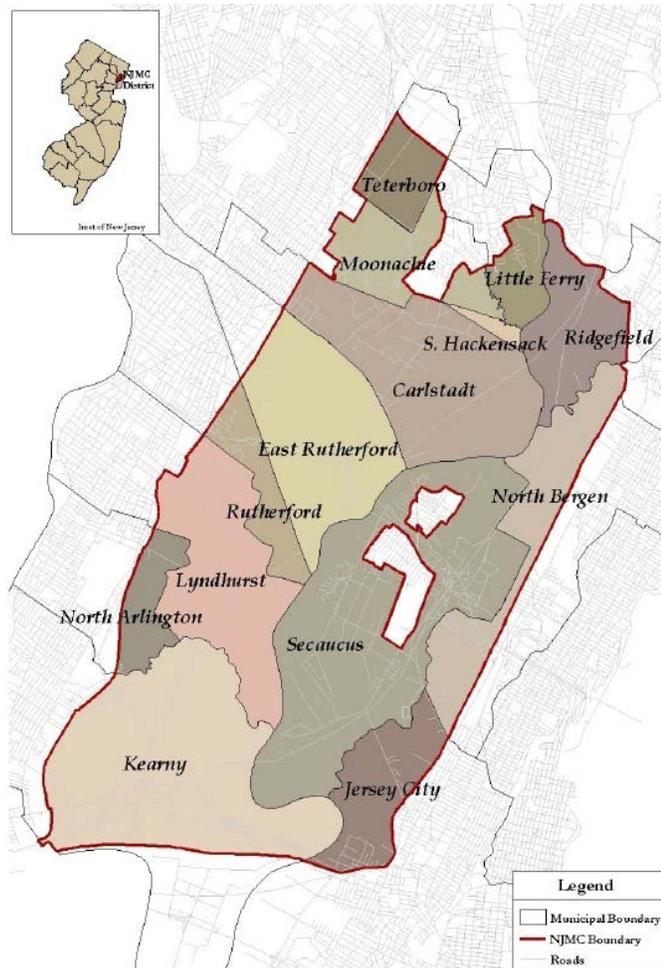


Figure 1. Map of Meadowlands District Municipalities, including Secaucus

⁶ U.S. Census Bureau (2011-2015). Total Population American Community Survey 5-year estimates, https://censusreporter.org/data/table/?table=B01003&geo_ids=06000US3401766570&primary_geo_id=06000US3401766570. Accessed April 14, 2017.

⁷ U.S. Census Bureau (2011-2015). Tenure American Community Survey 5-year estimates, https://censusreporter.org/data/table/?table=B25003&primary_geo_id=06000US3401766570&geo_ids=06000US3401766570,05000US34017,04000US34,01000US. Accessed April 14, 2017.

⁸ U.S. Census Bureau (2011-2015). Units in Structure American Community Survey 5-year estimates, https://censusreporter.org/data/table/?table=B25024&primary_geo_id=06000US3401766570&geo_ids=06000US3401766570,05000US34017,04000US34,01000US. Accessed April 14, 2017.

these dwelling units.⁹ Secaucus also includes land surrounded by the Meadowlands District that consists of established one- and two-unit dwellings.¹⁰ The town has one train station, Frank R. Lautenberg Rail Station — Secaucus Junction, which connects virtually all NJ TRANSIT rail lines serving northern New Jersey. Residents living near Secaucus Junction are mostly professionals that commute into New York City. On average, Secaucus residents spend 30.1 minutes commuting to work each day.¹¹ The majority (64 percent) of commuters report driving to work and 27 percent take public transit.¹²

There is a concentration of industrial and commercial complexes in the Secaucus Outlet Center, located in the County Avenue and Meadowlands Parkway areas of Secaucus. Commercial uses, predominantly in the form of retail and hotels, have also flourished along the Route 3 corridor.¹³

⁹ New Jersey Meadowlands Commission (2004). Master Plan, http://www.njsea.com/doc_archive/NJMC%20Doc%20Archive/econgrow_docs/lum_docs/NJMC%20Master%20Plan.pdf. Accessed on April 14, 2017.

¹⁰ *Ibid.*

¹¹ U.S. Census Bureau (2011-2015). Travel Time to Work American Community Survey 5-year estimates, https://censusreporter.org/data/table/?table=B08012&geo_ids=06000US3401766570&primary_geo_id=06000US3401766570. Accessed April 10, 2017.

¹² U.S. Census Bureau (2011-2015). Sex of Workers by Means of Transportation to Work American Community Survey 5-year estimates, https://censusreporter.org/data/table/?table=B08006&primary_geo_id=06000US3401766570&geo_ids=06000US3401766570,05000US34017,04000US34,01000US. Accessed April 10, 2017.

¹³ New Jersey Meadowlands Commission (2004). Master Plan, http://www.njsea.com/doc_archive/NJMC%20Doc%20Archive/econgrow_docs/lum_docs/NJMC%20Master%20Plan.pdf. Accessed on April 10, 2017.

Alternative Fuel Vehicle Readiness Planning Goals

The project team and Secaucus staff met throughout the course of the project. Staff from the environmental department and municipal engineering, construction and zoning officials were key members of the stakeholder advisory committee (SAC). The committee also included representatives from the police department, Secaucus Middle School, Hudson County, Hudson Transportation Management Association (TMA), and local businesses. SAC members provided valuable background data and critical review throughout the project. SAC meetings helped to articulate the town's vision for AFV readiness, to provide sufficient background material to stakeholders, and to gather input about the challenges, barriers, and opportunities related to AFV readiness. Secaucus considered stakeholder input and community priorities in developing the following goals:

- Climate Change
 - Reduce community reliance on fossil fuels and reduce carbon footprint by increasing usage of low carbon fuels and PEVs.
 - Make PEVs more accessible by providing options for public charging to encourage PEV use.
- Increasing Resilience
 - Use AFVs such as electric, biodiesel, biogas, and natural gas (advanced biofuels) to diversify fuel options for municipal and fleet use.
 - Provide useful information and insight for businesses in Secaucus, especially those with fleets, to adopt AFVs for employees/visitors/customers.
- Decreasing Air and Water Pollution
 - Encourage transportation options that help to reduce air and water pollutants.

Structure of the Readiness Plan

The Secaucus readiness plan is structured as follows:

[Section 1. Plug-In Electric Vehicles and Charging Infrastructure](#): This section begins with an overview of the PEV market today, including the type and number of PEVs registered in Secaucus; the location, quantity, and level of available charging infrastructure; a market outlook; a review of barriers to increased PEV adoption; a review of the regulatory framework in Secaucus and the region that impacts PEVs and charging infrastructure deployment; and a review of the incentives available.

[Section 2. Natural Gas Vehicles and Fueling Infrastructure](#): This section provides an overview of the status of NGVs and natural gas fueling infrastructure in Secaucus, a discussion of barriers to increased NGV adoption, and a natural gas market outlook.

[Section 3. Recommendations and Steps to Implementation](#): This section lays out the roadmap and recommended actions to achieve the town's AFV readiness goals. Recommendations are presented in a way that aligns with the types of infrastructure demand. Each recommendation references an entity or entities best suited to take responsibility for leading actions.

[Appendix A. Acronyms](#): This appendix lists the acronyms used in this document.

[Appendix B. Plug-in Electric Vehicle Forecasting Methodology](#): This appendix describes the methodology and assumptions used for the PEV forecasts presented in the plan.

[Appendix C. Charging Infrastructure Demand Forecasting Methodology](#): This appendix describes the methodology and assumptions used for the charging infrastructure siting analysis presented in the plan.

[Appendix D. Municipal Policy Examples](#): This appendix includes additional detail on policy examples mentioned in this plan.

[Appendix E. Plug-in Electric Vehicle Community Readiness Resources](#): This appendix is adapted from a compilation developed by the DOE and links to relevant documents, websites, case studies, and other resources.

[Appendix F. Additional Information on Parking](#): This appendix includes municipality-specific parking information beyond the scope of the main discussion.

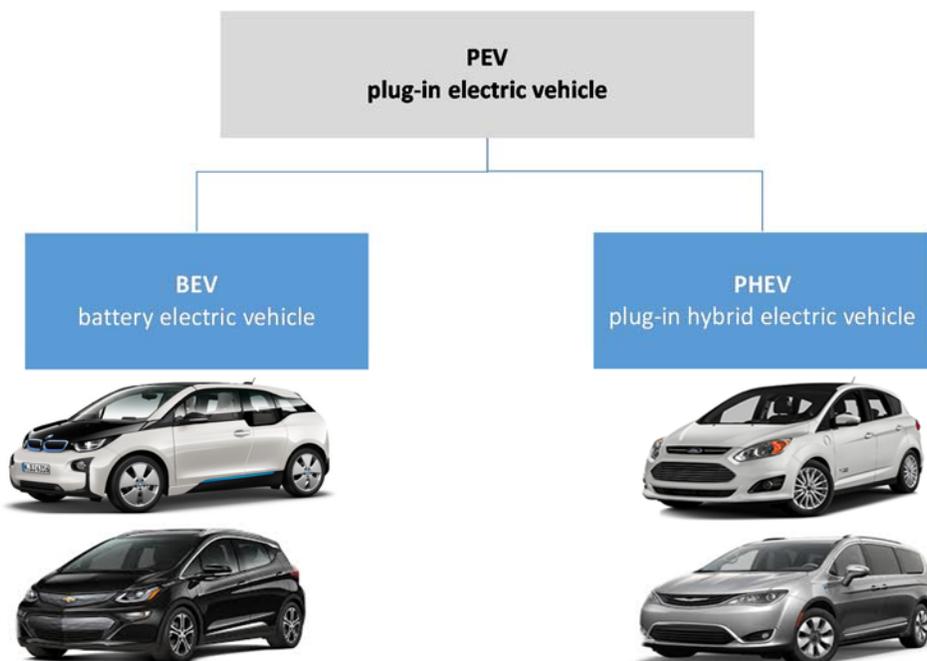
[Appendix G. Regional Planning Area](#): This appendix provides a description of the NJTPA region.

1 Plug-in Electric Vehicles and Charging Infrastructure

Overview

The national PEV market has expanded in scale, geography, and technology since manufacturers released the first modern PEVs in 2011. Driven by incentives, mandates, investment from industry, and enthusiasm from early adopters, new PEV sales in the United States grew from approximately 17,000 vehicles in 2011 to nearly 160,000 in 2016.¹⁴ Over that same period, charging infrastructure increased nearly 10 times.¹⁵ While California has historically led in PEV adoption, the Northeast and Mid-Atlantic regions are quickly becoming primary markets for PEVs. However, PEVs still account for less than 1 percent of the total light-duty vehicle market nationwide. There are many potential benefits associated with an increase in PEVs on the road, including lower operating and maintenance costs, improved air quality, and economic growth.

Both plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) make up the broader PEV category. PHEVs have both a battery-powered motor and an internal combustion engine (that uses gasoline) capable of powering the wheels; BEVs are powered exclusively by a battery-powered motor and do not use gasoline. The BMW i3 and Chevy Bolt (BEVs) and the Ford C-Max Energi and the Chrysler Pacifica (PHEVs), shown below, are examples of vehicles available to consumers



¹⁴ Argonne National Laboratory, Light Duty Electric Drive Vehicles Monthly Sales Updates, <https://www.anl.gov/energy-systems/project/light-duty-electric-drive-vehicles-monthly-sales-updates>. Accessed April 3, 2017.

¹⁵ U.S. DOE, U.S. Alternative Fueling Stations by Fuel Type, <http://www.afdc.energy.gov/data/10332>. Accessed April 3, 2017.

In 2017, there were upwards of 25 light-duty PEVs to choose from, and the market continues to expand as automobile manufacturers roll out additional models. Longer range BEVs – such as Tesla models and the Chevy Bolt – can drive 200 miles or more on a single charge. Other BEV models, like the Nissan Leaf and Volkswagen eGolf, have an electric range of 80-100 miles. There are a variety of PHEVs available that can travel 13-50 miles (depending on the model) in all-electric mode, after which the gasoline engine kicks in to provide additional range. Over the past several years, technological advancements (largely in batteries) have extended the electric range significantly. Continued advancements are likely to result in longer vehicle ranges and reduced purchase prices.

PEV charging infrastructure is typically differentiated by the maximum amount of power that can be delivered to a vehicle's battery. This determines the time that it takes to fully charge. Three categories of charging stations are dominating the market:

- **Level 1** chargers consist of a standard 110-volt alternating current (AC) outlet that provides 2-5 miles of range per hour of charging, depending on the vehicle and other factors. Level 1 is most commonly found in residential applications but can be suitable for some fleet and workplace charging applications.
- **Level 2** is a 220 or 240-volt AC outlet, and provides 10-20 miles of range per hour of charging. Level 2 can also be used at the home and workplace.
- **Direct current (DC) fast chargers** are more in line with the typical gas station refueling model, and provide 50-70 miles of range per 20 minutes of charging through different types of connectors – J1772 combo, CHAdeMO, and Tesla. The connectors for DC fast charging units are not standardized across vehicle manufacturers in the same way that Level 2 charging hardware is (via the J1772 standard). Furthermore, there are no PHEVs on the market today that can use a DC fast charger.¹⁶ In other words, not all PEVs currently available can use DC fast chargers, and even those that are equipped for fast charging may not have on-vehicle hardware compatible with the charging unit.

Just as vehicle and battery technology is advancing, so is charging infrastructure technology. For example, wireless charging is gaining attention as an option in certain applications, like home and fleet charging. Higher powered DC fast charging technology, providing up to 20 miles of range per minute of charging, is also in the works.

¹⁶ A potential exception to this is the “range extender” or REX. For the sake of simplicity, this plan refers to BEVs and PHEVs; the REX is a kind of hybridized powertrain. Range extenders typically have an engine powered by gasoline that is used to drive an electric generator, which supplies the vehicle's motor with electricity.

Vehicles and Infrastructure in New Jersey and Secaucus

Figure 2 shows PEV counts by county in New Jersey as of July 2017. Hudson County is among the bottom half of New Jersey counties, with more than 450 PEVs.

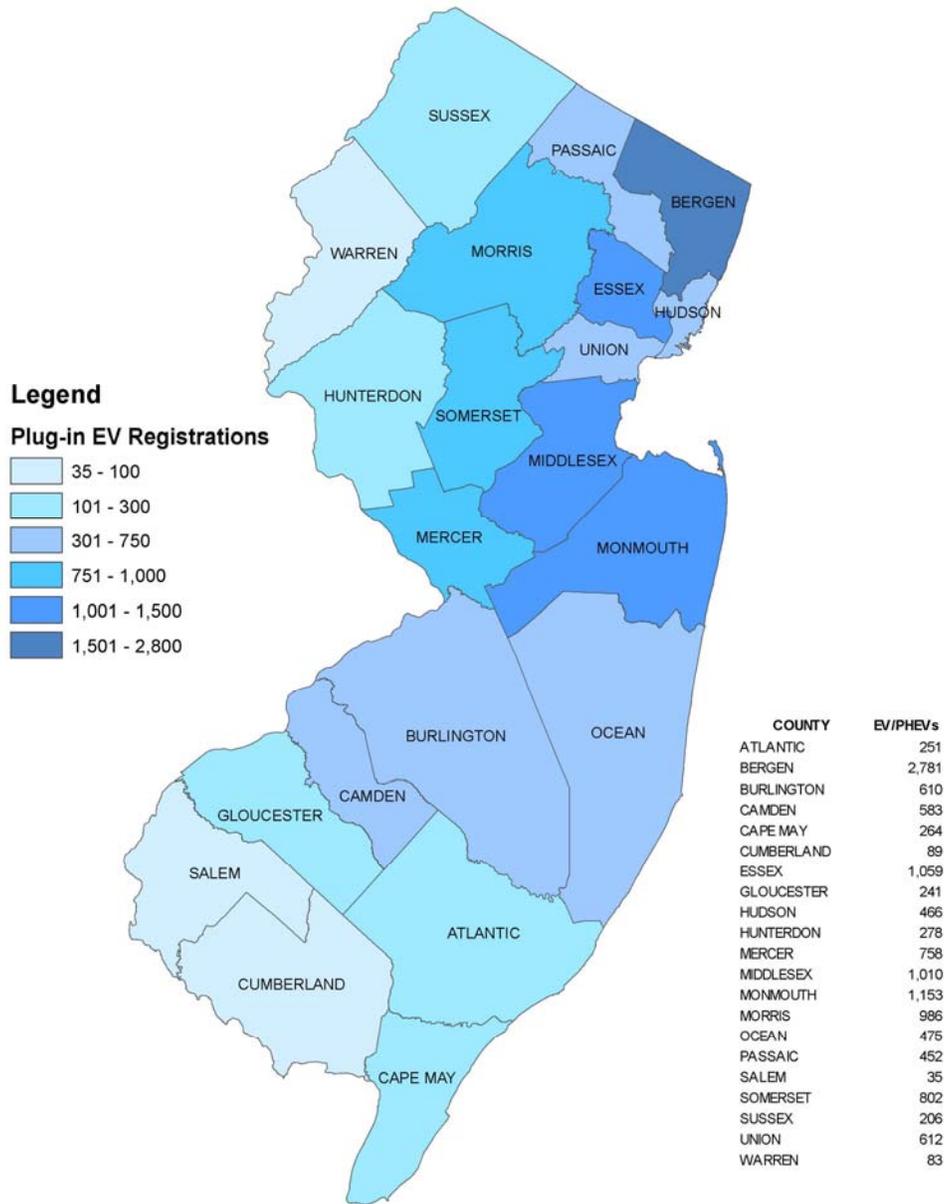


Figure 2. New Jersey PEV Registrations by County, July 2017¹⁷

¹⁷ Figure provided by the New Jersey Department of Environmental Protection (NJDEP) in August 2017. Data shown here may differ from the final version posted to the NJDEP Clean Vehicles website, <http://www.nj.gov/dep/cleanvehicles/>. Note that other PEV data sources exist, which may present different estimates.

Table 1 below provides data on the types of vehicles being used in Secaucus, as of July 2017. This data serves as an important baseline both in terms of tracking growth in ownership and forecasting future PEV demand in Secaucus.

Table 1. Vehicle Population in Secaucus, July 2017¹⁸

	PHEV	BEV	Total Vehicles	Percentage of Total
Secaucus	31	20	13,480	0.38%

PEVs make up 0.38 percent of total vehicles within Secaucus. This share is more than double the PEV percentage in Hudson County (0.16 percent), and is not significantly far off the national PEV penetration rate, which is less than 1 percent.

Providing adequate charging infrastructure can help accommodate and encourage increased use of PEVs. The DOE’s Alternative Fuels Data Center (AFDC) Station Locator¹⁹ provides data on charging infrastructure availability across the country.

As of October 2017, New Jersey had 216 public charging locations (14 Level 1, 186 Level 2, and 49 DC fast charging stations), with a combined total of 513 charging outlets (note that some locations have more than one charger type). There are an additional 45 private access locations with Level 2 charging stations, many of which are at Nissan dealership service departments.

Table 2 below includes the operational charging stations in Secaucus, according to the AFDC Station Locator, as of October 2017. The charging stations are also shown on the demand maps beginning with [Figure 3](#). Not shown in the table or on the maps, as they are not yet operational, are Level 2 charging stations located at the Secaucus Public Library and Business Resource Center and the Secaucus Recreation Center.

Table 2. Charging Infrastructure in Secaucus, October 2017

Charging Station Host/Name	Address	Accessibility	Charging Type	Charging Stations		
				L1	L2	DC Fast
Secaucus Town Hall	1203 Paterson Plank Rd	Private	Fleet/Workplace		2	
Secaucus Municipal Lot	1535 Paterson Plank Rd	Public	Public		1	
EDISONPARKFAST	675 New County Rd	Public	Public	1	1	
Residence Inn Meadowlands	800 Plaza Dr	Public/Guests	Public		2	

¹⁸ PEV counts were provided by the NJDEP, based on registration data from the Motor Vehicle Commission (NJMVC).

¹⁹ U.S. DOE, Alternative Fueling Station Locator, <http://www.afdc.energy.gov/locator/stations/>.

Barriers to Increased Plug-in Electric Vehicle Use

While there are significant benefits to increased PEV use, certain barriers exist which could limit the market's expansion.

- Vehicle Cost** — Upfront vehicle cost is likely one of the largest barriers to widespread PEV use. Battery costs comprise the largest percentage of a PEV's price; however, that cost has been decreasing per unit of energy and will continue to do so as manufacturers achieve additional technological breakthroughs and economies of scale in the future. Incentives are available at the federal and state levels to help reduce vehicle costs.

- Charging Station Build-out and Range Anxiety** — The majority of PEV charging occurs at residential locations when drivers plug in their vehicles after finishing a trip. The distance of some trips require additional charging — either at work or around town when visiting shops, restaurants, and other destinations. While public charging station network development can help with this (particularly DC fast charging for long-distance trips), the perceived lack of charging infrastructure may contribute to “range anxiety,” the fear that a vehicle may leave a driver stranded because it runs out of charge before reaching the intended destination.

Key Consideration: Charging Infrastructure Costs

The high costs of the infrastructure to provide publicly accessible charging infrastructure make it difficult to earn a profit because the commodity (i.e., electricity) being sold is comparatively inexpensive. While highly dependent upon specific site conditions, publicly accessible installations of Level 2 charging infrastructure can cost in excess of \$10,000; whereas DC fast charger installations can cost more than \$150,000. A [2015 National Academies Consensus Study Report](#) states that the high cost of installing public charging stations and the minimal revenue obtained from providing electricity present challenges for developing business models for profitable charging stations.

There are several challenges

associated with the deployment of publicly accessible charging infrastructure including funding, siting, permitting, and operational costs. On the municipal side, permitting and inspection processes can be a barrier. These issues are addressed further below and recommendations to overcome these barriers are included in [Section 3](#).

- Consumer Awareness** — The introduction of new technologies such as PEVs requires continuous outreach to consumers to deliver messaging that highlights PEV availability and benefits, including long-term cost savings as well as environmental, health, and community benefits. Furthermore, it is important to communicate the direct financial and nonfinancial benefits to drivers including tax credits, grants, and the PEV driving experience (e.g., fast acceleration and quiet vehicle operation) and the differences associated with fueling from the grid rather than from a gas station.

Market Outlook in Secaucus

As part of PEV readiness planning, it is important to understand the existing deployment of PEVs and charging infrastructure, as well as the market outlook, including factors such as who is buying PEVs, what type of PEVs are likely to be purchased, and projected market growth. Tracking the market using available data and through partnerships at the local, regional, and state level are means by which the town can stay informed and in touch. The type of PEVs that are on the roads and the locations in which they are registered can help characterize the demand for the different types of charging and applications (such as residential, workplace, and public charging). For instance, a market that is dominated by BEVs is likely to need more DC fast charging than a market that is dominated by PHEVs because BEV charging demands will likely be higher as a result of the larger batteries. This section provides a summary of the potential rate of PEV adoption in Secaucus and areas within where PEV demand might be highest.

Forecasted Plug-in Electric Vehicle Populations in Secaucus

For the purposes of this plan, residential PEV ownership forecasts in Secaucus were projected over a planning horizon from 2016-2030. Projecting PEV ownership at a local level beyond 2030 is not practical given the rapidly changing nature of the technology, demographics, land use changes, and local economic conditions. The forecasts are meant to guide the planning process, to help support deployment of PEV infrastructure, and to guide local policy and regulatory changes as appropriate.

Three PEV projections for Secaucus were developed based on varying assumptions around adoption trends. Table 3 summarizes the approach used to forecast PEVs in low and high usage scenarios. It also includes a GHG stretch scenario in which the state meets the emissions reductions set forth in the New Jersey Global Warming Response Act.²⁰

Table 3. PEV Forecast Scenario Descriptions

Scenario	Description
Low	Reflects usage trends comparable to the Reference Case in the Energy Information Administration's (EIA) Annual Energy Outlook (AEO) 2016, ²¹ adjusted slightly for increased potential indicated in the Mid-Atlantic region.
High	Assumes that PEV usage rates in Secaucus will be consistent with the Zero Emission Vehicle (ZEV) mandate in place for New Jersey, ²² with a fair-share assumption (i.e., that ZEV deployment will occur in the state on a population-weighted basis in the long-term).
GHG Stretch	The PEV strategy of the NJTPA Regional GHG Mitigation Plan calls for a 60 percent market share of PEVs by 2040 to meet state goals. The GHG stretch scenario assumes that PEV adoption rates will be slightly lower than the plan, with a 50 percent market share by 2040.

²⁰ Public Law 2007, c.112, N.J.S.A 26:2C-37

²¹ U.S. EIA, AEO 2016, [https://www.eia.gov/outlooks/aeo/pdf/0383\(2016\).pdf](https://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf), August 2016.

²² ZEV programs aim to increase sales of ZEVs, which include PEVs and fuel cell electric vehicles, by requiring that some portion of vehicle manufacturer sales in the state be ZEVs. More information on New Jersey's ZEV mandate is available on the NJDEP website at <http://www.nj.gov/dep/cleanvehicles/LEV.pdf>.

A more detailed description of the forecasting methodology, as well as corresponding graphs, are provided in [Appendix B](#). The results of these three forecast scenarios are as follows:

- Low Scenario: Approximately 450 PEVs on the road in Secaucus in 2030 (200 PHEVs and 250 BEVs).
- High Scenario: Approximately 1,250 PEVs on the road in 2030 (875 PHEVs and 375 BEVs).
- GHG Stretch Scenario: About 8,000 PEVs on the road in Secaucus by 2040.

To provide context, forecasts project that total light-duty vehicles will increase by about 10-12 percent in Secaucus by 2030, with about 15,000 vehicles of all types registered. The forecasts indicate that PEVs will comprise 6-17 percent of registered vehicles in Secaucus by 2030, compared to the current 0.38 percent. PEV market penetration will also increase across the region, with perhaps a larger number of PEVs driven by people working in and accessing public transit from the municipality. This will likely increase demand for charging infrastructure, positioning Secaucus to be an important contributor to a regional network supporting and reinforcing PEV market growth opportunities.

It is worth noting that the AEO is the source of adoption trends for the low case. The EIA is generally conservative in its electrification outlook, and the outlook does not force compliance with regulations like the ZEV program. Despite these limitations, the AEO is a useful source because it is transparent and typically consistent with national-level assessments. Further, it is updated annually, allowing the town and others to review updates to the outlook from one year to the next. The EIA's 2017 AEO is considerably more bullish on BEVs than the 2016 version. This type of update and change to the forecast can help planning processes and reinforces the notion of a flexible planning process than a deterministic one.

Forecasted Charging Infrastructure Demand in Secaucus

As part of this plan, a charging infrastructure demand analysis was conducted to broadly identify the areas within Secaucus that are most likely to see an increased demand for charging infrastructure. This analysis complements the vehicle forecasting discussed above, and introduces an important geographic component that can guide municipal policy and investments to meet the increased demand for charging infrastructure. [Appendix C](#) includes a detailed methodology of the charging infrastructure demand analysis.

The analysis uses key PEV ownership indicators and regional travel patterns to identify areas where there is potential demand for charging infrastructure. The Town of Secaucus can use these results to identify areas where charging station deployment is projected to have the greatest potential to be cost effective, as chargers located in areas where PEV drivers are most likely to travel will be utilized more. Research by Idaho National Laboratory demonstrated that charging equipment deployed as a result of a planning process, similar to this plan, experienced nearly 90 percent greater utilization (as measured by charging events per week) compared to charging equipment deployed in a sporadic, unplanned

manner.²³ However, it is important to note that the results of the demand analysis should not exclude areas from charging as their demographics evolve.

There are four primary types of charging to consider:

- Residential Charging – Highlights areas that will likely experience high demand for residential charging. Since residential charging takes place at home, these are locations in which likely PEV owners live. Residential charging is limited to Level 1 and Level 2 charging infrastructure. Today, the average PEV driver charges at home about 70-90 percent of the time. Most residential charging occurs at Level 1, as it typically does not require any additional investment on the part of the PEV owner. Level 2 charging is more common at residences for BEVs compared to PHEVs, especially those vehicles with ranges above 150 miles.
- Multi-Unit Dwelling Charging – Highlights areas in the region that will likely experience high demand for residential charging and have high incidence of multi-family units. Like residential charging, MUD charging is expected to be a combination of Level 1 and Level 2 charging. The market for MUD charging is in very early stages, and it is unclear which level of charging is most appropriate for this application.
- Workplace Charging – Highlights areas that will likely experience high demand for workplace charging, particularly areas where likely PEV owners work and vehicles are parked for several hours during the day. Level 1 and Level 2 charging are appropriate for workplace charging; ultimately, the appropriate level of charging is something that should be dictated by the facilities management, funding, and demand.
- Public Charging – Highlights areas that will likely experience high demand for public charging (i.e., other non-home or non-work charging), also referred to as opportunity charging. This includes areas where likely PEV owners shop, dine, and travel for recreational activities. Level 1, Level 2, and DC fast charging are all options for public charging, with dwell times (i.e., how long are drivers likely to be parked) and local site conditions (e.g., accessibility to sufficient electrical power) the most important factors in determining which strategy is appropriate.

The resulting analysis illustrates charging demand. Areas shown as warmer colors represent higher demand for charging while the cooler colored areas rank lower for charging demand. Each separate area is a traffic analysis zone (TAZ). The rankings and corresponding colors are based on the TAZ's demand score relative to the entire NJTPA region. For example, a TAZ ranked high (red) on the workplace charging demand map means that area scored in the top 5 percent for workplace charging demand across the NJTPA region. Similarly, a TAZ with a public/opportunity charging ranking of low (blue) scored among the bottom 40 percent for public charging in the region. Additional information about these percentiles can be found in [Appendix C](#).

²³ Idaho National Laboratory, *How Does Utilization of Non-Residential EVSE Compare Between those Installed in Oregon in Planned versus Unplanned Locations?*, <http://avt.inl.gov/pdf/EVProj/UtilizationOfNonResEVSEInstallationVsPlan.pdf>. April 2015.

Residential Charging

The infrastructure demand analysis is based on vehicle registration data and key socio-economic indicators that are positively correlated with PEV ownership, such as income, hybrid vehicle ownership rates, and property characteristics.

Figure 3 presents the results of the residential charging demand analysis, illustrating that the majority of Secaucus ranks in the medium category for demand. While the current socio-economic characteristics of households in Secaucus do not align with likely PEV adoption, this will change over time. Residential charging demand is the most market-driven of the four charging types, as the number of chargers installed at residences throughout Secaucus will grow as more PEVs are purchased or leased. [Section 3](#) includes recommendations to support the growth of residential charging in Secaucus, primarily through consumer education and outreach.

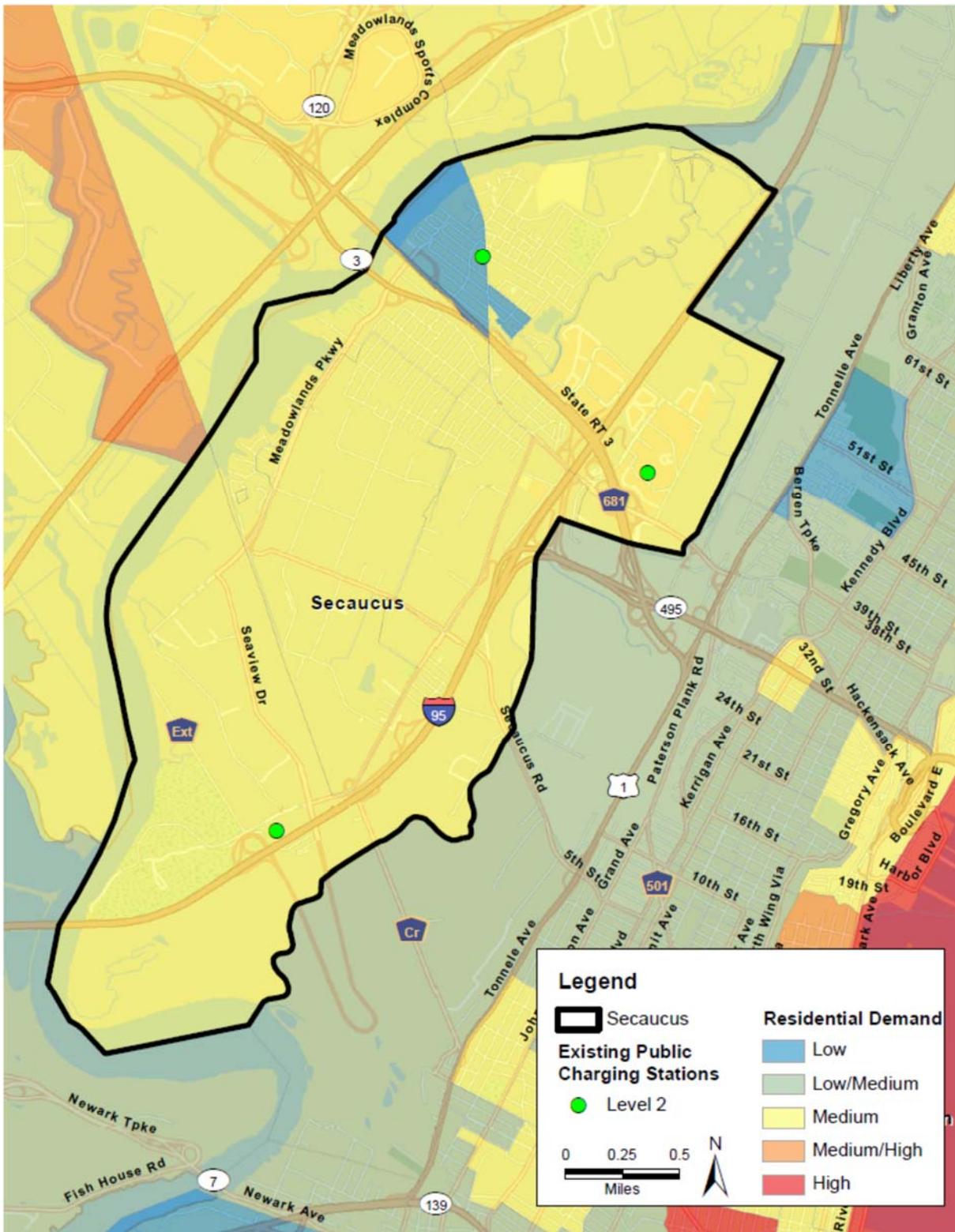


Figure 3. Residential Charging Demand Ranking

Multi-Unit Dwelling Charging

Secaucus is home to multiple large MUDs and mixed-use developments. A charging demand analysis was not conducted for Secaucus, as the locations of these buildings and upcoming developments are known by town staff. Areas include Harmon Cove and the Xchange.

Conversations with MUD management companies suggest there is limited demand for PEV charging at older, established buildings. Future demand for MUD charging will be driven by new developments and significantly renovated buildings that may draw higher income tenants who view PEV charging as an attractive amenity. [Section 3](#) includes recommendations specific to MUD charging, including outreach to property managers to gauge demand.



Workplace Charging

Figure 4 presents the results of the workplace charging demand analysis for Secaucus. Areas likely to experience high demand for workplace charging are typically found around employment clusters or centers. For Secaucus, workplace charging demand is high throughout the town, which is expected given the prevalent commercial and industrial land uses. In contrast, the northern residential area has a low demand, as that is not a workplace destination for likely PEV owners.

While the results of this analysis confirms that there is demand for workplace charging infrastructure throughout most of Secaucus, it does not point to specific areas or employers. The high opportunity zone analysis and resulting map (Figure 6) presented later in this section will be a useful tool to help the Town of Secaucus target businesses with a corporate presence, such as Hartz Mountain Industries, Inc., and other organizations with employee charging demand. [Section 3](#) includes specific recommendations to support workplace charging, primarily through employer outreach.

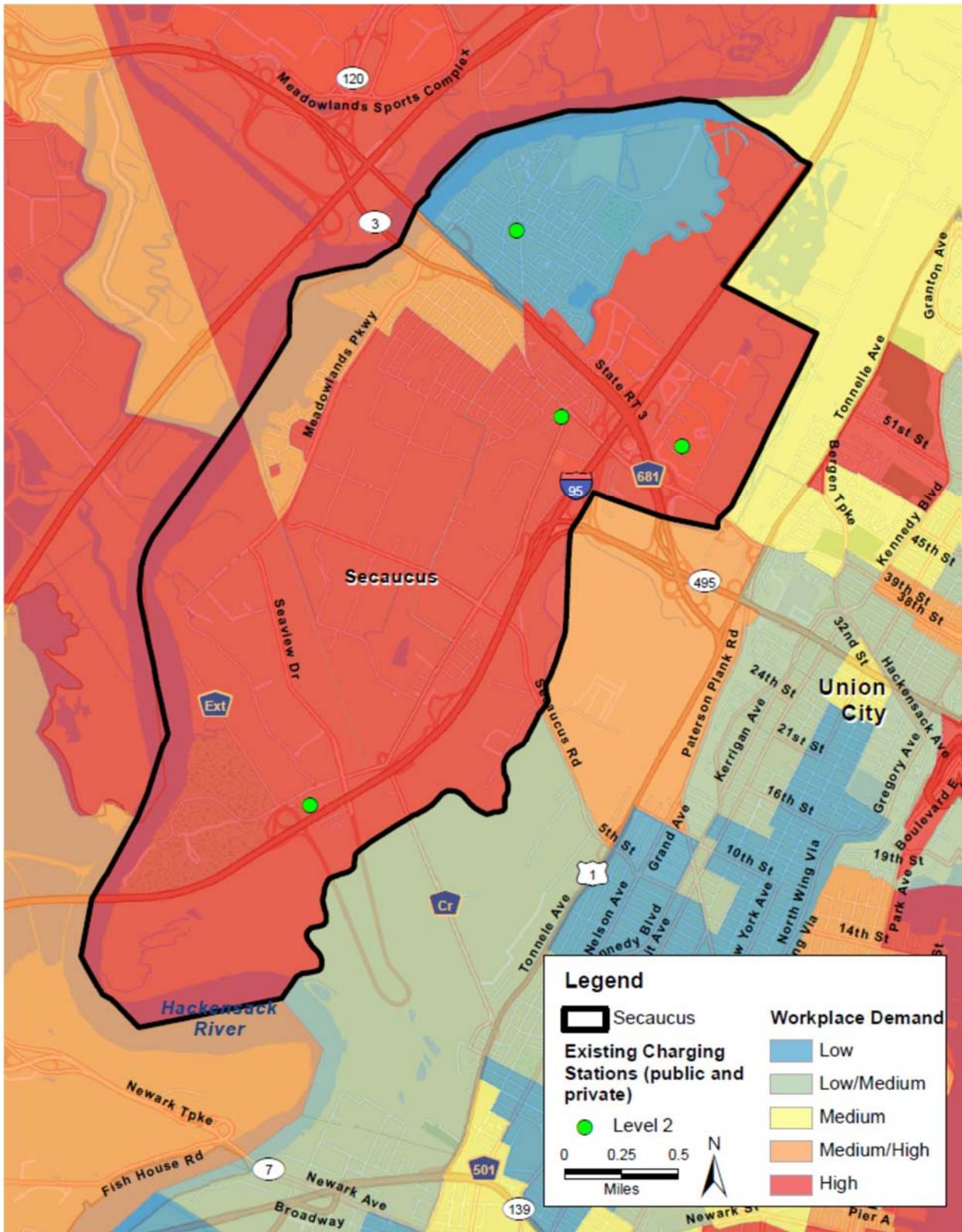


Figure 4. Workplace Charging Demand Ranking

Public Charging

Public charging, also referred to as opportunity charging, covers a wide range of potential charging situations (or opportunities) for a PEV driver away from home or work. Unlike residential and workplace charging, where vehicles are parked for long enough that they achieve a significant charge even with Level 1 charging, public charging will take place at locations where drivers are parked for varying times; therefore, it is important to consider the level of charging the stations offer. Table 4 shows the recommended charging method based on the available charging time at different venues.

Table 4. Available Charging Time and Recommended Charging Level for Different Venues²⁴

Typical Venue	Available Charging Time	Charging Level (Primary/Secondary)
Shopping Centers	0.5–2 hours	Level 2/DC Fast
Other (e.g., stand-alone retail)	< 1 hour	Level 2/DC Fast
Street/Meters	1–2 hours	Level 1/Level 2
Parking Garages	2–10 hours	Level 2/Level 1
Hotels/Recreation Sites	8–72 hours	Level 2/Level 1

Public charging will consist of predominantly Level 2 and DC fast stations, as it is more convenient for drivers to spend less time charging their vehicles.²⁵ The Secaucus public charging analysis focuses primarily on Level 2 charging infrastructure. Figure 5 shows the location of areas that are likely to experience high demand for public charging — these are locations where likely PEV owners shop, dine, and visit for recreational activities. In Secaucus, public charging is predicted to be the highest within the commercial district near Harmon Meadow and the Mall at Mill Creek. This is expected given the retail centers and other destinations, including restaurants, located in those parts of Secaucus. In addition, the central part of Secaucus, bordered by County Avenue to the east and Meadowlands Parkway to the west, appears as high demand. [Section 3](#) includes specific recommendations to support the deployment and use of public charging infrastructure.

²⁴ Source: ICF

²⁵ The Association of Electrical and Medical Imaging Equipment Manufacturers (NEMA), “EVSE: Powering the Electric Vehicle.” <https://www.nema.org/Products/Documents/nema+evse+presentation+for+communities.pdf>. Accessed February 1, 2017.

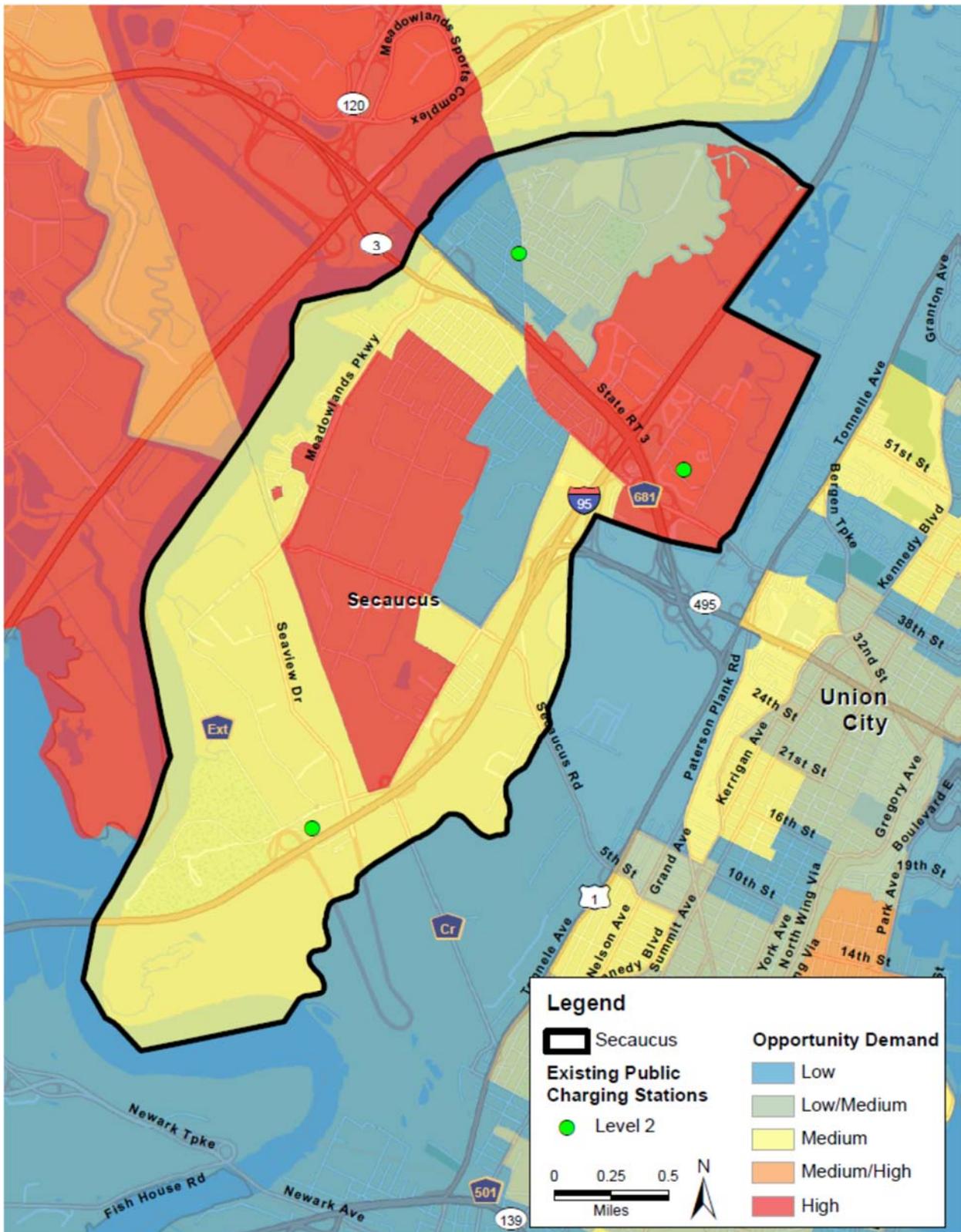


Figure 5. Public Charging Demand Ranking

While not a focus of the public charging analysis, DC fast charging is present in North Jersey and is seeing a great deal of growth in the Mid-Atlantic and across the country. DC fast charging is particularly well-suited for long-distance travel along corridors, as it provides a greater charge in a shorter period of time and correlates with the gas station way of fueling. This corridor approach has become the foundation of numerous infrastructure deployment efforts, such as the Express Charging Corridors Initiative,²⁶ and other private partnerships.

In late 2016, the U.S. Federal Highway Administration (FHWA) designated approximately 55 Interstate corridors as Alternative Fuel Corridors.²⁷ I-95 is a designated corridor, specifically for PEV charging, from Maine to Washington, DC, including the portion running through Secaucus. Both DC fast chargers and Level 2 chargers were considered during FHWA's review process for the initial designations. While this designation does not guarantee funding for projects, it may give I-95 and other Alternative Fuel Corridors priority for future funding. The FHWA also intends to provide support by facilitating cooperation and collaboration between states and within regions through convenings beginning in 2018.

High Opportunity Zones for Public and Workplace Charging

It can be challenging to select locations for public charging stations. Workplaces and homes typically have dedicated parking spaces for each worker or resident, vehicles spend the majority of time at work or at home, and commute trips are long, which means PEVs can often use a charge when they arrive at work or home. It is therefore easy to determine the right amount of charging stations at workplaces and homes; ideally these locations have at least one charger for every two PEVs. By contrast, demand for public charging, which currently accounts for less than 10 percent of all charging, is much more sporadic, and in locations where parking is either undersupplied (e.g., a bustling downtown commercial center) or oversupplied (e.g., a big-box retail store on a weekday morning). Furthermore, public charging can be expensive or labor-intensive to install, since charging stations may be in the public right-of-way, far from electrical panels, or in locations where adding a charging space means also adding a parking space in order to meet minimum parking requirements. Though public chargers can send a message to residents and others considering purchasing a PEV that charging is available, those charging stations can also end up as high-profile failures if they are underutilized or consistently occupied by non-charging vehicles.

Although public charging only accounts for a small share of the market today, this will likely change over time with increased access to DC fast charging. National and corridor-based infrastructure deployment efforts, such as Electrify America, are likely to increase opportunities for DC fast charging, or utilities may seek to support market expansion. Together, these types of market developments may help increase access to charging for MUD residents or enable more inter-regional travel, thereby increasing the share of public charging.

All that said, public charging is a key component to PEV readiness and deployment. For this reason, it is important to be thoughtful in placing such charging infrastructure. In addition to looking at where demand for charging is likely to be located, an effective public charging analysis identifies high opportunity zones where the environment supports successful charging stations. These zones are often

²⁶ For more information, see ChargePoint's press release at <https://www.chargepoint.com/about/news/bmw-volkswagen-and-chargepoint-announce-completion-electric-vehicle-express-charging/>, as well as various news articles.

²⁷ For more information about the FHWA Alternative Fuel Corridors, see https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/.

busy commercial areas with high demand for parking and ample turnover, which is conducive to well-utilized, highly-visible chargers. They can also be redevelopment areas or areas with public land uses where local governments have more control over development and therefore greater ability to place charging stations in the right location.

The high opportunity zone analysis for Secaucus leveraged municipal zoning data to identify commercial areas, redevelopment areas, and public land uses that could serve as an initial set of high opportunity zones. The second step was to overlay the high opportunity zones with the demand maps for workplace and public charging, confirming that the zones aligned with the demand analysis. Town of Secaucus staff reviewed the zones and provided input to help eliminate areas that may not be suitable, as well as consider additional areas not originally identified. Figure 6 identifies the resulting high opportunity zones for public charging and workplace charging. Note that some areas provide opportunities for both types of charging while others are more suitable for one or the other.

The high opportunity areas for public charging include the southern portion of the County Avenue/Route 653 corridor, Mill Creek Mall, along Wood Avenue, and multiple areas along Paterson Plank Road and Flanagan Way. Among these high opportunity zones are several municipal parking lots, specifically those located at the Secaucus Town Hall, Center Avenue, Plaza Center, and the Secaucus Public Library and Business Resource Center. Recognizing the town is already installing public charging at the town hall and library lots, these lots should be considered for expanded infrastructure that can serve residents, employees, and visitors.



For workplace charging, high opportunity areas are located north of Secaucus Junction station, along Castle Road and commercial buildings clustered near Osprey Cove. There are also several parts of Secaucus that may be ideal for charging intended to serve multiple users. The largest area is centered on the Harmon Meadow, south of I-95, which includes a large amount of retail and workplace destinations



such as Hartz Mountain Industries, Inc. In addition, Meadowlands Hospital²⁸ may be a suitable location, as the healthcare industry has been actively installing chargers serving both employees and hospital visitors. Similarly, the area to the north of the hospital, along Meadowlands Parkway, is home to workplaces as well as retail and other commercial locations.

[Section 3](#) includes specific recommendations for how the Town of Secaucus can use this analysis to focus effort and investment in a way that will support public and workplace charging infrastructure.

²⁸ The New Jersey Board of Public Utilities (NJBP) funded a microgrid feasibility study at the same location, see <http://www.state.nj.us/bpu/pdf/boardorders/2017/20170630/6-30-17-9G.pdf>. According to Mike Hornsby, NJBP, the project may incorporate PEV charging (noted during the Technical Advisory Committee meeting held October 17, 2017).

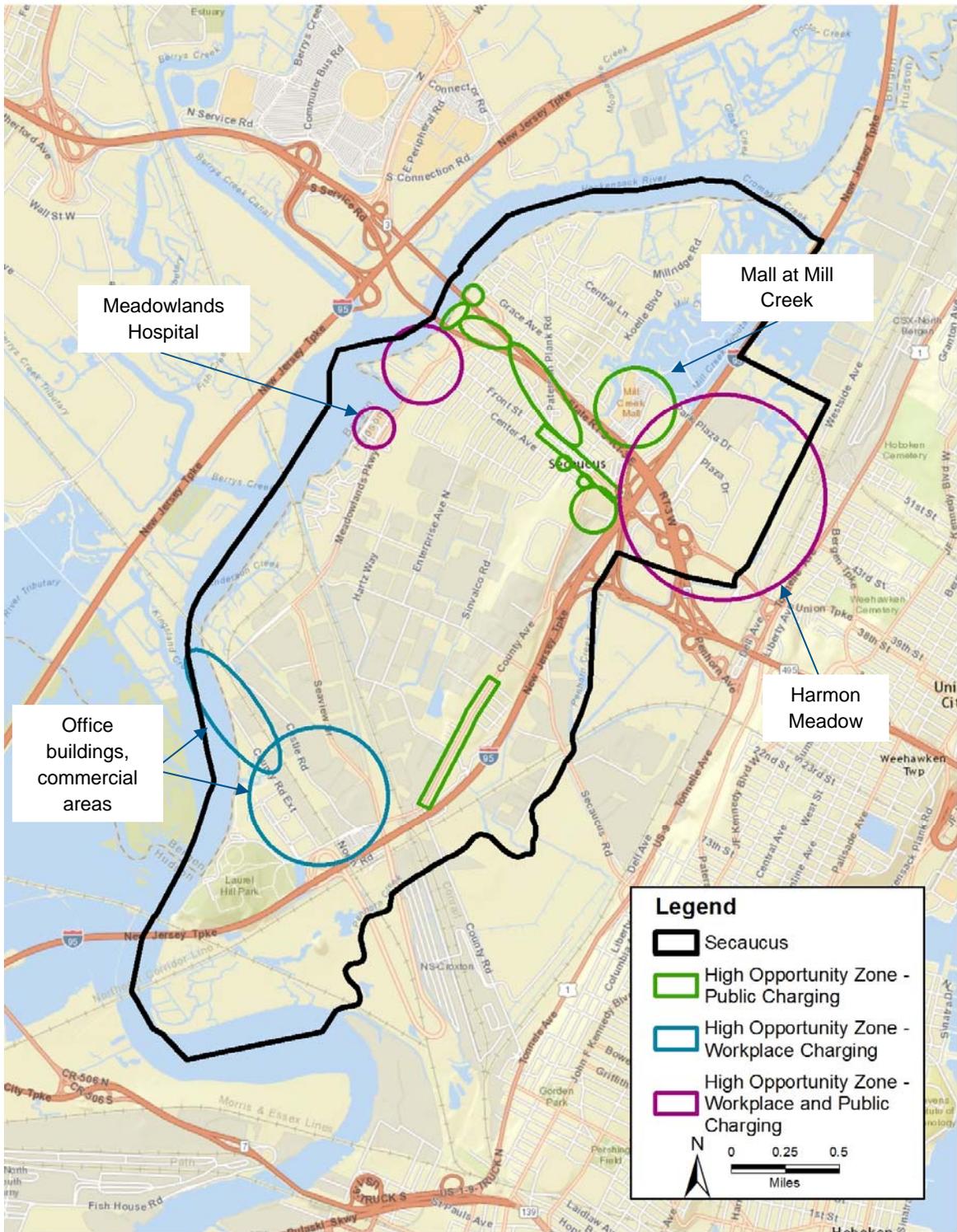


Figure 6. High Opportunity Zones – Public and Workplace Charging

Regulations

Regulations and policies at the municipal, state, and federal levels can play a role in facilitating increased PEV use. Regulations that can support the deployment of PEV charging infrastructure include building, electrical, and zoning codes; parking rules; permitting processes; and incentives.²⁹ This section provides an overview of the town's community plans as they relate to facilitating AFVs, PEVs in particular. It also addresses Secaucus' local zoning regulations and analyzes their potential to affect PEV charging station installation; regulations addressed include those relating to parking, site plans and site development, and environmental performance standards (noise, air quality, etc.). The relevant language and provisions related primarily to PEVs are described below. Regulatory information specific to NGVs and natural gas fueling infrastructure can be found in [Section 2](#).

Local Community Plans

Local community plans are forward-looking documents that both define a community's vision for the future and respond to anticipated future conditions with strategies and related actions. Community plans can proactively facilitate and encourage AFV use. They can do so by establishing policies that encourage inclusion of PEV charging infrastructure in new development or that support charging stations as a key element of the local transportation system.

Secaucus is unique in that approximately 90 percent of the town is within the NJSEA Meadowlands District.³⁰ Consequently, the town adopts and abides by the plans the NJSEA prepares for properties within the district. Current long-range plans for Secaucus were prepared under the auspices of the NJSEA regional land use planning programs. The NJSEA plan that addresses transportation issues relative to Secaucus is the *Meadowlands District Master Plan* (2004, NJSEA). The plan's vision is focused on preserving wetlands and open space while calling for the revitalization of polluted or blighted parcels into economic and community-oriented growth. The plan does not directly address the topic of AFVs. It does, however, indirectly support the concept of AFVs. The plan notes the need to improve air quality conditions by managing traffic and congestion, to provide a healthy environment, and to provide for "rapid mobility of people and goods and imaginative use of modern design and technology."

Zoning and Parking Codes

Through zoning codes, design standards, and parking rules, local governments have the opportunity to ensure both that there are sufficient charging opportunities to meet projected PEV demand and that PEV parking spaces are effectively designed and regulated to accommodate charging vehicles. Zoning codes can allow, encourage, or require appropriate placement of charging infrastructure in certain land use designations. Zoning code provisions, design standards, and parking rules can also specify requirements for design and installation, signage, accessibility, fees, time limits, lighting, and maintenance.

²⁹ Note that incentives are addressed in more depth in the Incentives and Funding section below

³⁰ For more information about the district, see <http://www.njsea.com/njmc/about/meadowlands-district.html>.

Local zoning provides for the direct implementation of land use policy in a community by setting standards and guidelines for land development. While PEV charging stations are generally not considered independent land uses in and of themselves, they have implications for site function and character. In terms of site functionality, they are a distinct element of the parking supply, impacting site circulation, including pedestrian circulation and safety and handicap access. Infrastructure for charging PEVs is, therefore, an important element of site planning and design in terms of location, scale, and relationship to overall site use. Consequently, it is to a community's advantage to address charging infrastructure in the course of zoning language in general and parking requirements and site plan review in particular. Zoning also offers an opportunity to include incentives for site design as a tool to encourage accommodations for PEV use.

Zoning in Secaucus for properties within the district is provided in accordance with the town's ordinance Adopting Meadowlands Regional Commission Master Plan, Zoning Regulations, Codes and Standards. This ordinance details responsibilities of each for development review. Neither the municipal site development requirements nor Meadowlands zoning requirements directly address AFVs. However, any Special Exception use is subject to a public hearing and to more detailed site design review, which gives the NJSEA zoning authority an opportunity to examine any planned developments for inclusion of PEV parking spaces and charging stations.

Permitting and Inspection

Streamlined permitting and inspection processes are key to PEV planning. These processes can help expedite the installation of charging stations at appropriate locations, provide the service at a reasonable cost to consumers, and maintain the safety of consumers and the public.

The New Jersey Clean Cities Coalition (NJCCC) has worked with the New Jersey Department of Community Affairs (NJCA), the agency that oversees the statewide code, to clarify and, where possible, streamline the permitting process for PEV charging stations. In 2011-2012, the NJCA published an article, *"Electric Vehicle Charging Stations – What you need to know,"* which is the most recent guidance available from the state on the installation of PEV charging stations at residential locations. The article includes Table 5 showing when construction permits and inspections are required for the installation of PEV charging infrastructure.

Table 5. New Jersey Permit Requirements for Charging Stations³¹

Project	Permit Required	Inspection Required	Classification
Existing outlet is sized correctly but plug configuration is not compatible with equipment plug necessitating the replacement of the outlet to one with proper configuration.	No	No	Ordinary Maintenance NJAC 5:23-2.7(e)3 http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
Upgrade circuit breaker and wire to higher rating (15 amp to 20 amp)	Yes ¹	Yes ²	Minor Work NJAC 5:23-2.17A http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
Vehicle charging system being installed that requires new 120 or 240 volt outlet or an electrical line that will be directly connected to the system.	Yes ¹	Yes ²	Minor Work NJAC 5:23-2.17A http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
1 - The issuance of a construction permit is not required before the work may proceed. However, the owner or electrical contractor acting on behalf of the owner must notify the local code enforcing agency before the work begins. Also, a permit application must be filed and must be delivered in person or by mail within five business days from the date of oral notice.			
2 - An inspection must be performed within 30 days of the request for inspection and is based upon what is visible at the time of the inspection with the certificate of approval stating so.			

Another NJDCA article provides more detailed information on permitting for residential PEV charging stations: *“Electric Vehicle Charging Stations – Installation and Permit Requirements”* (in NJDCA’s Construction Code Communicator, Vol. 23, Number 1, Spring 2011). NJDCA provides contacts for additional information regarding the installation of PEV charging stations: NJDCA, Division of Codes and Standards, Code Assistance Unit at (609) 984-7609.

In June 2011, NJDCA announced the results of its review of applicable state codes and regulations and determined that installation of residential PEV charging equipment is considered “minor work”, i.e., the homeowner or contractor need only provide verbal notification to the local code enforcement agency prior to starting the installation and submit the permit application within five days of notification, so they do not have to wait up to three weeks for permit approval.

The challenges associated with local permitting and inspection of PEV charging infrastructure vary depending on the type of property at which the infrastructure will be located. For PEV charging, factors include whether it is at a single-family residence, at a MUD, or a commercial property. Since the majority of demand for PEV charging infrastructure is likely to be at privately owned residences and workplaces, local governments can support successful large-scale deployment of PEVs by being prepared to handle

³¹ NJDCA, *Electric Vehicle Charging Stations – What you need to know*, http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

increased volumes of permit requests for charging infrastructure installations in an efficient and safe manner.

The main approval process applicable to AFV infrastructure installation is the issuance of permits relative to the building code, and sub-codes relating to electrical, fire, etc., whose application contents and process requirements are set out in state law. New Jersey municipalities are responsible for administering and enforcing the state codes through state-mandated permitting and inspection processes.

Secaucus has not yet developed processes for administering building codes or electrical subcodes specific to the installation of PEV charging infrastructure. The list below summarizes key permitting process characteristics for Secaucus:

- **Time to Issue Permit:** Within 2-3 weeks, assuming good quality application
- **Permit Fee:** Dependent on sub-code and installation type
- **Permit Availability:** Over the counter only
- **Permit Staff Training:** None specific to AFV infrastructure

Building Codes

Building codes contain safety standards and specifications that guide new construction and renovations. NJDCA, specifically the Division of Codes and Standards, establishes and enforces statewide building codes—referred to as the Uniform Construction Code (UCC). There are two major opportunities to create building codes that support PEV deployment. The first is to specify standards for PEV charging infrastructure in the building code to ensure that any charging station installations are safe and accessible. The second is to require pre-wiring for charging stations to lower the cost of future installations. Pre-wiring refers to the practice of providing sufficient basic infrastructure, such as conduits, junction boxes, outlets serving garages and parking spaces, adequate wall or lot space for future charging infrastructure, and adequate electrical panel and circuitry capacity, to meet anticipated future charging demand.

Municipalities like Secaucus are limited to the statewide UCC, and are therefore not in a position to take a more progressive approach to building codes as they are related to PEVs or other issues. Some, municipalities have taken steps to advocate for UCC updates that incorporate PEVs where appropriate and feasible.

Incentives and Funding

There is a variety of financial support at the federal, state, and local levels for individuals and local fleets interested in investing in PEVs and charging infrastructure. These include financial incentives, such as tax credits, vehicle rebates, and insurance discounts, as well as non-financial incentives, like high occupancy vehicle (HOV) lane access. This section provides an overview of each primary form of financial support as well as who the funding is available for (consumers, businesses, non-profits, and/or public entities may be eligible for any given program).

Additional funding opportunities and incentives may emerge in the future, such as state-level programs funded through the Volkswagen Clean Air Act Settlement and auto manufacturer partnerships to offer vehicle purchase price discounts. The New Jersey Department of Environmental Protection (NJDEP) has established a website to provide more information for New Jersey.³²

Volkswagen Clean Air Act Settlement

The Volkswagen (VW) Settlement established two funding sources that may result in AFV deployment and infrastructure support in and around the Town of Secaucus.

- ZEV Investment Plan: VW, through a newly formed entity called Electrify America, will install, operate, and maintain ZEV infrastructure nationwide, initially focusing on 11 major metropolitan areas. The New York City metro area, which includes Secaucus, will receive the following benefits:
 - Level 2 charging installation at MUDs, workplaces, and public sites
 - DC fast charging facility installation on highway and other transportation corridors
 - Education and outreach that builds or increases public awareness of ZEVs
- Environmental Mitigation Trust: The State of New Jersey is eligible to receive and use approximately \$72 million in funding. While the specific program in New Jersey has yet to be established or implemented, these funds could be used to replace polluting diesel equipment with cleaner vehicles, including local freight trucks, transit buses, school buses, shuttle buses, and refuse trucks. A certain portion of these funds could also be used to install PEV charging stations.

For more information, see www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement.

Incentives for Vehicle Purchasers

Vehicle purchase incentives typically help to reduce the upfront cost of a qualified PEV, either at the point-of-sale or later. Other variations of vehicle purchase incentives include cost reductions, fee waivers, and other special privileges associated with the vehicle. Some utilities, for example, offer reduced charging rates for eligible PEV drivers. Table 6 provides an overview of the available incentives for PEV purchasers in New Jersey.

³² See <http://www.state.nj.us/dep/vw/>.

Table 6. Incentives for PEVs

Type	Incentive/Program	Funder/Administrator	Eligible Entities	Timeline	Incentive Summary
Federal	Plug-In Electric Drive Vehicle Tax Credit	IRS	Individuals, businesses, government entities	Available, deadline not specified; phases out based on sales	\$2,500-7,500, depending upon battery capacity. Tax credit can be combined with state level rebates.
Federal	Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Federal Highway Administration	State DOTs, MPOs, local governments, transit agencies	As funds are available	The CMAQ program provides funding (via DOTs and MPOs, including the NJTPA) for eligible transportation projects that contribute to air quality improvement and congestion relief. Publicly owned AFVs, such as PEVs, are eligible for CMAQ funding; however, vehicles must provide a dominant transportation function.
State	ZEV Tax Exemption	NJ Division of Taxation	Individuals, businesses	Timeline not specified	ZEVs sold, rented, or leased in New Jersey are exempt from state sales and use tax. This exemption is not applicable to partial ZEVs, including HEVs.
State	HOV Lane Exemption and Toll Discount	NJ Turnpike Authority (NJTA)	Individuals, businesses, government entities	Expires September 30, 2019	The NJTA allows qualified PEVs to travel in the HOV lanes located between Interchange 11 and Interchange 14 on the New Jersey Turnpike. The NJTA offers a 10 percent discount on off-peak New Jersey Turnpike and Garden State Parkway toll rates through NJ EZ-Pass for drivers of vehicles that have a fuel economy of 45 miles per gallon or higher and meet the California Super Ultra Low Emission Vehicle standard.

Incentives for Charging Infrastructure Deployment

Incentives and financing options are available to help defray the costs of deploying charging infrastructure. Some programs aim to reduce or eliminate the cost of eligible equipment (e.g., Level 2 charging station) while others provide funding for equipment and installation costs. Table 7 includes an overview of the available incentives for PEV charging infrastructure deployment in New Jersey. In addition, programs such as the NJDEP NJ Charging Challenge provide special recognition to employers making their workplaces PEV ready.³³

³³ For more information, see www.drivegreen.nj.gov/programs.html.

Table 7. Incentives for PEV Charging Infrastructure

Type	Incentive/ Program	Funder/ Administrator	Eligible Entities	Timeline	Incentive Summary
Federal	Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Federal Highway Administration	State DOTs, MPOs, local governments, transit agencies	As funds are available	The CMAQ program provides funding (via DOTs and MPOs, including the NJTPA) for eligible transportation projects that contribute to air quality improvement and congestion relief. PEV charging infrastructure may be eligible for CMAQ funding.
Federal	Low and Zero Emission Vehicle Research, Demonstration, and Deployment Funding	Federal Transit Administration	Local, state, and federal government entities; public transportation providers; private and non-profit organizations; and higher education institutions	Not specified	Financial assistance is available for research, demonstration, and deployment projects involving low or zero emission public transportation vehicles. Funding may cover up to 80% of project costs, with a required 20% non-federal cost share requirement. Eligible vehicles must be designated for public transportation use and significantly reduce energy consumption or harmful emissions compared to a comparable standard vehicle.
State	Workplace Charging Station Grants	NJDEP and New Jersey Board of Public Utilities (NJBPU)	Businesses, nonprofits, government entities	As funds are available	Reimbursement grants are offered on a first-come, first-served basis for the cost and installation of eligible charging stations at workplaces, government and educational facilities, nonprofits, and parking facilities. Funding up to \$250 is available for each Level 1 charging stations installed and up to \$5,000 for each Level 2 charging stations installed. Current funding has been allocated as of January 2017, though interested applicants may be put on a waitlist in anticipation of additional funding.
Utility	Workplace Charging Station Incentives	PSE&G	Businesses, nonprofits, government entities	As funds are available	PSE&G provides free charging stations to companies in their service territory for the purpose of workplace charging. Chargers are available on a first-come, first-served basis to companies that secure a commitment from at least five employees who will use a PEV for their commute. PSE&G will own the chargers and collect usage data.
Nonprofit	Sustainable Jersey Small Grants	Sustainable Jersey	Municipal governments	As funds are available	Grants are available to help municipalities achieve progress toward Sustainable Jersey certification and general sustainability. Eligible projects must align with actions for which municipalities could score points toward certification, such as "Make Your Town Electric Vehicle Ready" and "Public Electric Vehicle Charging Infrastructure."

2 Natural Gas Vehicles and Fueling Infrastructure

Overview

While PEVs primarily serve the light-duty consumer market, the NGV industry targets the medium- and heavy-duty fleet sectors. Following an initial surge in NGV interest in the mid- to late-1990s, natural gas fueling infrastructure increased steadily from approximately 750 stations across the country in 2007 to more than 1,800 in 2016.³⁴ The use of natural gas as a vehicle fuel grew by 75 percent in that same period.³⁵ Once again, incentives and investment from industry have been important drivers for this growth. Currently, natural gas only accounts for 3 percent of transportation fuel (based on energy content).³⁶ Additional development of this market is focused on strategic deployment of NGVs in appropriate fleets. For example, nationwide, CNG vehicles account for 35 percent and 55 percent of the transit bus and refuse truck markets, respectively.^{37,38}

The deployment potential for natural gas vehicles is mainly linked to the medium- and heavy-duty truck fleet market sectors. For instance, as part of the American Recovery and Reinvestment Act, the NJCCC led a statewide public/private partnership — including Clean Energy, Atlantic County Utilities Authority, Waste Management of New Jersey, Atlantic City Jitney Association, Central Jersey Waste & Recycling, and others — that put more than 300 NGVs on the road in refuse and shuttle bus applications, and included the development of six CNG fueling stations. There are significant market barriers to more widespread use of natural gas in the transportation sector. These are not unique to any particular town or municipality. Rather, they are a function of issues outside the purview of local governments.

Vehicles and Infrastructure in New Jersey and Secaucus

Given that the primary market sectors for NGVs are medium- and heavy-duty vehicles, municipal NGV readiness planning is more limited than the consumer focus of PEVs. That said, NGV readiness involves close coordination with the gas utility; adopting policy language that will support natural gas (and, more broadly, alternative) fueling stations; creating a regulatory framework for NGV fueling infrastructure; and possibly incentivizing or requiring NGVs. Several locations across New Jersey, for example, have provided bid preferences for municipal contractors (e.g., trash collection) who use natural gas or other AFVs.

According to the most recent report by the NJCCC,³⁹ there are just over 1,000 light- and heavy-duty NGVs in New Jersey. Although this list is not exhaustive, it represents a robust estimate of the NGVs registered statewide. Of the vehicles reported, more than 85 percent are heavy-duty vehicles; and of

³⁴ U.S. DOE, U.S. Alternative Fueling Stations by Fuel Type, <http://www.afdc.energy.gov/data/10332>. Accessed April 3, 2017.

³⁵ U.S. Energy Information Administration (EIA), U.S. Natural Gas Vehicle Fuel Consumption, <https://www.eia.gov/dnav/ng/hist/n3025us2m.htm>. Accessed April 3, 2017.

³⁶ U.S. EIA, Energy Use in Transportation, http://www.eia.gov/energyexplained/?page=us_energy_transportation. Accessed April 3, 2017.

³⁷ NGVAmerica, Transit, <http://www.ngvamerica.org/vehicles/for-fleets/transit/>. Accessed April 3, 2017.

³⁸ NGVAmerica, Refuse, <http://www.ngvamerica.org/vehicles/for-fleets/refuse/>. Accessed April 3, 2017.

³⁹ U.S. DOE, 2016 Transportation Technology Deployment Report: NJCCC, March 2017.

those heavy-duty vehicles, more than 50 percent are refuse or transit vehicles. More granular data, specifically at the municipal level, is not readily available. The NJDEP provides NGV estimates, but the counts are inclusive of propane vehicles.⁴⁰

Of the 28 CNG fueling stations in New Jersey as of October 2017, 13 are accessible to the public and 15 are meant for private (i.e., fleet only) use. There are no liquefied natural gas (LNG) fueling stations in New Jersey.⁴¹

Barriers to Increased Natural Gas Vehicle Use

Deploying NGV technology offers numerous benefits as compared to gasoline and diesel vehicles, including emissions reductions and improved air quality. However, there are substantial barriers to NGV implementation that impede progress towards more significant market growth. Understanding the key barriers below can help municipalities and fleet owners plan wisely and act accordingly.

Low Gas Quality for Transportation Applications

Natural gas in common carrier pipelines has a variety of end uses — space heating, industrial processes, electricity generation, and as a transportation fuel (after compression). Natural gas quality in the pipeline transmission system can vary depending on a number of factors. In the northern PSE&G territory, including Secaucus, there have been gas quality issues linked to the presence of refinery gas in the pipeline, a function of an agreement between PSE&G and the Bayway Refinery (Phillips 66) in Linden, New Jersey. Furthermore, during periods of peak gas demand (i.e., extremely cold winter days), PSE&G often supplements its natural gas supply by adding propane to the distribution system. Both of these issues hinder the use of pipeline natural gas as a transportation fuel since higher quality gas is required for combustion in heavy-duty CNG vehicles. Similarly, the combustion engines in CNG vehicles are not designed to manage the potential blend of propane and natural gas.

As of September 2017, PSE&G no longer accepts Bayway Refinery gas into its system.⁴² However, it is unclear if this alone will resolve the gas quality issue hampering NGV adoption in the region.

Lack of Incentives

Although there are certain applications of NGVs that provide attractive payback periods compared to their diesel counterparts (after accounting for fuel and operational savings), the incremental cost of purchasing an NGV compared to a diesel or gasoline vehicle remains an impediment to increased use. Part of this is due to the lack of sustained state incentives for the purchase of cleaner-burning NGVs. Across the country, states are encouraging increased use of AFVs and AFV infrastructure through incentives, such as vouchers, rebates, and grants. In addition, many jurisdictions allow preferences in public procurements for those bidders that use, or pledge to use, AFVs in executing their contract.

⁴⁰ NJDEP, Natural Gas Vehicle Distribution, <http://www.nj.gov/dep/cleanvehicles/Alt-Fuel%20Vehicles%20&%20Stations%20-%20Natural%20Gas.pdf>. Accessed October 20, 2017.

⁴¹ U.S. DOE, Alternative Fuels Data Center, Station Locator, <http://www.afdc.energy.gov/locator/stations/>. Accessed April 10, 2017.

⁴² Kenny Esser, PSE&G, via email communication, September 6, 2017.

Funding resulting from the VW Environmental Mitigation Trust mentioned previously may be used for NGVs and fueling infrastructure, depending on the state's implementation approach. The NJBPU has also provided grants for commercial NGVs in specific counties, including Hudson County.⁴³

Fuel Price Differential

The increase in accessible supply of natural gas in the 2010-2011 timeframe contributed to a significant price differential between diesel and natural gas. Because NGVs have a higher incremental cost due to the expense of specialized fuel systems and fuel tanks, the payback period is greatly dependent upon the lower cost of natural gas relative to diesel and gasoline. While the low price of diesel has extended this payback period, as diesel prices rise, the price differential will help improve deployment potential. The diesel fuel tax increase in New Jersey, enacted in October 2016, gives a further advantage to NGVs. One clear economic advantage of natural gas is the relative price stability, which is an important factor to consider for a fleet manager or business owner. The commodity price for natural gas makes up a relatively small portion of the price for CNG at the pump. For example, an increase of \$1.50 per million British thermal units (MMBtu) in the cost of natural gas translates to only a \$0.25 increase per diesel gallon equivalent (DGE) at the pump. Diesel, on the other hand, suffers price spikes because the raw commodity makes up a much larger portion of the price at the pump. Although the price of natural gas is much more stable than that of petroleum fuels, the price differential is often not sufficient to offset the higher upfront cost. Absent incentives and improved accessibility to fueling infrastructure, truck owners and fleets have been reluctant to convert to CNG vehicles.

Market Outlook in Secaucus

The NGV market outlook in Secaucus is inextricably tied to the three barriers outlined above. Further, these three issues are linked to market forces beyond the purview of municipal governments: Local governments like Secaucus have no control over gas quality (this is under the purview of the gas utility); resource constraints at the local level limit the ability of municipalities to incentivize NGVs to spur adoption; and lastly, local governments have no influence over commodity energy prices. Until these issues are addressed by other market actors, Secaucus, and communities like it, will likely be best served by relying on local partners, such as the NJCCC, for relevant information and updates.

Potential for Renewable Natural Gas

Renewable natural gas (RNG) is produced over a series of steps — namely collection of a feedstock (such as waste or manure), delivery to a processing facility for biomass-to-gas conversion, gas conditioning, compression, and injection into a common carrier pipeline. RNG can be combusted to generate on-site electricity and be used to fulfill renewable energy goals and requirements. Over the last several years, however, there has been considerable growth in the use of RNG in the transportation sector. This is linked in large part to the U.S. Environmental Protection Agency's (EPA) determination in 2013 that RNG

⁴³ NJBPU. CNG Vehicle Grant Program. <http://www.nj.gov/bpu/commercial/cng.html>. Accessed October 23, 2017.

is an eligible fuel under the federal Renewable Fuel Standard (RFS).⁴⁴ Feedstocks for RNG include, but are not necessarily limited to landfill gas, municipal solid waste, animal manure, agricultural residue, and forestry or forest product residues.

The introduction of RNG into the transportation sector has the potential to allay some of the local and regional concerns linked to the GHG emissions and other potential environmental impacts from fossil natural gas use. The GHG footprint of RNG is linked to the feedstock, location of the facility relative to the end user, and the type of vehicle in which the fuel is used. RNG from landfill gas, for instance, reduces GHG emissions by about a factor of two to three when compared to conventional diesel fuel on a lifecycle basis. RNG from animal manure can reduce GHG emissions even more by capturing methane—a GHG pollutant with 25 times the global warming potential of carbon dioxide—that would have otherwise been vented into the atmosphere.

The NGV industry and the RNG industry are advocating around the prospects of pairing the low carbon fuel with a recently certified engine for medium- and heavy-duty vehicles from Cummins Westport, the ISL G 8.9 liter engine. This engine is appropriate for many applications in the goods movement sector, including short and regional haul applications, as well as in refuse hauling applications. This engine received certification from the EPA at levels 90 percent lower than the current standard for nitrogen oxide (NOx) emissions of 0.20 g/bhp-hr.⁴⁵ In other words, pairing RNG with the so-called low NOx engine has the potential to reduce criteria pollutant emission reductions, reduce GHG emissions, and decrease petroleum consumption.

Regulations

This section provides an overview of Secaucus’s community plans as they relate to facilitating AFVs in the community and to identify any language that supports the use of AFVs — NGVs in particular. It also reviews provisions in Secaucus’s local zoning regulations for their potential to affect installation of AFV infrastructure, such as parking, site plans and site development, and environmental performance standards (noise, air quality, etc.). The relevant language and provisions relate primarily to PEVs and were described in [Section 1](#). None are specific to NGVs and natural gas fueling infrastructure.

⁴⁴ In 2015 the EPA determined that RNG from landfill gas (LFG) is eligible to generate renewable identification numbers (RINs; the currency of the federal RFS program) in the category labeled as cellulosic biofuels or D3 RINs. These are the highest value RINs in the RFS market.

⁴⁵ The NOx emission standards for engines are established in units of grams of pollutant per brake horsepower hour (g/bhp-hr).

3 Recommendations and Steps to Implementation

This section recommends actions the Town of Secaucus can take in order to facilitate AFV use and meet the future infrastructure demands.

Each recommendation correlates with the demand for charging or fueling infrastructure discussed throughout the previous sections of this plan. In the case of PEVs, recommendations are distinguished by their role in residential charging, MUD charging, workplace charging, and public charging. The recommendations are similarly distinguished by planning areas — general plans and policies, building codes, zoning and parking codes, permitting and inspection, and fleet planning. Furthermore, for each recommendation, a lead organization or stakeholder has been identified, distinguishing largely between local government, regional agencies, and utilities.

The time horizon for the recommended actions is 10 years, with actions that may be ongoing, as well as those to be implemented in the near-term (1-3 years) and medium- to long-term (4-10 years). The town and its stakeholders should refer to their AFV readiness goals as they determine which activities are priorities now and in the future.

The Town of Secaucus is limited in its authority over planning decisions, adhering to a two-tiered zoning application review and approval process that involves both the town and the NJSEA. The town's opportunities, particularly related to zoning, are framed by that arrangement. It is important to note that changes would need to occur in the NJSEA zoning district ordinance to fully integrate consideration of AFVs.

Several recommendations appear multiple times, though with different steps to implementation depending on the targeted infrastructure. These recommendations include the identification of grants and other funding opportunities, and conducting targeted outreach to install charging infrastructure at high-priority locations.

Stakeholder input has helped to shape the recommendations in this section. During the interactive portion of Secaucus' second SAC meeting, participants provided input on and discussed a series of strategies that could be included in the readiness plan. This exercise aimed to:

Technical Assistance Resources

New Jersey is home to several established organizations that are well-versed in AFVs, community planning, sustainability, and other topics relevant to AFV readiness. These groups can provide technical assistance to support many of the recommended activities. They include:

New Jersey Clean Cities Coalition – a fuel neutral, nonprofit organization promoting partnerships that advance the use of alternative fuels. See www.njcleancities.com.

Sustainable Jersey – a nonprofit organization supporting community sustainability efforts through tools, training, and incentives. See www.sustainablejersey.com.

- Broaden stakeholders' understanding of the strategies available to enhance AFV readiness;
- Gather feedback on the AFV strategies that may be best suited to the community; and
- Help determine priority areas and areas of emphasis to be highlighted in the Secaucus readiness plan.

Stakeholders considered five groups of strategies, described in detail below. Prior to voting, participants were asked to briefly evaluate the strategies based on the following three criteria as they pertained to Secaucus:

- The strategy is/strategies are feasible.
- The strategy/strategies could be implemented in a timely fashion.
- The strategy/strategies could be effective at increasing AFV opportunities in the community.

The Secaucus SAC input can be summarized as follows:

1. Conduct Community Education and Outreach – Most stakeholders thought these strategies generally met all three criteria, as education and outreach comes naturally to the Secaucus Environmental Department
2. Adopt Community-wide Policies – Stakeholders agreed these strategies generally met all three criteria.
3. Facilitate Municipal Infrastructure and/or Public-Private Collaboration – Stakeholders were unanimous in indicating these strategies met all three criteria, and pointed to several large developers and developments as targets.
4. Amend the Zoning Code to Include Requirements or Incentives for AFV Infrastructure – Stakeholders did not have sufficient knowledge of existing zoning requirements and procedures to provide feedback, but indicated the Town Council may be interested in pursuing innovative incentives.
5. Modify Approval Processes – Stakeholders indicated these strategies could meet several criteria.

The priorities, opportunities, and challenges identified and discussed helped determine the recommendations presented in this section.

Whenever possible, recommendations point to specific resources that are available to help guide and assist the town's implementation. See the examples mentioned throughout this section, as well as [Appendix E](#), which is a collection of PEV readiness resources developed by or in partnership with the DOE. The forthcoming NJTPA guidebook on AFV readiness will serve as a key resource for the Town of Secaucus and other municipalities throughout North Jersey.

General Market Support

Due to the myriad considerations involved in PEV adoption — consumer behavior, gasoline pricing, vehicle pricing, etc. — deployment will be linked to factors beyond the purview of local and regional governments, utilities, and other stakeholders. Similarly, NGV adoption is closely linked to fuel prices and vehicle cost. However, Secaucus has an opportunity to support infrastructure development through planning, coordinating education and outreach efforts, collaborating with utilities, and leading by example. Table 8 highlights the recommendations that will provide general market support to AFVs.

Table 8. General Recommendations to Support the Market for Secaucus AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Create cross-jurisdictional opportunities for sharing lessons learned	Ongoing	Town of Secaucus in partnership with neighboring municipalities
	Update the PEV infrastructure demand analysis	Ongoing	Town of Secaucus
	Collaborate with PSE&G to share market information	Ongoing	Town of Secaucus, PSE&G
	Conduct community education and outreach to increase awareness about the benefits of AFVs and the role they can play in decreasing transportation costs and achieving environmental goals	Near-term	Town of Secaucus
	Establish design criteria for AFV infrastructure	Medium- to long-term	Town of Secaucus
	Integrate AFV readiness into local planning efforts, including general plans and climate action plans, to support AFV infrastructure development	Near- to medium-term	Town of Secaucus
Permitting & Inspection	Streamline and expedite approval processes	Medium- to long-term	Town of Secaucus
	Educate permitting, inspection, and first responders in AFV station basics	Medium- to long-term	Town of Secaucus
Fleet Planning	Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities for fleet AFVs	Medium- to long-term	Town of Secaucus
	Provide technical assistance and training to local fleet managers	Medium- to long-term	Town of Secaucus

General Plans & Policies

Create cross-jurisdictional opportunities for sharing lessons learned

The NJTPA region encompasses many local governments, each with its own challenges and experiences with AFV adoption. Secaucus stands to benefit from sharing best practices and lessons learned from stakeholders. Successful collaboration and information-sharing will require Secaucus to invest the time and resources necessary to actively engage with its neighbors, and creating and sustaining a network of stakeholders who work on AFV-related issues will help strengthen AFV readiness in both the municipality and throughout the region. Sustainable Jersey provides one such forum; the town can leverage Sustainable Jersey’s network and engage with other communities and county organizations.

Town staff have already engaged with other municipalities in the region as a result of publicity regarding the grant funding Secaucus received for PEV charging stations.

There are two broader initiatives of which Secaucus and its partners should be aware related to AFVs and AFV readiness, namely:

- At the state level, ChargeVC was recently formed as a coalition of car manufacturers, technology companies, utilities, consumer advocates and non-governmental organizations to promote PEV use in New Jersey.
- The NJCCC formed the New Jersey Natural Gas Vehicle Workgroup committee. Participating members include representatives from gas distribution utilities, vehicle and engine manufacturers; fuel infrastructure providers; transit, refuse haulers and other fleet users of natural gas; and others interested in increasing and strengthening the deployment of low-emission NGVs throughout New Jersey.

Both initiatives provide Secaucus with a means to stay updated on developments and opportunities related to complementary activities at the state and regional level, such as alternative fuel corridor planning and utility rate filings.

Update the PEV infrastructure demand analysis

The goal of a demand analysis is to help guide and coordinate future PEV charging infrastructure placement efforts based on anticipated or projected demand for charging infrastructure. The demand analysis included in this plan combines various parameters such as characteristics of PEV ownership and usage, land use, and regional travel patterns. As these characteristics change over time, the Town can work with the NJTPA, the NJDEP, and other stakeholders to regularly update (every three to five years) the analysis with the latest vehicle registration, demographic, and travel demand data so the results remain current and relevant in the context of the likely demand for residential charging, workplace charging, MUD charging, and public charging.

AFV Registration Data

The NJDEP maintains AFV registration data, coordinating with the NJMVC to provide updated statistics twice a year (January and July). A spreadsheet containing this data is available upon request by sending an email to drivegreen@dep.nj.gov, using the subject line "Vehicle Registration Data Request."

Collaborate with PSE&G to share market information

Secaucus can take a leading role in the support of PEVs and charging infrastructure by collaborating with the local utility to share relevant market information. In particular, the town can seek more proactive ways to engage and collaborate with PSE&G. The regional impacts on the electrical grid (in terms of greater demand for electricity as more vehicles are charging) will likely be negligible for many years. However, unmanaged charging station installations and increased regional PEV ownership in specific areas could negatively affect local electrical distribution systems. One of the primary causes of concern for PEVs is clustering of the load associated with vehicle charging. Utilities generally have a transformer replacement program to regularly target transformers that have reached the end of their useful life or have been identified as grossly overloaded. However, the adoption of PEVs may occur faster in some

areas, thereby potentially altering the utility's transformer replacement program target areas and schedule.

The Town of Secaucus should maintain open lines of communication with the utility as it evaluates its electricity distribution infrastructure and provide insights wherever helpful. When PSE&G upgrades or adds distribution infrastructure, it should consider potential PEV charging demand impacts as part of the analysis and, where possible, make strategic and cost-effective investments. The town can assist in this process by providing valuable perspective and advanced notice regarding anticipated PEV clustering, new construction, and DC fast charging corridors along the way.

Conduct community education and outreach to increase awareness about the benefits of AFVs, PEVs in particular, and the role they can play in decreasing transportation costs and achieving environmental goals

Secaucus should develop and distribute educational resources that target the range of relevant audiences: residents, multi-family building owners, employers, fleet owners and managers, and commercial and other developers. Residents of multi-family units are often overlooked for targeted awareness and education activities related to PEVs because it is not often within a resident's power to install charging infrastructure. Secaucus should therefore consider creating materials to inform developers and/or property managers about the benefits and costs of installing AFV fueling infrastructure during construction as well as the overall benefit of providing the spaces. Additionally, Secaucus should consider developing resources that target younger residents, such as student drivers, to teach them about AFV options, particularly PEVs. Even basic information about how much it costs to fuel a PEV can be helpful to start the conversation with any audience.⁴⁶ Housing all of these resources in one place online will also enable residents to seek out the information on demand beyond active outreach events.

Executing this recommendation would require some financial resources and staff time to prepare materials, conduct outreach, and maintain the online resource database, but it would be relatively low cost to build upon existing outreach efforts and could be highly impactful over the long-term. The town can leverage the Environmental Department's established distribution practices, including e-blasts, newsletters, and community events such as the annual Secaucus Green Festival.

Separate recommendations introduced later in this section provide additional detail about more targeted education and outreach specific to MUD, workplace, and public charging.

Establish design criteria for AFV Infrastructure

Adopting AFV infrastructure design guidelines that address the many unique considerations associated with them can go a long way to help charging station and fueling station hosts determine the best configuration for their installations and ensure that installations are safe, follow industry-recommended standards, and are consistent with other community development goals.

The New Jersey code includes a streamlined permitting process and definitions for PEV charging stations, which the Town of Secaucus could adapt based on local conditions. Design guidelines will likely

⁴⁶ One simple yet useful tool is the U.S. DOE's eGallon calculator, which shows the cost of fueling a PEV compared to a similar gasoline vehicle. See <https://energy.gov/maps/egallon>.

vary depending upon the configuration of parking and upon the context in which parking is located, so the town will likely need to create multiple sets of PEV parking guidelines that apply to a variety of scenarios.

At a minimum, charging station design criteria should address the following issues:

- Minimum dimensions of PEV parking spaces
- Parking configurations, including guidance on whether it is preferable to locate chargers in perpendicular, parallel, or angled parking spaces, and on the location of wheel stops, guard posts, and signage
- Adopted technical standards that apply to PEV charging stations
- Regulatory signage and signs directing drivers to available PEV parking
- Area lighting
- Clearances, including minimum clearances around chargers to maintain access to controls, as well as on adjacent walkways to maintain pedestrian access. Pedestrian clearance guidelines should include recommendations for keeping sidewalks and walkways clear of cords and cables. Clearance recommendations should also address needs for snow plowing during the winter months.
- Landscaping
- Location relative to other spaces, adjacent land uses, and electrical infrastructure. For example, guidance on locating on-street parking could include language such as “the last space on the block in the direction of travel will usually minimize cord management issues, and places user closer to crosswalks and curb ramps.”
- Additional considerations that apply in overlay zones, such as flood control zones
- Design of disabled access spaces, including requirements for the number of spaces in areas that must be accessible in areas with multiple PEV parking spaces and design standards for accessible spaces.

Integrate AFV readiness into local planning efforts, including general plans and climate action plans, to support AFV infrastructure development

Secaucus should integrate AFV readiness policies and goals into local planning efforts, including general plans or similar documents. These plans are broader and less detailed than building codes and zoning ordinances, so policies calling for increased charging opportunities typically do not contain specific details on where chargers are needed or on how much charging should be provided. However, even voluntary or broad policies can provide a basis for local governments to negotiate with developers to install chargers during discretionary review, as well as set the stage for more detailed implementation through building codes or zoning ordinances. Secaucus could consider Woodbridge Township’s *Sustainable Community Plan and Climate Action Plan*, included in [Appendix D](#), as a model. Secaucus should also consider incorporating this plan and follow-up efforts into its Sustainable Jersey participation, both for recognition and to provide an example to other municipalities.

Taking steps to amend municipal general plans and codes to encourage PEV deployment can be an important step in building consensus among policymakers and the public to support more specific PEV

readiness implementation measures. The exact policies that local governments choose to include can range from broadly encouraging increased adoption of PEVs to requiring charging stations at specific land uses or sites where local agencies see development opportunities or anticipate high demand for charging. These policies can also help pave the way to fund plans and capital projects that accelerate the deployment of PEVs. The incremental cost of PEV readiness planning is lower if it is part of a larger-scale effort. For example, tying PEV readiness to local policies can make it easier to allocate different funding streams toward PEV plans and projects. Secaucus should identify and pursue opportunities to incorporate explicit language that encourages PEV and charging infrastructure deployment, as well as natural gas. Refer to [Appendix D](#) for example language relevant to pre-wiring and redevelopment plans.

Permitting & Inspection

Streamline and expedite approval processes

To remove barriers to charging station installation, Secaucus should create approval processes that are easy to navigate, fast, and affordable. In the case of commercial and workplace charging stations, reducing permitting fees is particularly effective to incentivize installations by property owners and employers. For both residential and non-residential installations, minimizing permit requirements will reduce the amount of staff time devoted to permit review, which will enable the town to expedite permits and levy lower fees to recover costs.

In particular, the following actions will streamline and expedite the charging station approval process:

- Make permits available online or over-the-counter;
- Issue required permits within 48 hours;
- Reduce fees for both residential and non-residential installations;
- Issue supplementary guidance, such as residential and non-residential-specific permitting checklists, to help applicants through the permitting process, and post it online for easy access;
- Limit the number of required inspections to one;
- Focus requirements for supporting materials that provide information about the PEV charging system itself (i.e., level of charger, compliance with national standards, proposed location) and electrical service (i.e., existing electrical panel service information, load calculations, whether panel upgrades or a new meter installation are required);
- Do not require site plans for PEV charging station installations in single-family residences;
- Integrate permits with a utility notification protocol to help PSE&G understand where PEVs are being deployed and how they are being charged.

Where possible, the Town of Secaucus should work together with neighboring municipalities to make their processes, fees, and requirements consistent with the rest of the region. Consistency between municipalities will also make it easier and faster for electrical contractors who work throughout the region to permit and install charging stations.

Educate permitting officials, inspection officials, and first responders on the basics of AFV station installation

Providing permitting staff with basic information about PEV charging stations and installations will help them process permits more efficiently and ensure staff can provide property owners with additional information about safety practices and other requirements. Similarly, inspectors would benefit from access to factual information and relevant details specific to the town (e.g., public charging locations) since they interface with residents, businesses, and others. Secaucus may consider organizing an educational session focused on codes, safety, standards, site assessments, electric load calculations, permitting processes, and utility notification. Training first responders will ensure that safety procedures are in place in the case of any AFV or fueling/charging station-related emergencies.

Secaucus could work with organizations such as the Electric Vehicle Infrastructure Training Program (EVITP)⁴⁷ to organize training sessions on charging station installations and outreach to share local best practices among staff. Secaucus should also collaborate with neighboring communities, the county, the NJTPA, and others to create an ongoing region-wide schedule of training and outreach events so that stakeholders can stay informed on educational opportunities across the region.

Fleet Planning

Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities for fleet AFVs

The town has expressed interest in increasing their use of AFVs in the fleet, particularly PEVs given existing charging infrastructure. The Secaucus Police Department's parking enforcement vehicles may be the ideal application for PEVs.

Secaucus should develop a comprehensive fleet management plan that can provide a framework for decision making and investments. The fleet management plan should pull together relevant goals and activities (e.g., Sustainable Jersey Green Fleet actions) and include meaningful metrics for measuring progress toward goals. If the town reaches the point of vehicle procurement, it should be aware of aggregated purchase options for both vehicles and infrastructure, including the Mid-Atlantic Region initiative under Fleets for the Future as well as EV Smart Fleets.⁴⁸

Provide technical assistance and training to local fleet managers

Fleet managers often require assistance navigating and weighing the various considerations associated with AFV ownership as compared to conventional vehicle ownership. Local governments can take part in trainings offered by Clean Cities coalitions, such as the NJCCC. Beyond providing educational materials, Secaucus could also organize technical assistance and training workshops in collaboration with the NJTPA and other partners.

⁴⁷ For more information, see <http://evitp.org/training/>.

⁴⁸ For more information, see <http://www.fleetsforthefuture.org/> and <http://evsmartfleets.com/>.

Residential Charging

In the near- to mid-term, most PEV charging will occur at drivers’ residences. Today, for instance, about 70-90 percent of charging occurs at home. Furthermore, the majority of residential charging occurs at Level 1 charging, which is particularly attractive because it requires little to no consumer investment. However, as the market evolves, there are a variety of factors that will likely increase the need for more investments in residential charging. For instance, as batteries in vehicles become larger and as utilities seek to play an increased role in managed charging, higher level charging equipment will likely be required. As a result, the Town of Secaucus should monitor and coordinate with PSE&G and other relevant agencies on the electricity demands and potential impacts to the local grid. Table 9 includes this and other key actions the town can take to help support the expansion of residential charging.

It is worth restating that residential charging demand is very market-driven, so Secaucus’ role in increasing this demand will be limited, allowing the town to focus its efforts on MUD, workplace, and public charging.

Table 9. Recommendations to Support Residential Charging for Secaucus AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
Permitting & Inspection	Produce guidance documents outlining permitting requirements for residential PEV charging station installations	Medium- to long-term	Town of Secaucus
Building Codes	Work with the state to amend the building code to require PEV station readiness in new single-family developments	Medium- to long-term	Town of Secaucus
General Plans & Policies	Collaborate with PSE&G to facilitate necessary electricity distribution infrastructure upgrades	Ongoing	Town of Secaucus

Permitting & Inspection

Produce guidance documents outlining permitting requirements for residential PEV charging station installations

Providing information to local residents about the requirements to permit their residential charging station installation will both make the installation/permitting process more accessible and streamline the process. The Town of Secaucus should consider developing a permitting checklist that helps applicants through the process and post it online for easy access. While this will require some staff time and resources up front, the time savings down the road will be significant, and NJDCA’s “Electric Vehicle Charging Stations – What you need to know” can serve as a starting point for the checklist.⁴⁹ The NJTPA can also provide support in this area by creating a template that municipalities can adjust for particularities in their towns.

⁴⁹ NJDCA, *Electric Vehicle Charging Stations – What you need to know*, http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

Building Codes

Work with the state to amend the building code to require PEV station readiness in new single-family developments

Amendments to the UCC can only be made at the state level. Therefore, Secaucus should consider coordinating with other municipalities to work with the state to amend the building code to require that new single-family residential developments with off-street parking include pre-wiring for PEV charging station installations. The town should also collaborate with its neighboring municipalities to work with the state to amend the New Jersey State Residential Site Improvement Standards (RSIS) to apply this requirement to property redevelopment.

General Plans & Policies

Collaborate with PSE&G to facilitate necessary electricity distribution infrastructure upgrades

Although sales of PEVs are forecasted to grow, regional impacts on the electrical grid (in terms of greater demand for electricity as more vehicles are charging) will likely be negligible for many years. However, unmanaged charging station installations and increased regional PEV ownership in specific areas could negatively affect local electrical distribution systems.

One of the primary causes of concern for PEVs is clustering of the load associated with vehicle charging. Utilities generally have a transformer replacement program to regularly target transformers that have reached the end of their useful life or have been identified as grossly overloaded. However, the adoption of PEVs may occur faster in some areas, thereby causing gaps in the information that utilities would generally use to inform their replacement programs. Utilities need to know where the vehicles are being used and how they are being charged (e.g., Level 1 vs. Level 2) so that they can evaluate whether the local distribution system is adequate to serve PEV charging needs. One simple, but not always utilized, solution to this potential challenge is for utilities to establish a clear notification protocol so that utilities are aware of new chargers being added to the grid.

Multi-Unit Dwelling Charging

Most PEV charging is likely to occur at home. However, with more than 60 percent⁵⁰ of the Secaucus population living in MUDs without dedicated garages like single-family homes, the purchase of a PEV may not make sense without easy access to charging. Further, MUD owners and management companies will need to respond to tenant interest as the number of PEVs on the road increases. The recommendations in Table 10 represent the key actions the town can take to help address current and future demands for MUD charging.

As noted in [Section 1](#), much of the opportunity to expand charging infrastructure at MUDs will be through new developments or possibly as part of renovations to upgrade existing buildings. MUD decision makers are not likely to pursue PEV charging infrastructure unless residents express an interest

⁵⁰ Estimate from Hudson County Division of Planning, based on 2010 U.S. Census data, via email correspondence, October 23, 2017.

or the management company recognizes charging as an amenity to attract tenants. Therefore, it will be necessary for Secaucus to be proactive with regard to targeted outreach and education.

Table 10. Recommendations to Support MUD Charging for Secaucus AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Conduct targeted outreach to MUD managers and developers to install chargers at high-priority locations	Near-term	Town of Secaucus
	Collaborate with MUDs to create and implement policies that allow residents to install PEV charging infrastructure	Medium- to long-term	Town of Secaucus
Zoning & Parking Ordinances	Amend zoning codes to require or incentivize PEV charging stations or pre-wiring in new MUD developments	Medium- to long-term	Town of Secaucus

General Plans & Policies

Conduct targeted outreach to MUD managers and developers to install chargers at high-priority locations

Property owners and developers, and home owner associations (HOA) can have a tangible impact on PEV deployment in the region by providing charging for multi-family residents. In the case of MUDs, decision makers will need to consider the logistics of providing charging equipment, including who pays for the electricity and charging station upkeep, how to determine resident access/parking space sharing between resident PEV owners, and particular zoning and permitting considerations. They will also need to understand the approval process for new development versus existing development installations, and what activities would require a permit/approval versus being done independently. The Town of Secaucus can facilitate this discussion by providing targeted outreach and educational materials that address the specific questions and challenges these communities will face in the context of PEV and charging station deployment.

The Town of Secaucus is proactive in its environmental and sustainability outreach, so it would be feasible and require little additional cost to build upon that foundation by developing a variety of situation- or user-specific PEV materials for distribution. Strategic outreach can take additional time, but it can also be highly impactful, particularly given the large MUD developments in Secaucus. The high opportunity zone map provided in [Section 1](#) (Figure 6) will be helpful as the town prioritizes target developments and areas. The town should also make educational information available to companies developing new or enhancing existing MUDs. See the resources in [Appendix E](#), particularly the link to an AFDC web page providing case studies, guidelines, and other information.



Collaborate with MUDs to create and implement policies that allow residents to install PEV charging infrastructure

Secaucus has many residents that own or rent property in MUDs, where they might have a dedicated parking space but do not technically own the property on which they park. This presents unique challenges for PEV owners seeking to access a charging station at their home. Given the proportion of population that might face such issues, the town can have a very tangible impact on PEV deployment by working with multi-family developments, such as Harmon Cove, to develop policies that allow residents to install PEV charging infrastructure or provide shared charging for residents. Refer to [Appendix D](#) for an example of “right to charge” language. The town might also consider accompanying these policies with education materials for landlords about the benefits (i.e., added property value) of providing PEV charging infrastructure for tenants.

Zoning & Parking Ordinances

Amend zoning codes to require or incentivize PEV charging stations in new MUD developments

Zoning codes, if developed thoughtfully, can facilitate PEV and charging infrastructure deployment. The Town of Secaucus should consider taking steps to amend zoning codes to require or incentivize pre-wiring or charging station installations at new MUD developments, including guidance on locating and installing PEV charging stations in such settings. Ideally, requirements should specify the number of chargers or pre-wired spaces to be provided at developments of different sizes. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed.

Workplace Charging

The PEV charging infrastructure market has focused considerable attention on workplace charging—through funding, outreach, and pilot programs. Although most PEV charging occurs at home, and is expected to for the next several years, PEVs are still parked for many hours as part of regular commuting. The availability of charging as part of a regular commute can help increase the electric vehicle miles traveled by PHEVs, while also helping demonstrate to potential drivers that there is sufficient infrastructure to maintain driving habits in a BEV (i.e., overcome range anxiety). Table 11 highlights the key recommendations to help meet the demand for workplace charging, as well as private fleet AFV adoption, as part of Secaucus’ AFV readiness planning.

Table 11. Recommendations to Support Workplace Charging for Secaucus AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Identify AFV grants and other funding opportunities for workplace charging infrastructure development	Ongoing	Town of Secaucus
	Conduct targeted outreach to employers to install chargers at high-priority locations	Near-term	Town of Secaucus, Hudson TMA
Fleet Planning	Provide educational resources to local fleet managers regarding AFV and infrastructure deployment	Near-term	Town of Secaucus, Hudson TMA
Permitting & Inspection	Produce guidance documents outlining permitting requirements for commercial PEV charging station installations	Near-term	Town of Secaucus
Zoning & Parking Ordinances	Amend zoning codes to require or incentivize PEV charging stations or pre-wiring in new commercial developments	Medium- to long-term	Town of Secaucus

General Plans & Policies

Identify AFV grants and other funding opportunities for fueling infrastructure development and other opportunities

The Town of Secaucus can play an important role in accelerating regional AFV adoption by helping stakeholders identify and pursue grant funding, both for AFVs and for workplace and fleet fueling/charging infrastructure. Table 6 and Table 7 (in [Section 1](#)) summarize available incentives for PEVs and charging infrastructure, respectively. Each opportunity varies in terms of eligibility and timelines, though several are suitable for employers and fleets in Secaucus. The town itself has been successful in pursuing grant funding through NJDEP to install multiple public chargers to date.

In terms of electrification, Secaucus has significant commuter and workplace traffic, meaning the town can maximize the number of electric miles traveled by identifying grant funding opportunities for the purchase and installation of workplace charging stations. Secaucus is a particularly strong candidate for grant funding if it can show that it has identified particular facilities that are well suited for charging stations. The high opportunity zone map in [Section 1](#) (Figure 6) provides Secaucus employers with a starting point to identify specific areas best suited for workplace charging. This analysis is backed by the workplace charging demand illustrated in Figure 4.

While PEVs and charging infrastructure apply to the broader population, natural gas technology is still predominantly applicable only to fleets since commercially available vehicles are medium- to heavy-duty. Given the number of fleets based in Secaucus, including UPS, the town can also have an impact on the region’s shift to alternative fuels by supporting the implementation of NGVs and natural gas fueling stations. Area fleets may be interested in funding for NGVs and natural gas fueling stations, should it become available in the future. The town can point fleet managers and other stakeholders to the NJCCC and other organizations closely tracking funding solicitations and other incentives.

Funding could also be used for workshops, trainings, outreach campaigns, and events that support workplace charging and fleet use of AFVs. These may be specific to Secaucus, or coordinated with other municipalities in the region to conserve costs and increase the reach and impact. Depending on resource

availability, the town might also consider participating in an information sharing process in order to assist – and receive assistance from – neighboring municipalities in these efforts. Organizations such as Sustainable Jersey are in an ideal position to facilitate information sharing among engaged municipalities.

Conduct targeted outreach to employers and commercial developers to install chargers at high-priority locations

Building on the previous recommendation, the Town of Secaucus should leverage the high opportunity zones and workplace charging demand maps in [Section 1](#) as resources to target workplace charging station development outreach. The town is demonstrating leadership by installing multiple public access charging stations, and it is important for local landowners to contribute to a growing charging network. In Secaucus, employers are high-priority targets, particularly those that may have sustainability goals or initiatives. Commercial property owners and developers can have a tangible impact on PEV deployment in the region by providing charging for employees. Employers will need to gauge demand and consider the logistics of providing charging equipment, including the etiquette for moving vehicles once the charging session is complete. They will also need to understand the approval process for new development versus existing development installations, and what activities would require a permit/approval. The town can facilitate this discussion by providing targeted outreach and educational materials that address the specific questions and challenges employers may face in the context of PEV and charging station deployment.

In Secaucus, the opportunity presented by AFV infrastructure may manifest itself by attracting and retaining more industrial and commercial development and make it easier to recruit and accommodate staff, supply chain partners, etc. Strategic outreach can take additional time, but it can also be highly impactful. This is an area in which the Hudson TMA can serve a key role, reaching out to its network of employers to provide factual and relevant information. The workplace charging demand map provided in [Section 1](#) (Figure 4) will be helpful as Secaucus prioritizes target employers and areas. The Town should also make educational information available to companies developing new or enhancing existing commercial properties.

Fleet Planning

Provide educational resources to fleet managers

Public and private fleets can provide opportunities for AFV introduction. However, fleets often require assistance navigating and weighing the various considerations associated with AFV ownership as compared to conventional vehicle ownership. For this reason, information sharing can encourage investment in AFVs among corporate and government fleets alike.

Secaucus should consider providing educational resources (e.g., toolkits or guidebooks) to fleet managers and employers to educate them regarding the total cost of AFV ownership, operating considerations, and fueling/charging station installation costs and guidelines. Secaucus can also work with the Hudson TMA to effectively reach employers in the area. Hartz Mountain, for example, is represented on the TMA board.

In the case of electrification, since most PEVs available today are passenger cars, the town's near-term focus should include fleets with light-duty vehicle applications. As more medium and heavy-duty PEV technology develops, Secaucus can provide additional resources that draw upon best practices and lessons learned from local and regional case studies of fleets deploying such vehicle models. The opposite is true with NGVs: most natural gas technology is available for medium- and heavy-duty vehicles. Secaucus should therefore focus on fleets with these applications in the near-term, which may include shuttle buses/vans and trash collection and recycling fleets that serve commercial entities throughout the municipality. Should light-duty NGVs become more readily available in the future, the Town can provide additional resources that draw upon best practices and lessons learned in light-duty scenarios in order to support further expansion of the technology.

Permitting & Inspection

Produce guidance documents outlining permitting requirements for commercial PEV charging station installations

Providing information to employers and other site hosts about the requirements to permit charging station installation will streamline the process. The Town of Secaucus should consider developing a permitting checklist that details the process and post it online for easy access. While this will require some staff time and resources up front, the time savings down the road will be significant, and NJDCA's "Electric Vehicle Charging Stations – What you need to know" can serve as a starting point for the checklist.⁵¹ The NJTPA could also provide support in this area by creating a template for municipalities to use.

Zoning & Parking Ordinances

Amend zoning codes to require or incentivize PEV charging stations in new commercial developments

Zoning codes, if developed thoughtfully, can facilitate PEV and charging infrastructure deployment. Secaucus should consider amending zoning codes to require or incentivize pre-wiring or charging station installations at new commercial developments (e.g., office buildings or mixed use), including guidance on identifying locations for and installing charging stations in such settings. Ideally, requirements should specify the number of chargers or pre-wired spaces to be provided at new developments of different sizes and land-use types. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed.

Incentives, which may be more effective based on Secaucus Town Council's historical decision making, may include density or floor-to-area ratio bonuses or reduced application/design review fees. In terms of requirements, Secaucus could look to Montclair Township as an example, as redevelopment plans

⁵¹ NJDCA, *Electric Vehicle Charging Stations – What you need to know*, http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

include installed PEV charging stations and their necessary infrastructure. For sample language, see [Appendix D](#).

Because much of Secaucus is flood-prone, zoning ordinances currently require structures to be installed elevated by one foot.⁵² The town should determine whether this requirement applies to PEV charging stations, and whether a charging station installation would require site plan approval. Clarifying and simplifying this process will help make station installation more feasible for employers.

Public Charging

Public charging refers to away-from-home charging that does not occur at the workplace, and is part of a non-work trip. These stations are typically accessible to the public or specific drivers, and as noted previously can include Level 1, Level 2, and DC fast charging. Public charging typically takes place at locations where drivers are parked for varying times; the actual demand for public charging is difficult to predict. In some regards, the likely utilization of public charging infrastructure will vary considerably depending on factors including but not limited to driving patterns and the fee charged. Although there is an opportunity for public entities to provide public charging at recreational and other sites, this plan assumes that site hosts will generally be private or commercial entities working with a PEV charging infrastructure provider. Site hosts may be keen to support public charging infrastructure for a variety of reasons, including demonstrating a commitment to sustainability, attracting new visitors to a site, or increasing the time that visitors spend at a site.

As the demand for public charging becomes clearer, it is important that Secaucus provide technical and policy support where possible, and seek opportunities to conduct targeted education and outreach. Table 12 below highlights the key recommendations for consideration by Secaucus as they relate to opportunity charging.

⁵² Jennifer Modi, Town of Secaucus Engineering Department, Stakeholder Advisory Committee meeting, September 12, 2017.

Table 12. Recommendations to Support Public Charging for Secaucus AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Identify AFV grants and other funding opportunities for infrastructure development	Ongoing	Town of Secaucus
	Conduct targeted outreach to landowners to install chargers at high-priority locations	Near-term	Town of Secaucus, Hudson TMA
	Pursue public-private partnerships to fund publicly accessible charger installations	Near-term	Town of Secaucus
Zoning & Parking Codes	Establish preferential parking policies for PEVs	Medium-term	Town of Secaucus
	Amend parking codes to regulate the use of PEV charging spaces	Medium-term	Town of Secaucus
	Amend zoning codes to require or incentivize PEV charging stations or pre-wiring in new commercial developments	Medium- to long-term	Town of Secaucus

General Plans & Policies

Identify AFV grants and other funding opportunities for fueling infrastructure development

The Town of Secaucus has already taken important steps toward accelerating regional AFV adoption by identifying and pursuing grant funding for the purchase and installation of multiple municipality-owned public fueling stations. Other stakeholders, including businesses, can follow the town’s lead. Table 6 and Table 7 (in [Section 1](#)) summarize the available incentives for PEVs and charging infrastructure, respectively. Each opportunity varies in terms of eligibility and timelines. Some are opportunities the town can apply for, possibly to procure AFVs for the municipal fleet. Others are more suitable for private businesses in Secaucus to expand the use of AFVs and the network of supporting infrastructure.

Secaucus and its businesses should actively seek support in developing a robust charging station network that will ensure visitors and residents can access nearby charging options. This will both ease range anxiety and maximize the number of miles driven in electric mode. The high opportunity zone map in [Section 1](#) (Figure 6) provides Secaucus with a starting point to identify specific areas of the best suited for public charging. This analysis is backed by the public charging demand illustrated in Figure 5.

Should the town choose to pursue additional municipally-owned charging infrastructure, there are several public parking lots that would provide highly visible locations serving residents and visitors. These were mentioned earlier and include lots at Secaucus Town Hall, Center Avenue, Plaza Center, and the Secaucus Public Library and Business Resource Center.

Conduct targeted outreach to landowners to install chargers at high-priority locations

Building on the previous recommendation, Secaucus should leverage the high opportunity zone and public charging demand maps in [Section 1](#) (Figure 6 and Figure 5, respectively) as resources to target outreach. Retailers, in addition to workplaces and MUDs, are particularly high-priority targets. Property owners, developers, and other decision makers at these locales can have a tangible impact on PEV deployment in the region by providing charging for residents and visitors. Hudson TMA is in a position to bring businesses to the table, leveraging their regional network. PEV charging stations can be amenities that help draw customers, and ultimately, pose opportunities to grow the local economy through increased visitor traffic and community spending.

Pursue public-private partnerships to fund publicly accessible charger installations

There are various opportunities for Secaucus to acquire funding for public charging station installations outside of current grants. The town should consider fostering public-private partnerships and partnering with businesses that have a local presence (e.g., UPS, other cargo/hauling companies); retail centers (e.g., the Secaucus Outlets, The Plaza at Harmon Meadow); and mixed-use developments (e.g., the Xchange development) to finance such installations. In the realm of public-private partnerships, there are display advertising opportunities for companies that sponsor charging stations. In both this case and that of partnerships with business improvement districts, the town will need to provide information supporting the business case for installing PEV charging stations, including customer attraction, dwell time, etc. For example, one consideration is that the average length of customer stay at outlet malls aligns well with Level 2 public charging. Prospective station hosts should consider the potential increased revenue, as well as upfront costs.

Zoning & Parking Codes

Establish preferential parking policies for PEVs

Secaucus should consider offering additional incentives for drivers to purchase PEVs, by creating dedicated parking spaces or waiving parking fees for these vehicles. If Secaucus provides PEV parking that exceeds immediate demand, the town can consider specifying interim regulations that allow conventional vehicles to use these spaces in order to avoid under-utilization.

Amend parking codes to regulate the use of PEV charging spaces

After establishing policies and strategies to encourage the deployment of PEVs, the next step for Secaucus is to amend parking ordinances to specify the regulations that apply to parking spaces designated for PEVs. The goal of these amendments is to ensure that PEVs have unobstructed access to PEV charging and to ensure the town can recoup the costs of public charging at the stations it owns and operates.

When designating PEV parking, Secaucus should consider applicable definitions, restrictions, enforcement policies, time limits, and fees. In general, it is a best practice to restrict the use of PEV charging stations to vehicles that are actively charging to ensure that the equipment is available for drivers who need them. For example, the City of Raleigh's Code of General Ordinances requires that

vehicles parked in designated PEV spaces be connected to the charging station or be subject to a \$50 fine.⁵³ See [Appendix D](#) for an example ordinance from Montclair Township.

Amend zoning codes to require or incentivize PEV charging stations in new commercial developments

Zoning codes can facilitate (or, if not developed thoughtfully, prevent) PEV and charging infrastructure deployment. Secaucus should consider amending zoning codes to require or incentivize pre-wiring or charging station installations at new commercial developments, including guidance on identifying locations for and installing EV charging stations in such settings. Ideally, requirements should specify the number of chargers or pre-wired spaces to be provided at new developments of different sizes and land-use types. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed.

Incentives, which may be more effective based on Secaucus Town Council’s historical decision making, may include density or floor-to-area ratio bonuses or reduced application/design review fees. In terms of requirements, Secaucus could look to Montclair Township as an example and case study, as redevelopment plans include installed PEV charging stations and their necessary infrastructure. For sample language, see [Appendix D](#).

Because much of Secaucus is flood-prone, zoning ordinances currently require structures to be installed elevated by one foot.⁵⁴ The town should determine whether this requirement applies to PEV charging stations, and whether a charging station installation would require site plan approval. Clarifying and simplifying this process will help make station installation more feasible for commercial developers and landowners.

⁵³ City of Raleigh, NC, *Raleigh City Ordinance 11-2174(c) Electric Vehicle Parking FAQs*, <http://www.raleighnc.gov/content/PWksParkingMgmt/Documents/EVParkingFAQ's.pdf>. Accessed April 10, 2017.

⁵⁴ Jennifer Modi, Town of Secaucus Engineering Department, Stakeholder Advisory Committee meeting, September 12, 2017.

Appendix A. Acronyms

Acronym	Stands For
AC	alternating current
AFV	alternative fuel vehicle
AEO	Annual Energy Outlook
AFDC	Alternative Fuels Data Center
BEV	battery electric vehicle or all-electric vehicle
CNG	compressed natural gas
DC	direct current
EIA	U.S. Energy Information Administration
EVSE	electric vehicle supply equipment
GHG	greenhouse gas
HEV	hybrid electric vehicle
MUD	multi-unit dwelling
NGV	natural gas vehicle
NJBPU	New Jersey Board of Public Utilities
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJSEA	New Jersey Sports and Exposition Authority
NJTPA	North Jersey Transportation Planning Authority
PEV	plug-in electric vehicle
PHEV	plug-in hybrid electric vehicle
SAC	stakeholder advisory committee
TAZ	traffic analysis zone
TMA	Transportation Management Association
UCC	Uniform Construction Code
ZEV	zero emission vehicle

Appendix B. Plug-in Electric Vehicle Forecasting Methodology

For the purposes of this plan, residential PEV ownership forecasts for Secaucus were projected over a planning horizon from 2016-2030. PEV projections for Secaucus were developed as a range based on varying assumptions around adoption trends. Estimates of new vehicle sales included in this plan were developed using the following assumptions:

- The total annual sales of light-duty vehicles in New Jersey has been about 550,000 to 600,000 over the last several years, based on data from the National Automobile Dealers Association.
- New sales in Secaucus are proportional to the share of total vehicles in Secaucus relative to the entire state.
- New vehicle sales increase at a rate similar to the forecasted new vehicle sales reported by the Energy Information Administration (EIA) in the Reference Case of the Annual Energy Outlook (AEO) 2016, for the Middle Atlantic Region.⁵⁵

The increased deployment of PEVs coincides with increased deployment of more efficient conventional vehicles, driven largely by federal fuel economy and tailpipe greenhouse gas (GHG) emissions standards. Broadly speaking, the total stock of vehicles on the road is forecast to increase by about 10-12 percent between 2015 and 2030, and the stock of conventional vehicles is going to become more efficient, with efficiencies ranging from 40-50 miles per gallon (up from an average of around 25-30 miles per gallon today).

The table below summarizes the approach used to forecast PEVs in Secaucus in low and high adoption scenarios. It also includes a GHG stretch scenario in which New Jersey meets the emissions reductions set forth in the New Jersey Global Warming Response Act.

⁵⁵ U.S. DOE Energy Information Administration, *Annual Energy Outlook: 2016*, [http://www.eia.gov/outlooks/aeo/pdf/0383\(2016\).pdf](http://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf). August 2016.

PEV Forecast Scenario Descriptions

Scenario	Description
Low	Reflects adoption trends comparable to the Reference Case in the EIA's AEO 2016, adjusted slightly for increased potential indicated in the Middle Atlantic region. ⁵⁶
High	Assumes that PEV adoption rates in Secaucus will be consistent with the ZEV mandate in place for New Jersey, ⁵⁷ with a fair-share assumption (i.e., that ZEV deployment will occur in the state on a population-weighted basis in the long-term).
GHG Stretch	The PEV strategy of the NJTPA Regional GHG Mitigation Plan calls for a 60 percent market share of PEVs by 2040 to meet state goals. The GHG stretch scenario assumes that PEV adoption rates will be slightly lower than the plan, with a 50 percent market share by 2040.

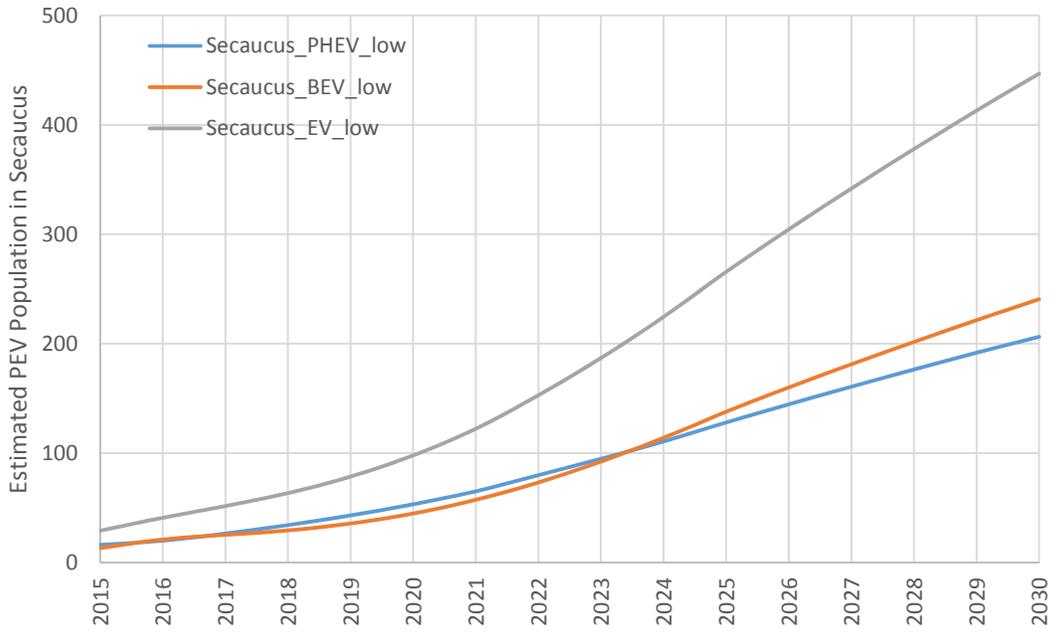
The figures that follow present the three PEV demand scenarios for Secaucus based on the forecast descriptions in the table above. In the low scenario, approximately 450 PEVs (200 PHEVs and 250 BEVs) are expected to be on the road in Secaucus in 2030. In the high scenario, the forecast is approximately 1,250 PEVs (875 PHEVs and 375 BEVs). The GHG stretch scenario yields about 8,000 PEVs on the road by 2040 in Secaucus. To provide context, total light-duty vehicles are expected to increase by about 10-12 percent in Secaucus by 2030, with a population of about 15,000 vehicles. The forecasts indicate that PEVs will make up to 6-17 percent of the vehicle fleet by 2030.

Additionally, note that the shape of each of the curves in the low scenarios and the shape of each of the curves in the high scenarios are similar. This is because both scenarios come from the same root functions, modified slightly based on the characteristics assumed in each case.

⁵⁶ AEO forecasting is typically used as a base for forecasts because it provides the benefit of transparency and consistency with national-level assessments. Further, the amount of data that is required to conduct a locally specific forecasting exercise is generally prohibitive. Lastly, the data are something that can be updated annually and modified by stakeholders easily, rather than relying on some proprietary methodology.

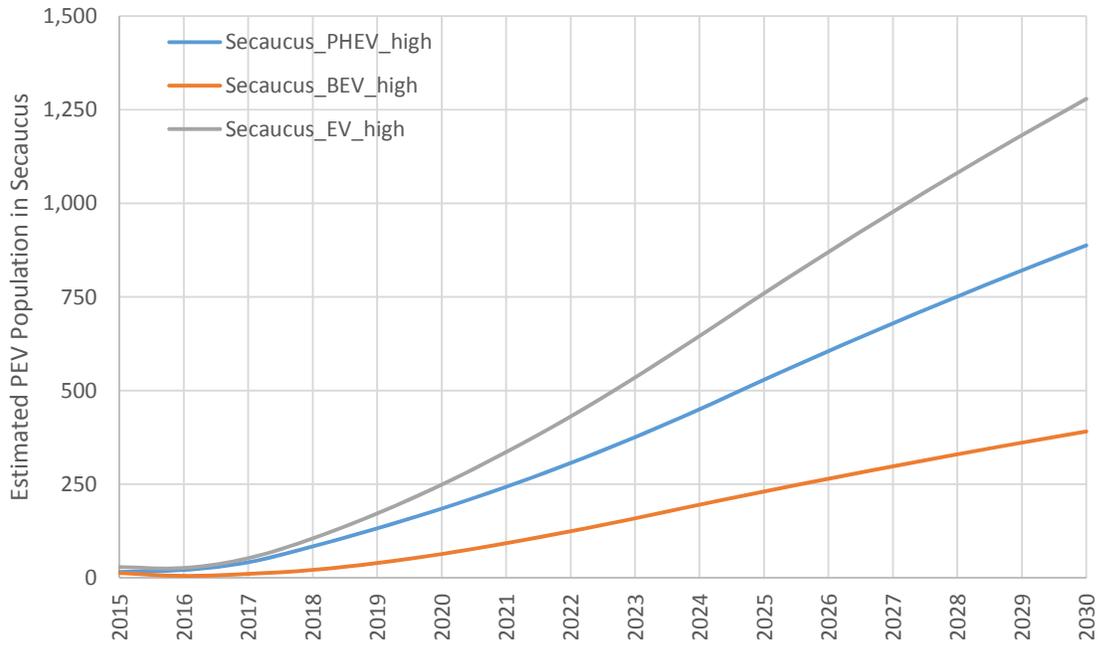
⁵⁷ ZEV programs aim to increase sales of ZEVs, which include PEVs and fuel cell electric vehicles, by requiring that some portion of vehicle manufacturer sales in the state be ZEVs. More information on New Jersey's ZEV mandate is available online at <http://www.nj.gov/dep/cleanvehicles/LEV.pdf>.

Low Scenario



Forecasted PEV Adoption in Secaucus, Low Scenario

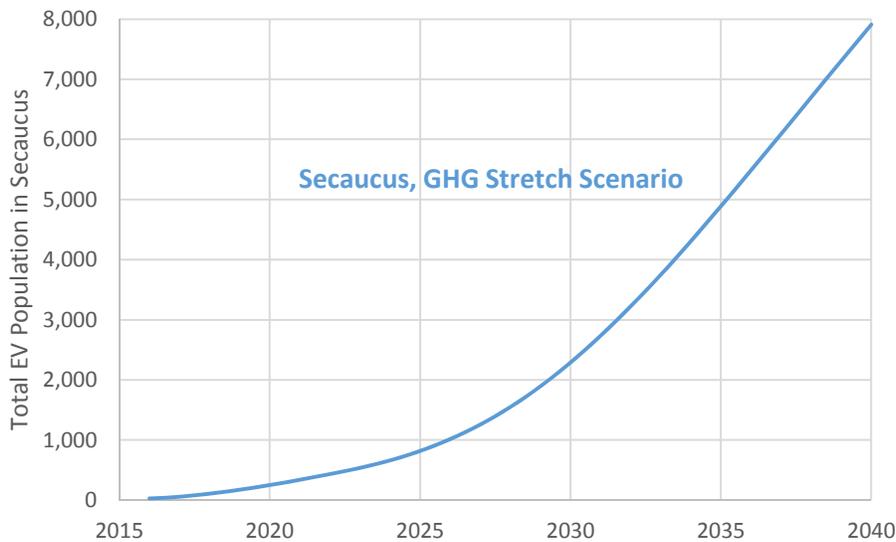
High Scenario



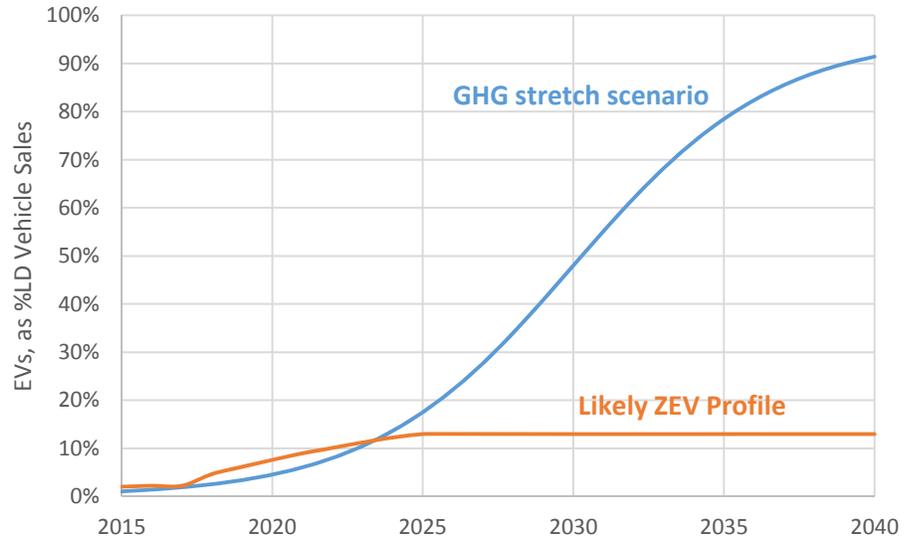
Forecasted PEV Adoption in Secaucus, High Scenario

GHG Stretch Scenario

The New Jersey Global Warming Response Act requires a statewide reduction in emissions of 80 percent from a 2006 emissions baseline by 2050. In the NJTPA Regional GHG Mitigation Plan, a PEV strategy is included with the myriad strategies designed to reduce GHG emissions from on-road transportation. The EV Plan Implementation and Clean Fuels strategy calls for a 60 percent market share of PEVs by 2040. This level of penetration of PEVs by 2040 would effectively require PEVs to capture 50 percent of all new vehicle sales by 2028, and increase rapidly to greater than 90 percent of new vehicle sales by 2040. The GHG stretch scenario assumes PEVs will capture 50 percent of the light-duty market by 2040. The first figure below compares the GHG stretch scenario with the likely compliance outlook for the ZEV program, which plateaus post-2025. As shown in the second figure below, the ZEV program will help PEVs with an initial trajectory, but much higher sale volumes will be needed post-2025 to achieve a 50 percent market share by 2040. In fact, in order to achieve the 50 percent market share by 2040, PEVs will have to make up 80 percent of new sales by 2035 and 90 percent by 2040.



Forecasted PEV Adoption in Secaucus, GHG Stretch Scenario



GHG Stretch Scenario vs Likely ZEV Profile

Appendix C. Charging Infrastructure Demand Forecasting Methodology

Overview

The infrastructure demand analyses are largely based upon the foundational data points of the NJTPA region's current and likely PEV ownership.⁵⁸ Socio-economic data were extracted from the 2014 American Community Survey (five year estimates). These data are available at the Census Block Group (CBG) level and include income, tenure or property ownership, and dwelling type. The analysis also relies on vehicle registration, particularly of HEVs.⁵⁹ The key socio-economic indicators used to develop the charging infrastructure siting analysis were:

- **Income.** Market research on early adopters of PEVs suggests that households with higher incomes are more likely to purchase a PEV. Because these vehicles tend to have higher upfront costs, income can be a limiting factor and individuals with a low income might not be able to afford the upfront cost of a PEV. Furthermore, higher income households generally buy a disproportionate share of new vehicles across all market segments and vehicle types.
- **HEV Ownership.** There can be long-term fuel savings associated with HEV (and PEV) ownership, which is one of the main reasons some might invest in such a vehicle. However, research shows that households who value the non-economic (e.g., environmental) benefits of HEVs are more likely to purchase PEVs, particularly in the early adoption phases. Many HEV owners have shown a willingness to pay to reduce gasoline use that goes beyond the economic benefits of using an HEV. A Ford Motors representative noted that typical Focus Electric buyers have purchased HEVs in the past.⁶⁰ Research from the University of California, Davis (UC-Davis) supports this assumption: 68.3 percent of PEV owners surveyed either own or have owned an HEV and locations of HEV owners correlate with locations of PEV owners.⁶¹
- **Property Ownership.** Households who own their property are more likely to purchase a PEV than those who rent, according to market research by Nissan and Chevrolet and surveys by UC-Davis and California's Clean Vehicle Rebate Project recipients. Home ownership reduces both financial and non-financial barriers to charging infrastructure deployment.

⁵⁸ There are multiple overlapping geographies considered in the charging infrastructure siting analysis. For instance, vehicle ownership data are provided at the ZIP code level; socio-economic indicators are provided at the CBG level; and trip data are generated for TAZs. These overlapping geographies can lead to uncertainty in the analysis; however, the analysis typically relies on values as percentages rather than absolute numbers. Through iterative analyses in other jurisdictions, the consultant team (ICF) has found that this approach minimizes uncertainty. Furthermore, this makes the analysis less sensitive to changes on a time scale less than a year. For instance, if a municipality obtains PEV ownership at six-month intervals, and seeks to update the analysis, it is unlikely it will observe substantive changes in the results.

⁵⁹ Data provided by the NJDEP, based on NJMVC registration data.

⁶⁰ Mike Tinsky, Associate Director, Sustainability and Vehicle Environmental Matters, Vehicle Electrification and Infrastructure, Ford Motor Company. Phone interview, April 9, 2012.

⁶¹ Gil Tal, Michael Nicholas, Justin Woodjack, Daniel Scrivano, Tom Turrentine, Plug-in Hybrid and Electric Vehicle Research Center of the Institute of Transportation Studies, University of California, Davis. Plug-In Vehicles in the San-Diego Region: A Spatial Analysis of the Demand for Plug-In Vehicles. Presented by Gil Tal, May 9, 2012, at EVS 26, Los Angeles, CA.

- Dwelling Type.** Dwelling type (e.g., single-family detached, single-family attached, or multi-unity dwelling) can help indicate PEV ownership. Consumers with a single-family detached home generally have fewer barriers to PEV adoption as they usually have access to a garage or driveway. Consumers living in MUDs are more likely to encounter barriers to installing chargers (e.g., limited space for infrastructure installation, home owners’ association restrictions, installation costs for trenching, additional metering requirements, power availability).⁶²

The charging infrastructure demand analysis leverages origin-destination trip tables from the NJTPA, which indicate the number of trips from an origin traffic analysis zone (TAZ) to a destination TAZ.⁶³ Trip types include home-based work (HBW), home-based other (HBO), and non-home non-work (NHNW) trips.

The readiness plan includes the mapped results of each infrastructure demand analysis – residential, workplace, and public/opportunity charging. Each map includes five levels of shading, based on the percentile of each TAZ’s score relative to the entire NJTPA region, and ranked as shown in the table below.

Scoring	Percentile	Demand
1	0—40%	Low
2	40—60%	Low/Medium
3	60—80%	Medium
4	80—95%	Medium/High
5	95—100%	High

Residential Charging

The residential charging demand analysis (associated with both HBW and HBO trips) relies exclusively upon socio-economic data for each TAZ. This data determined a General Residential Charging (ResGeneral) Score, which is directly correlated with residential charging infrastructure demand. As such, no trip data was incorporated into this assessment.

The socio-economic indicators explained above were scored with different weighting factors, which were linked to survey and market research of PEV owners and based heavily on California’s extensive PEV ownership data. These factors contributed to a ResGeneral Score:

$$ResGeneral\ Score = \sum \alpha Income, \beta HEV_Ownership, \gamma Tenure, \delta DwellingType,$$

where

$$\alpha + \beta + \gamma + \delta = 1.$$

Each weighting factor was based on the level of correlation associated with PEV ownership to date, and each factor is skewed towards the first two parameters: income and HEV ownership. The latter two factors – tenure and dwelling type – were used to differentiate amongst areas with higher potential.

⁶² Graham, R.L., J. Lieb, J. Sarnecki, R. Almazan, B. Neaman. Wise Investment in Electric Vehicle Charging Infrastructure through Regional Planning. EVS26 International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium, 2012.

⁶³ The socio-economic data are scored at the CBG-level and the trip data are available at the TAZ level. NJTPA staff provided a look-up table linking each CBG with a TAZ.

The most critical parameter in this infrastructure demand analysis is income, which accounts for 60 percent of the scoring. To integrate this factor, CBGs were scored against one another by comparing the share of different income groups. This provides more granularity to the analysis than simply comparing median incomes.

The second most prominent parameter in the analysis is HEV ownership, which accounts for 30 percent of the scoring. This analysis compared the percent of HEVs owned in each CBG against the percent of HEV ownership in that CBG's municipality and against the entire state of New Jersey. CBGs scored higher in the analysis if they had HEV ownership higher than the state median.

The tenure parameter represents the rate of home ownership relative to the median rate of home ownership for the state of New Jersey. Based on survey data and PEV market research, home ownership as a percent of the number of residential units available in a given area are short- to mid-term indicators for PEV ownership but are less effective indicators over the long-term. For this reason, the tenure parameter accounts for 5 percent of the total score. Additionally, these parameters were used exclusively to differentiate amongst areas with better than median income and HEV ownership profiles. In other words, if an area did not have a higher than median income but did have a higher than median rate of home ownership, the home ownership factor would not impact the ResGeneral Score. However, for areas with a similar median income or HEV ownership profile, a higher rate of home ownership would yield a higher ResGeneral Score.

For the final parameter, dwelling type, areas were scored based on the rate of single-family units relative to the median rate of single-family units. This parameter also accounts for 5 percent of the total score and a higher rate of single-family units yields a higher ResGeneral Score.

Workplace Charging

To forecast the likely demand for workplace charging infrastructure, the results of the residential demand analysis were combined with regional travel demand data to determine the TAZs within the Town of Secaucus that have the highest number of trips originating from TAZs with the highest likelihood of PEV ownership. The analysis relied upon an output matrix from the NJTPA's travel model, referred to as origin-destination trip tables for home-based work trips. The trip originating from TAZ_O was multiplied by the score determined in the residential analysis, *ResGeneral Score_O*. The likelihood of workplace charging is simply correlated with the number of trips concluding at the workplace destination TAZ_D. The letters O and D represent origin and destination.

Public Charging

In the long run, public charging will consist of predominantly Level 2 and DC Fast charging, with Level 2 being the charging type most feasible for Secaucus to install and support. For this reason, the forecast for public charging focuses on Level 2 charging, using a methodology similar to the workplace charging analysis. However, instead of multiplying the ResGeneral Score by HBW trips, it is multiplied by HBO trips, which served as a proxy for public charging.

Appendix D. Municipal Policy Examples

Sustainability/Climate Action Plan

Woodbridge *Sustainable Community Plan and Climate Action Plan*,
<http://www.twp.woodbridge.nj.us/DocumentCenter/Home/View/2813>

- Transportation and Circulation objectives include:
 - “Use fuel-efficient and alternative-fuel vehicles to reduce energy consumption, fossil fuel use, and associated air pollution emissions, including greenhouse gas emissions”
 - Continue to track alternative technologies such as electric, CNG or hybrid.”
- Includes indicators and targets specific to AFVs in the municipal fleet:
 - “Year 1 target: add at least five alternative fuel or high efficiency vehicle to the fleet
 - Further target: at least 25% of fleet using alternative fuels and/or high efficiency vehicles within 10 years.”
- Energy Conservation and Green Buildings action steps include:
 - “Adopt ordinances to change zoning to become electric vehicle friendly
 - Create a program that encourages work place and multifamily charging
 - Hold an event that promotes electric vehicle awareness”
- Other specific actions outlined in detail include:
 - “Create a Carpool Board for Municipal Employees and Promote Carpooling/Alternative Fuel Vehicles,” which seeks to provide information resources and explore the possibility of extending incentives to municipal employees.
 - “Create and Implement “Anything But Cars” (ABC) Program,” which aims to “provide choice and interconnectivity among sustainable transport modes and measures.”

PEV Parking Ordinance

Chapter 230: Parking Lots

Article I: Parking Permits

[Adopted 4-15-1980 by Ord. No. 80-12 as Art. I of Ch. 161A of the 1979 Code]

§ 230-3.1 Reserved parking for recharging electric vehicles.

[Added 8-12-2013 by Ord. No. O-13-42]

A. It shall be unlawful for any person to park or leave standing a vehicle in a stall or space designated for the recharging of electric vehicles unless the vehicle is connected for electric charging purposes.

B. It shall be unlawful for any person to obstruct, block, or otherwise bar access to parking stalls or spaces described in Subsection A except as provided in Subsection A.

C. Notice of reserved parking for recharging of electric vehicles shall be posted on a sign not less than 17 inches by 22 inches in size with lettering not less than one inch in height that clearly and conspicuously states the following: "Unauthorized vehicles not connected for electric charging purposes may be towed away at owner's expense. Towed vehicles may be reclaimed at designated towing facility

or by calling Montclair Police Department - 973-744-1234." The sign shall be posted in both of the following locations:

- (1) Immediately adjacent to, and visible from, the stall or space.
- (2) In a conspicuous place at each entrance to the parking facility.

New Construction Pre-Wire Requirement

New York City requires that newly constructed and upgraded parking garages and open lots include the necessary hardware for charging infrastructure in at least 20 percent of the parking spaces. See the General Administrative Provisions for Construction Codes, Section 28-101.4.3, as well as the Building Code, Sections 406.2.11 and 406.7.11 (<https://www1.nyc.gov/site/buildings/codes/2014-construction-codes.page>).

Redevelopment Plan Language

Montclair, NJ Seymour Street Redevelopment Plan,
<http://www.montclairnjusa.org/dmdocuments/SEYMOUR-Rdv-Plan-FINAL.pdf>

ELECTRIC CAR-CHARGING FACILITIES: All parking facilities within the Redevelopment Area shall include at a minimum two electric car charging stations as well as the infrastructure necessary to support additional car charging facilities to accommodate future demand. The car-charging facilities shall be the responsibility of the redeveloper.

“Right to Charge” Language

While it exists at the state level, rather than as a municipal ordinance, California’s “right to charge” policy is summarized as follows:

A common interest development, including a community apartment, condominium, and cooperative development, may not prohibit or restrict the installation or use of electric vehicle supply equipment (EVSE) in a homeowner's designated parking space. These entities may put reasonable restrictions on EVSE, but the policies may not significantly increase the cost of the EVSE or significantly decrease its efficiency or performance. If installation in the homeowner's designated parking space is not possible, with authorization, the homeowner may add EVSE in a common area for their use. The homeowner must obtain appropriate approvals from the common interest development association and agree in writing to comply with applicable architectural standards, engage a licensed installation contractor, provide a certificate of insurance, and pay for the electricity usage associated with the EVSE. Any application for approval should be processed by the common interest development association without willful avoidance or delay. The homeowner and each successive homeowner of the parking space equipped with EVSE is responsible for the cost of the installation, maintenance, repair, removal, or replacement of the station, as well as any resulting damage to the EVSE or surrounding area. The homeowner must also maintain a \$1 million umbrella liability coverage policy and name the common interest development as an additional insured entity under the policy. If EVSE is

installed in a common area for use by all members of the association, the common interest development must develop terms for use of the EVSE. (Reference [California Civil Code](#) 4745 and 6713)

Source: <http://www.afdc.energy.gov/laws/9579>

Appendix E. Plug-in Electric Vehicle Community Readiness Resources

This information was adapted from a collection of resources compiled by the DOE's Clean Cities program, focusing on tools, documents, websites, and other information available via DOE's Office of Energy Efficiency and Renewable Energy.

[DOE EV Everywhere Electric Vehicles: Stakeholder Solution Center](#)

States and Municipalities

States and municipalities are key players in increasing PEV readiness. The best way for states and municipalities to improve their PEV readiness is to partner with their [local Clean Cities coalition](#), which can connect them to specific regional resources and other relevant stakeholders.

- [Plug-in Electric Vehicle Readiness Scorecard](#): Hosted on the DOE's Alternative Fuels Data Center, the Scorecard allows communities to assess their readiness, receive feedback about ways to improve, read about best practices, and record progress.
- [Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects](#): This guide, which is on the DOE Clean Cities' website, summarizes the best practices in streamlining permitting processes, revising codes, training emergency personnel, developing incentives, and educating the public based on the experiences of 16 PEV readiness projects across the country.
- [Reports from the Clean Cities' EV Community Readiness Projects](#): These are individual reports and community readiness plans from each of the projects, hosted on the Clean Cities' website. (See list of projects in chart, below).
- [Zoning, Codes and Parking Ordinances](#): This page on the DOE's Alternative Fuels Data Center links to relevant NIST codes for electric vehicle charging.
- [Handbook for Public Charging Station Hosts](#): This handbook on the DOE's Alternative Fuels Data Center provides an overview for what cities hosting public charging stations need to know before installation.
- [Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools](#): Published by the Transportation and Climate Initiative, this guide provides information on the steps to create, administer, and amend planning processes, rules and regulations, including in zoning, parking, and permitting.
- [EV-Ready Codes for the Built Environment](#): This guide, published by the Transportation and Climate Initiative, provides an overview of building and electrical codes as relating to PEVs, as well as providing recommendations specific to jurisdictions in the Northeast and Mid-Atlantic.
- Training on PEVs for First Responders through the [National Alternative Fuels Training Consortium](#) and the [National Fire Protection Association](#) provides essential education to firefighters, police officers, EMTs and others that may need to respond to accidents involving PEVs.
- [Drive Electric Vermont Case Study](#): This case study examines the opportunities and barriers to enabling small and midsize communities to partake in the PEV market and benefit from the economic and environmental advantages of the vehicles.

Employers

Providing charging at the workplace can encourage employees to purchase PEVs, be an attractive employee benefit, and maximize all-electric miles driven by PEV owners. The EV Everywhere [Workplace Charging Challenge](#) was a DOE program to encourage and recognize employers providing workplace charging.

- [Resources to Install and Manage Workplace Charging](#)
- [Handbook for Workplace Charging Hosts](#)

Fleets

Like consumers, fleets can benefit from the low operating costs and other benefits associated with PEVs. [Local Clean Cities coalitions](#) can help fleets decide which technologies and models will be most appropriate to meet their needs.

- [Handbook for Fleet Managers](#): This handbook on the DOE's Alternative Fuels Data Center provides fleet-specific information on the basics of PEVs, including issues like maintenance and charging.
- [Plug-in Electric Light, Medium and Heavy-Duty Vehicle Search](#): This tool on DOE's Alternative Fuels Data Center provides information on PEVs that can be filtered by class/type and manufacturer.
- [AFLEET Tool](#): Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation Tool allows fleet managers to calculate the cost of ownership, petroleum use, greenhouse gas emissions, and air pollutant emissions of alternative fuel vehicles.

Electrical Contractors and Inspectors

The installation of residential, workplace and public charging is essential to establishing a PEV market.

- [Electric Vehicle Infrastructure Training Program](#): This program provides training and certification at community colleges and electrical training centers across the United States for people installing electric vehicle supply equipment for residential and commercial markets.
- [EVSE Residential Charging Installation Video](#): A series of segments on the Clean Cities TV YouTube channel walk electricians through the basics of installing PEV charging infrastructure in homes, including an overview of the equipment, the relevant National Electrical Codes, inspection, and best practices.

Utilities

Through a partnership with the Edison Electric Institute, DOE is developing a suite of tools for utilities to support the use of PEVs.

- [The Utility Guide to Plug-in Electric Vehicle Readiness](#): A guide from the Edison Electric Institute, this document covers structuring your company to support PEVs, adding PEVs to utility fleets, enhancing the customer experience, working with state and local governments, and managing the electrical grid with PEVs.
- [Utilities Power Change](#) – This case study showcases how New Jersey's Public Service Electric and Gas Company, and Southern Company's unit Georgia Power are launching workplace charging programs for their commercial customers.

Additional Resources

[At A Glance: Electric-Drive Vehicles](#)

[Charging Plug-In Electric Vehicles in Public](#)

[Charging Plug-In Electric Vehicles at Home](#)

[Resources for Electrical Contractors and Inspectors](#)

[Developing Infrastructure to Charge Plug-In Electric Vehicles](#)

[Plug-In Electric Vehicle Deployment Policy Tools: Zoning, Codes, and Parking Ordinances](#)

[Signage for Plug-In Electric Vehicle Charging Stations](#)

[Plug-In Electric Vehicle Handbook for Consumers](#)

[Workplace Charging: Charging Up University Campuses](#)

[Electric Vehicle Charging for Multi-Unit Dwellings](#) (webpage with links to resources and case studies)

[Massachusetts Plug-in Electric Vehicle and Charging Infrastructure Case Study](#)

[Rolling Down the Arizona EV Highway](#) (case study)

[San Diego Prepares for Electric Vehicles in Multi-Unit Dwelling Communities](#) (text version and video)

[Houston Energizes Deployment of Plug-In Electric Vehicles](#) (case study)

[Seattle Rideshare Fleet Adds EVs, Enjoys Success](#) (case study)

[Alternative Fuels Data Center Publications](#) (search by keyword for additional resources)

Appendix F. Additional Information on Parking

Secaucus has the power to designate a Parking Enforcement Officer under Chapter 23, Article XXXI (Secaucus Town Code; <http://clerkshq.com/default.ashx?clientsite=Secaucus-nj>); their power and duties are explained in sections 23-128 through 23-132. The Office of Inspections under Chapter 22 governs Residential Parking Permits. Commercial parking requirements are categorized by the type of business under site-specific ordinances. However, none of the ordinances mention AFV infrastructure or parking. It should also be noted that under Chapter 98 of the Town Code under the section on “Parking Tax,” the town collects a tax of 15 percent on moneys collected by most providers of paid parking spaces. It also states that no tax shall be imposed with respect to any parking or garaging on vehicle storing fees charged by any religious, charitable, or educational institution. Therefore, any future AFVs parking areas not exempted will also be subject to the tax.

Chapter 127 governs overall Vehicles and Traffic. Article II under this chapter oversees parking in general. Additional articles reference parking in the specific areas of Snipe’s Park, Kane Stadium, Municipal Parking Areas, and Restricted Parking Zones. Residential Parking is governed by Chapter 127A with the purpose to establish a residential parking program and to alleviate unfavorable parking conditions and other dangerous situations and conditions. This chapter also covers parking zones, time limits, and parking permits. Vehicles and Traffic regulations regarding Board of Education Property is governed by Chapter 128 and designates specific areas and the type of vehicle that may park in such areas. As mentioned before, none of the ordinances above cite AFVs, but future consideration should be given to adding language relating to AFVs.

Finally, zoning consideration is covered under Chapter 135, “Zoning” with Article IV of this chapter overseeing parking requirements. The Zoning Officer has the general duty and authority to administer and enforce the provisions of this chapter and may be assisted by the Construction Code Official and Department of Police. Zoning ordinances usually outline the amount of parking spaces required for a given building, and the type of spaces needed. It should be noted that the definition of a “structure” under this chapter is “a permanent piece of equipment, or item that is installed on concrete, a concrete pad or footings or which cannot be readily moved and which may or may not be attached to the residence through electrical or plumbing or other utility,” which may cover future alternative fuel vehicle infrastructure. Parking requirements for commercial, industrial, and other uses can be found in a table under Article IV. Parking design standards are governed by ordinance § 135-12.1. A minimum requirement for the amount of AFV spaces can be added to the table, while the design of AFVs spaces would be governed by the latter ordinance.

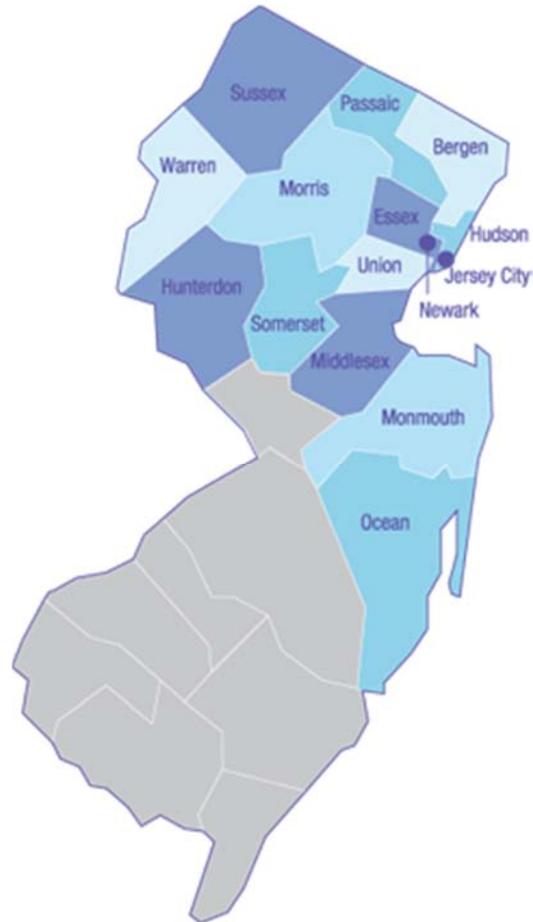
Appendix G. Regional Planning Area

The NJTPA regional planning area consists of 13 counties within North New Jersey; Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, and Warren; and its two largest cities, Newark and Jersey City. The region spans 4,200 square miles, about half of the state's land area. It is the fourth largest MPO in the nation in terms of population, serving more than 6.7 million people and over 3.1 million jobs.⁶⁴

The region has a robust multi-modal transportation network, including 26,000 miles of roads, 255 local and express bus routes, and 13 commuter/light rail lines with 228 stations, and 18 ferry routes from 19 piers.⁶⁵ Situated between New York and Philadelphia, the area is a regional corridor for both intra- and inter-state transportation. According to the American Community Survey (ACS), 34 percent of regional residents work outside their county of residence and 14 percent work outside of the state. The ACS found that the majority (70 percent) of commuters report driving alone, a rate that is significant but lower than most major metropolitan areas. In 2015, the region had 149.1 million miles of vehicle travel.⁶⁶

The NJTPA's regional transportation plan – Plan 2045: Connecting North Jersey – outlines the principles that guide project selection and provide policy and planning direction.⁶⁷ These include:

- **Help Northern New Jersey Grow Wisely** — Transportation investments should encourage economic growth while protecting the environment and minimizing sprawl in accordance with the state's Smart Growth plan, Energy Master Plan, and environmental plans.
- **Make Travel Safer** — Improving safety and security should be explicitly incorporated in the planning, design, and implementation of all investments.
- **Fix It First** — The existing transportation system requires large expenditures for maintenance, preservation, and repair, and its stewardship should be the region's highest priority.



NJTPA Region

⁶⁴ NJTPA, Plan 2045: Connecting North Jersey, <https://apps.nitpa.org/plan2045>.

⁶⁵ New Jersey Transit, *Facts at a Glance – Fiscal Year 2016*, <http://www.njtransit.com/pdf/FactsAtAGlance.pdf>.

⁶⁶ New Jersey Department of Transportation, *New Jersey's Roadway Mileage and Daily VMT by Functional Classification Distributed by County*, http://www.state.nj.us/transportation/refdata/roadway/pdf/hpms2015/VMTFCC_15.pdf.

⁶⁷ NJTPA, Plan 2045: Connecting North Jersey, <https://apps.nitpa.org/plan2045>.

- Expand Public Transit — Investment to improve the region’s extensive transit network should be a high priority, including strategic expansions to serve new markets.
- Improve Roads but Add Few — Road investments should focus on making the existing system work better and road expansion should be very limited without compromising the tremendous accessibility provided by the existing highway system.
- Move Freight More Efficiently — Investments should be made to improve the efficiency of goods movement because of its importance to the region’s economy and quality of life.
- Manage Incidents and Apply Transportation Technology — Investments should be made to improve information flow, operational coordination, and other technological advances that can make the transportation system work smarter and more efficiently.
- Support Walking and Bicycling — All transportation projects should promote walking and bicycling wherever possible.
- Increase Regional Resiliency — Investments should be made to mitigate risks associated with sea level rise, extreme weather, homeland security, and other potential threats. Investments should consider criticality of infrastructure, vulnerability, and level of risk.

While the expansion of transit and smart land-use planning work to reduce single occupant travel, the adoption of AFVs within the region will help reduce the environmental impact of the remaining vehicle trips by reducing oil consumption and transportation-related emissions, thus supporting the NJTPA’s goal of protecting the environment.



Woodbridge Township



Alternative Fuel Vehicle

Readiness Plan

December 2017

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Disclaimer

This publication was prepared with funding from the North Jersey Transportation Planning Authority (NJTPA) and the Federal Highway Administration (FHWA). This document is disseminated under the sponsorship of NJTPA and FHWA in the interest of information exchange. The NJTPA and FHWA assume no liability for its contents or use thereof.

Acknowledgments

This plan was prepared for the NJTPA by a consultant team consisting of ICF, Greener by Design, and Fitzgerald & Halliday, Inc.

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Executive Summary

Plan Overview

This Woodbridge Township Alternative Fuel Vehicle (AFV) Readiness Plan outlines actions that the township can take to reduce and resolve barriers to AFV usage. It includes 25 recommendations across five action areas for community leaders and other stakeholders interested in expanding the use of plug-in electric vehicles (PEVs) and natural gas vehicles (NGVs).

The North Jersey region, including Woodbridge Township in Middlesex County, stands to benefit from AFVs, specifically through reduced fuel costs, savings on maintenance, use of advanced technology, support of domestic industries, and promotion of environmental sustainability. The objective of readiness planning is to identify, prioritize, and implement strategies that unlock the potential for vehicle electrification and NGV deployment. If done thoroughly and thoughtfully, AFV readiness planning will set the course for municipalities to effectively accelerate the shift away from reliance on conventional vehicles to AFVs, both in the consumer and fleet markets.

The NJTPA project team, working closely with a stakeholder advisory committee (SAC) made up of municipal decision-makers, residents, and industry representatives, developed the Woodbridge Township Alternative Fuel Vehicle Readiness Plan. The readiness planning process includes data collection and analysis around the current and future market, barriers to increased adoption, regulatory framework, and existing and planned incentives and funding. The resulting recommendations focus on general plans and policies, zoning and parking codes, permitting and inspection, building codes, and fleet planning.

This study was conducted in keeping with the policies of Plan 2045: Connecting North Jersey to improve mobility, protect the environment, and take advantage of technology developments

Plug-in Electric Vehicle Readiness

As of July 2017, PEVs made up approximately 0.07 percent of all vehicles registered in the township. That is approximately 70 PEVs. Given the consumer focus, the opportunity for PEVs is closely linked to several socio-economic factors, including income, hybrid electric vehicle (HEV) ownership, home ownership, and housing type. While barriers to usage exist, the number of PEVs traveling in and around Woodbridge Township will continue to increase. Additional charging infrastructure will be needed to support this growing number of PEVs (see box).

Regulations, policies, and incentives at the municipal, state, and federal levels can play a role in facilitating PEV usage. The project team analyzed existing plans, codes, ordinances, and incentives to inform the recommendations below.

The project team organized both the charging demand analyses and readiness planning recommendations according to the charging infrastructure needs identified for Woodbridge Township:

- **Residential:** Throughout Woodbridge, there is modest potential for PEV ownership, with the higher likelihood of PEV ownership manifesting in the more affluent neighborhoods made up of mostly single-family homes. The Colonia section is representative of higher residential charging demand.
- **Multi-Unit Dwelling (MUD):** MUD charging demand is shown to be the highest surrounding and to the north of Woodbridge Center, driven by existing properties in the area.
- **Workplace:** The employment centers of Woodbridge appear as having the highest demand for workplace charging. These include Woodbridge Center, Woodbridge Corporate Plaza, and Metropark.
- **Public:** The demand for public charging is greatest surrounding Woodbridge Center and the stand-alone retail locations that include Wegmans and Lowe’s Home Improvement.

Natural Gas Vehicle Readiness

Given that NGVs are typically medium- and heavy-duty vehicles, both market penetration and opportunities for municipal NGV readiness planning are more limited than for PEVs. The NGV market outlook in Woodbridge is tied to both national (e.g., price differential) and local (e.g., resource constraints) barriers.

Recommendations

The plan's recommendations correlate with goals set by the SAC, as well as the demand analysis, existing municipal plans and policies, and incentives. The recommendations are organized by the type of infrastructure demand (general, residential, MUD, workplace, and public). In addition, for each recommendation, a lead organization or stakeholder is identified. The time horizon for the actions is 10 years, with actions that may be ongoing, as well as those to be implemented in the near-term (1-2 years), medium-term (3-5 years), and long-term (6-10 years). Below is a summary of the recommendations for Woodbridge Township:

- **General Plans & Policies:** The township has several long-range plans that consider transportation. In particular, the Sustainable Community Plan and Climate Action Plan developed in 2010 include targeted recommendations related to AFV integration into the municipal fleet, a PEV car-sharing pilot program, and PEV charging stations. This readiness plan includes the following recommendations to further incorporate AFV preparedness into local plans and policies:

- Integrate AFV readiness into local planning efforts, including **general plans** and **climate action plans**
- Create **cross-jurisdictional opportunities** for sharing lessons learned
- Update the **PEV infrastructure demand analysis**
- Establish **design criteria** for AFV infrastructure
- Collaborate with **utilities** to share market information and facilitate necessary electricity distribution infrastructure upgrades
- Conduct **community education and outreach** to increase awareness about the benefits of AFVs and the role they can play in decreasing transportation costs and achieving environmental goals
- Conduct **targeted outreach** to MUD managers, developers, employers, and other landowners to install chargers at high-priority locations
- Collaborate with MUDs to create and implement policies that **allow residents to install** PEV charging infrastructure
- Identify **AFV grants and other funding opportunities** for workplace and public charging infrastructure development
- Pursue **public-private partnerships** to fund publicly accessible charger installations
- **Zoning & Parking Codes:** The Woodbridge zoning code has no specific language relative to charging infrastructure, including in the parking requirements. However, there are no impediments to AFV use or AFV infrastructure in development. The plan includes the following recommendations for zoning and parking codes:
 - Amend zoning codes to **encourage or incentivize PEV charging stations or pre-wiring** in new commercial developments
 - Establish **preferential parking policies** for PEVs and **amend parking codes** to regulate the use of PEV charging spaces
- **Permitting & Inspection:** Municipalities are responsible for administering and enforcing New Jersey codes through the state-mandated permitting and inspection processes. The New Jersey Department of Community Affairs (NJCA) has been working to streamline the installation of PEV charging stations, including developing guidance on when construction permits and inspections are required and expediting the permitting process. Woodbridge Township has not yet developed processes for administering building codes or electrical subcodes specific to the installation of PEV charging infrastructure. The plan includes the following recommendations for permitting and inspection:
 - **Educate** permitting officials, inspection officials, and first responders in AFV station basics
 - Produce **guidance documents outlining permitting requirements** for residential and commercial PEV charging station installations

- **Building Codes:** The NJDCA establishes and enforces statewide building codes — referred to as the Uniform Construction Code (UCC). Municipalities like Woodbridge Township are limited to the statewide UCC, and are therefore not in a position to take a more progressive approach to building codes as they are related to PEVs or other issues. To that end, the plan includes only one recommendation for building codes:
 - **Work with the state to amend the building code** to require PEV station readiness in new single-family developments
- **Fleet Planning:** While often overshadowed by the consumer focus for PEVs, fleet planning is important to AFV readiness, particularly for NGVs. The plan includes the following recommendations related to fleet planning:
 - Assess **the existing municipal fleet**, develop a **fleet management plan**, and **explore opportunities** for fleet AFVs
 - Provide **technical assistance, training, and educational resources** to local fleet managers regarding AFV and infrastructure deployment

Conclusions and Next Steps

By following the recommendations outlined here, Woodbridge Township will be well-equipped to support AFV use within the municipality, thereby reducing fossil fuel use, supporting a healthy environment, increasing economic development, attracting residents and businesses, and demonstrating leadership.

This is a comprehensive plan, but it only provides a snapshot in time. AFV readiness planning is an iterative and ongoing process. The alternative fuel industry is dynamic and this plan should be a “living” document that Woodbridge Township revisits and updates as goals are achieved, new challenges arise, or circumstances change. In order to accomplish this, Woodbridge Township should continue to engage stakeholders and solicit feedback on areas that may need additional attention.

There are numerous technical assistance resources available to provide the township with ongoing support and direction, including the NJTPA and other organizations. The NJTPA project team also developed an AFV readiness guidebook to assist Woodbridge Township and other municipalities with future planning efforts.

Introduction to Alternative Fuel Vehicle Readiness Planning

With the increased availability of and attention paid to AFVs in recent years, the NJTPA is supporting local and regional efforts to deploy these vehicles and related infrastructure for both the consumer and fleet markets. This report focuses on municipal readiness planning in Woodbridge Township in Middlesex County, New Jersey.

Municipalities can benefit from AFVs, particularly PEVs and NGVs. Benefits include reduced fuel costs for consumers, savings on maintenance, supporting domestic industries, and promoting environmental sustainability. The objective of readiness planning is to identify, prioritize, and implement strategies that unlock the potential of transportation electrification and NGV deployment. More specifically, AFV readiness planning lays out the path to make municipalities “AFV ready” by identifying the barriers to widespread deployment of infrastructure and vehicles, and outlining actions that will reduce and resolve these barriers. This plan also includes recommended actions community leaders and other stakeholders can take to help expand the use of PEVs and NGVs.

The value of AFV readiness planning is highlighted by work from the U.S. Department of Energy (DOE) and the International Council on Clean Transportation (ICCT). Researchers at DOE national laboratories demonstrated a correlation between higher PEV deployments and readiness planning, even after factoring in cold weather and incentive availability.¹ Meanwhile, the ICCT assessed actions taken at the municipal level and concluded that there is quantitative support for the “ecosystem approach” as a best practice, where many stakeholders (including local municipalities) have key roles in enabling PEV growth; and that “cities are focal points for collaboration among governments, the auto industry, utilities, and advocates on electric vehicles.”²

Most readiness planning to date has been focused at the regional or state level. For instance, DOE awarded 16 projects in 2011, referred to as the Clean Cities Community Readiness and Planning for Plug-in Electric Vehicles and Charging Infrastructure,³ at the multi-state, state, regional, and metropolitan levels. This plan takes readiness planning to the municipal level, in an effort to accelerate the shift away from reliance on conventional vehicles to AFVs. This plan focuses on PEVs and NGVs. Both plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) make up the broader PEV category.

To the extent practicable, this plan considers the unique attributes that influence AFV usage in Woodbridge, providing customized insights and recommendations. This plan can help decision-makers in Woodbridge identify and prioritize the most effective ways to catalyze AFV deployment.

¹ DJ Santini, Electric Drive Technology Market Trends, 2015 Clean Cities Strategy,

http://www.eere.energy.gov/cleancities/pdfs/2015_strategic_planning_presentation_electric_drive.pdf.

² ICCT White Paper, Assessment of leading electric vehicle promotion activities in United States cities, 2015,

http://theicct.org/sites/default/files/publications/ICCT_EV-promotion-US-cities_20150729.pdf.

³ More information about these projects is available online at <https://cleancities.energy.gov/partnerships/projects#electric-vehicle-projects>.

This effort was sponsored by the NJTPA, the Metropolitan Planning Organization (MPO) for the 13 counties of northern and central New Jersey. Working with local stakeholders and drawing on national examples, three readiness plans were developed to understand existing conditions and recommend implementation strategies related to AFV readiness. The other plans were developed for the Town of Secaucus and Montclair Township.

Relevant Regional Planning Efforts

The NJTPA has been involved in developing and implementing two related northern New Jersey plans that provide long-term, regional context to the development of local readiness plans for AFV infrastructure.

Together North Jersey Plan

The Together North Jersey (TNJ) Regional Plan for Sustainable Development, completed in 2015, is the result of three years of planning activities by a coalition of diverse partners. The Plan provides detailed strategies and specific actions, serving as a technical guide for implementation.

The TNJ plan has 15 focus areas, including *Focus Area 11: Transition to a clean energy economy*. Within Focus Area 11, there are four strategies, one of which is *Strategy 11.4: Reduce transportation petroleum use*, which in turn recommends actions in two categories: *travel optimization* and *advanced vehicles* actions. The advanced vehicles actions involve regional and local governments “...working with state officials and the private sector to speed the adoption of new vehicle technologies, especially electric, hybrid and other alternative fuel vehicles by implementing incentive programs, investments and other measures to encourage the purchase and use of these vehicles by individuals and fleet owners and significantly expanding the number public and private electric vehicle charging stations and alternative fuel vehicle refueling stations available in our region and statewide.”

There are nearly a dozen AFV related actions recommended. Of these, two are related directly to the development of AFV infrastructure and local readiness plans: (1) “Incentivize and support municipalities to develop and adopt alternative fuel readiness plans... Implement a variety of programs that encourage development of public charging infrastructure for electric vehicles across the region, with particular focus on the involvement of municipal governments...”; and (2) “Incentivize, support, and promote the development of private EV charging infrastructure at commercial (for employees or visitors), and residential properties...” The TNJ plan outlines several steps to implement these actions.

Source: togethernorthjersey.com

Plan 2045

Plan 2045: Connecting North Jersey is the NJTPA’s Regional Transportation Plan for northern New Jersey. The plan considers how AFVs, as well as other “game changing” technologies will shape transportation while offering a long-term vision to support the region’s economy and quality of life. Developed with extensive public and stakeholder input, the plan addresses infrastructure and transportation needs that ultimately will shape a positive, productive future for North Jersey.

Source: <https://apps.njtpa.org/plan2045>

Woodbridge Township

Located in northeastern Middlesex County, one of 13 counties in the NJTPA region (see [Appendix G](#)), Woodbridge Township is home to more than 100,000 residents and spans 23.2 square miles (see Figure 1).⁴ The township is a suburb of the New York City metropolitan region and it is the only municipality where the Garden State Parkway and New Jersey Turnpike intersect. There are many other major roadways in the township, including Interstate 287, Route 1, Route 9, Route 440, Route 27, and Route 35. The township also has three train stations: Avenel, Metropark, and Woodbridge.

Woodbridge has 10 distinct sections, each tight-knit, with a unique character and history. Approximately 43 percent of developed land is for residential use, located throughout the township. The most residential sections include Avenel, Colonia, Fords, Iselin, and Woodbridge proper. Commercial land use accounts for approximately 13 percent of the township, concentrated along the major roadways noted above, in Woodbridge Proper, Iselin, Menlo Park Terrace, Fords, and Hopelawn. The township's industrial land use, accounting for 19 percent of developed areas, are mainly located in Avenel, Keasbey, Port Reading, and Sewaren. Due to its large size, variety of land uses, and the number of distinct neighborhoods, the township is very diverse in terms of ethnicity, age, and income.⁵

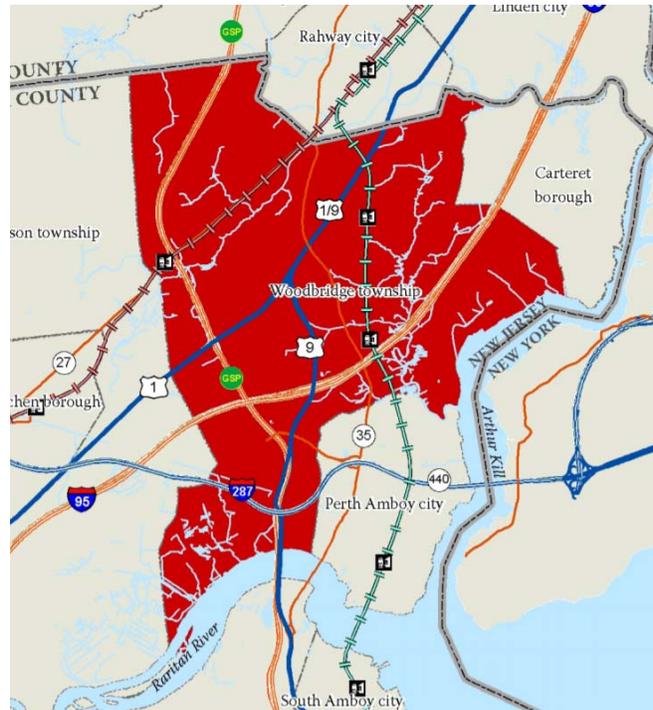


Figure 1. Map of Woodbridge Township

⁴ U.S. Census Bureau (2015). Total Population American Community Survey 1-year estimates, https://censusreporter.org/data/table/?table=B01003&geo_ids=06000US3402382000,05000US34023,04000US34,01000US&primary_geo_id=06000US3402382000. Accessed April 10, 2017.

⁵ Township of Woodbridge (2009). Master Plan – Township of Woodbridge, Middlesex County, <http://www.twp.woodbridge.nj.us/DocumentCenter/Home/View/728>. Accessed April 10, 2017.

There are 34,508 housing units within Woodbridge, 67 percent of which are owner-occupied. About two thirds of the housing units are single-unit structures and one third are multi-unit.⁶ On average, Woodbridge residents spend 32.5 minutes commuting to work each day.⁷ The majority (82 percent) of commuters report driving to work and 13 percent take public transit.⁸ As a fully-built out community, development opportunities within the township exist primarily through the rehabilitation and redevelopment of existing properties.

⁶ U.S. Census Bureau (2015). Units in Structure American Community Survey 1-year estimates, https://censusreporter.org/data/table/?table=B25024&primary_geo_id=06000US3402382000&geo_ids=06000US3402382000,05000US34023,04000US34,01000US. Accessed April 10, 2017.

⁷ U.S. Census Bureau (2015). Travel Time to Work American Community Survey 1-year estimates, https://censusreporter.org/data/table/?table=B08303&geo_ids=06000US3402382000&primary_geo_id=06000US3402382000. Accessed April 10, 2017.

⁸ U.S. Census Bureau (2015). Means of Transportation to Work American Community Survey 1-year estimates, https://censusreporter.org/data/table/?table=B08006&primary_geo_id=06000US3402382000&geo_ids=06000US3402382000,05000US34023,04000US34,01000US. Accessed April 10, 2017.

Alternative Fuel Vehicle Readiness Planning Goals

The project team and Woodbridge staff met throughout the course of the project. Staff from the planning and development department and the Mayor's Office were key members of the stakeholder advisory committee (SAC). The committee also included representatives from multiple Woodbridge-based businesses, Middlesex County, and Keep Middlesex Moving (KMM), the transportation management association (TMA) for Middlesex County. SAC members provided valuable background data and critical review throughout the project. SAC meetings helped to articulate Woodbridge's vision for AFV readiness, to provide sufficient background material to stakeholders, and to gather input about the challenges, barriers, and opportunities related to AFV readiness. Woodbridge considered stakeholder input as well as community priorities in developing the following goals:

- Improve air quality and reduce greenhouse gas (GHG) emissions by encouraging the deployment of AFVs and supporting infrastructure.
- Maximize the number of publicly available PEV charging stations throughout the township at popular commercial establishments (e.g., Woodbridge Center Mall, Shop-Rite, and Wegmans retail complexes).
- Encourage new residential complexes to deploy and maximize utilization of on-site PEV charging infrastructure.
- Upgrade municipal and school vehicle fleets with AFVs and deploy supporting fueling infrastructure.
- Maximize the number of large industrial sites in the township that utilize AFVs in their fleets; provide alternative fueling stations for use by these fleets, and the public where possible.

Structure of the Readiness Plan

The Woodbridge Township readiness plan is structured as follows:

[Section 1. Plug-In Electric Vehicles and Charging Infrastructure](#): This section begins with an overview of the PEV market today, including the type and number of PEVs registered in Woodbridge Township; the location, quantity, and level of available charging infrastructure; a market outlook; a review of barriers to increased PEV adoption; a review of the regulatory framework in Woodbridge and the region that impacts PEVs and charging infrastructure deployment; and a review of the incentives available.

[Section 2. Natural Gas Vehicles and Fueling Infrastructure](#): This section provides an overview of the status of NGVs and natural gas fueling infrastructure in Woodbridge, a discussion of barriers to increased NGV adoption, and a natural gas market outlook.

[Section 3. Recommendations and Steps to Implementation](#): This section lays out the roadmap and recommended actions to achieve the township's AFV readiness goals. Recommendations are presented in a way that aligns with the types of infrastructure demand. Each recommendation references an entity or entities best suited to take responsibility for leading actions.

[Appendix A. Acronyms](#): This appendix lists the acronyms used in this document.

[Appendix B. Plug-in Electric Vehicle Forecasting Methodology](#): This appendix describes the methodology and assumptions used for the PEV forecasts presented in the plan.

[Appendix C. Charging Infrastructure Demand Forecasting Methodology](#): This appendix describes the methodology and assumptions used for the charging infrastructure siting analysis presented in the plan.

[Appendix D. Municipal Policy Examples](#): This appendix includes additional detail on policy examples mentioned in this plan.

[Appendix E. Plug-in Electric Vehicle Community Readiness Resources](#): This appendix is adapted from a compilation developed by the DOE and links to relevant documents, websites, case studies, and other resources.

[Appendix F. Additional Information on Parking](#): This appendix includes municipality-specific parking information beyond the scope of the main discussion.

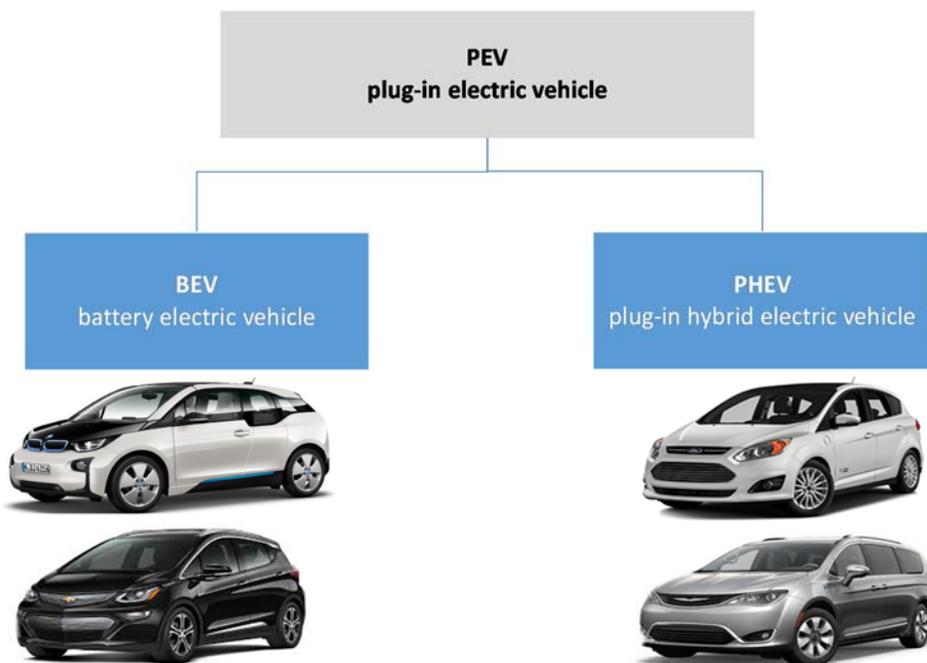
[Appendix G. Regional Planning Area](#): This appendix provides a description of the NJTPA region.

1 Plug-in Electric Vehicles and Charging Infrastructure

Overview

The national PEV market has expanded in scale, geography, and technology since manufacturers released the first modern PEVs in 2011. Driven by incentives, mandates, investment from industry, and enthusiasm from early adopters, new PEV sales in the United States grew from approximately 17,000 vehicles in 2011 to nearly 160,000 in 2016.⁹ Over that same period, charging infrastructure increased nearly 10 times.¹⁰ While California has historically led in PEV adoption, the Northeast and Mid-Atlantic regions are quickly becoming primary markets for PEVs. However, PEVs still account for less than 1 percent of the total light-duty vehicle market nationwide. There are many potential benefits associated with an increase in PEVs on the road, including lower operating and maintenance costs, improved air quality, and economic growth.

Both plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) make up the broader PEV category. PHEVs have both a battery-powered motor and an internal combustion engine (that uses gasoline) capable of powering the wheels; BEVs are powered exclusively by a battery-powered motor and do not use gasoline. The BMW i3 and Chevy Bolt (BEVs) and the Ford C-Max Energi and the Chrysler Pacifica (PHEVs), shown below, are examples of vehicles available to consumers.



⁹ Argonne National Laboratory, Light Duty Electric Drive Vehicles Monthly Sales Updates, <https://www.anl.gov/energy-systems/project/light-duty-electric-drive-vehicles-monthly-sales-updates>. Accessed April 3, 2017.

¹⁰ U.S. DOE, U.S. Alternative Fueling Stations by Fuel Type, <http://www.afdc.energy.gov/data/10332>. Accessed April 3, 2017.

In 2017, there were upwards of 25 light-duty PEVs to choose from, and the market continues to expand as automobile manufacturers roll out additional models. Longer range BEVs – such as Tesla models and the Chevy Bolt – can drive 200 miles or more on a single charge. Other BEV models, like the Nissan Leaf and Volkswagen eGolf, have an electric range of 80-100 miles. There are a variety of PHEVs available that can travel 13-50 miles (depending on the model) in all-electric mode, after which the gasoline engine kicks in to provide additional range. Over the past several years, technological advancements (largely in batteries) have extended the electric range significantly. Continued advancements are likely to result in longer vehicle ranges and reduced purchase prices.

PEV charging infrastructure is typically differentiated by the maximum amount of power that can be delivered to a vehicle's battery. This determines the time that it takes to fully charge. Three categories of charging stations are dominating the market:

- **Level 1** chargers consist of a standard 110-volt alternating current (AC) outlet that provides 2-5 miles of range per hour of charging, depending on the vehicle and other factors. Level 1 is most commonly found in residential applications but can be suitable for some fleet and workplace charging applications.
- **Level 2** is a 220 or 240-volt AC outlet, and provides 10-20 miles of range per hour of charging. Level 2 can also be used at the home and workplace.
- **Direct current (DC) fast chargers** are more in line with the typical gas station refueling model, and provide 50-70 miles of range per 20 minutes of charging through different types of connectors – J1772 combo, CHAdeMO, and Tesla. The connectors for DC fast charging units are not standardized across vehicle manufacturers in the same way that Level 2 charging hardware is (via the J1772 standard). Furthermore, there are no PHEVs on the market today that can use a DC fast charger.¹¹ In other words, not all PEVs currently available can use DC fast chargers, and even those that are equipped for fast charging may not have on-vehicle hardware compatible with the charging unit.

Just as vehicle and battery technology is advancing, so is charging infrastructure technology. For example, wireless charging is gaining attention as an option in certain applications, like home and fleet charging. Higher powered DC fast charging technology, providing up to 20 miles of range per minute of charging, is also in the works.

¹¹ A potential exception to this is the “range extender” or REX. For the sake of simplicity, this plan refers to BEVs and PHEVs; the REX is a kind of hybridized powertrain. Range extenders typically have an engine powered by gasoline that is used to drive an electric generator, which supplies the vehicle's motor with electricity.

Vehicles and Infrastructure in New Jersey and Woodbridge

Figure 2 shows PEV counts by county in New Jersey as of July 2017. Middlesex County is among the five leading counties, with more than 1,000 PEVs.

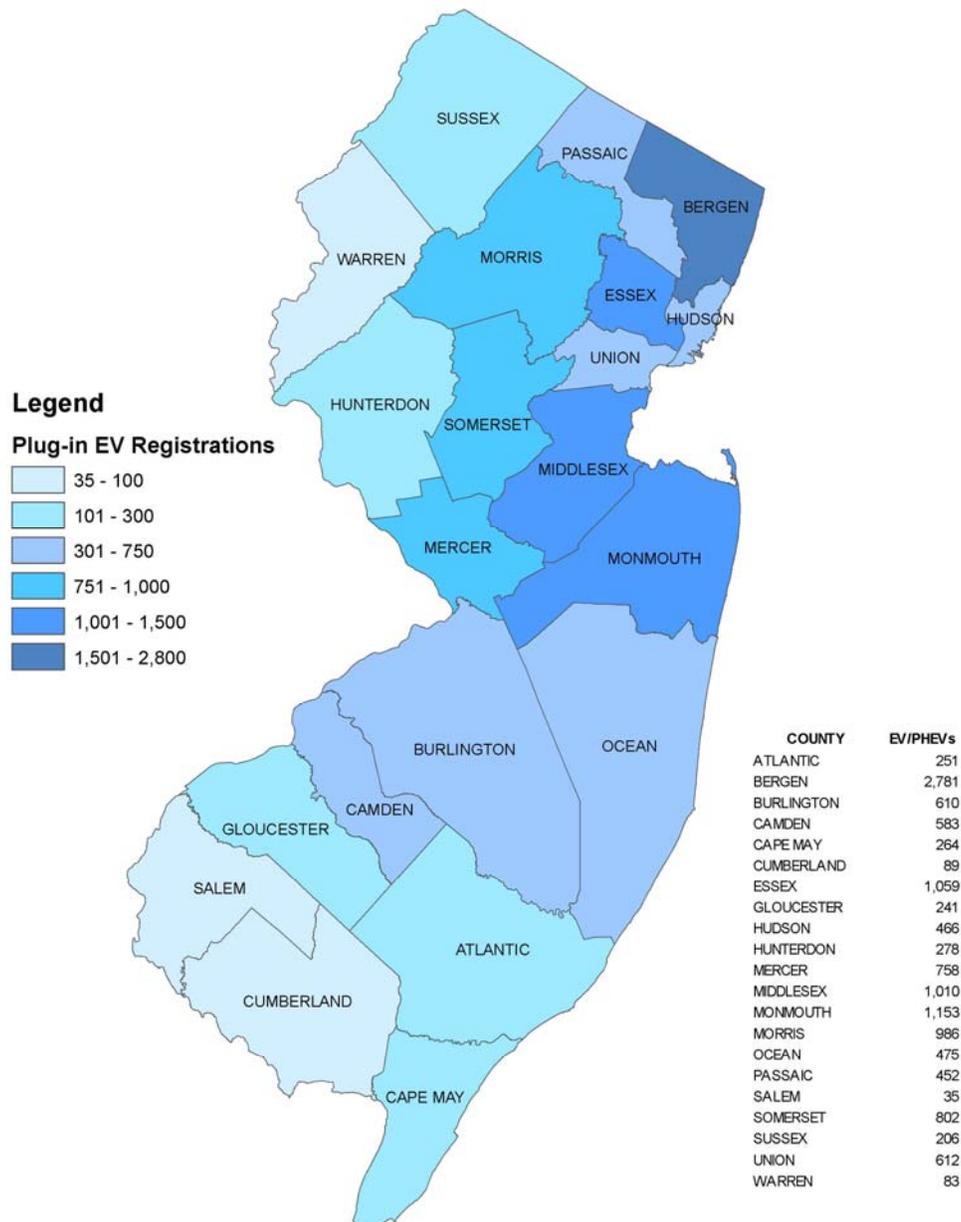


Figure 2. New Jersey PEV Registrations by County, July 2017¹²

¹² Figure provided by the New Jersey Department of Environmental Protection (NJDEP) in August 2017. Data shown here may differ from the final version posted to the NJDEP Clean Vehicles website, <http://www.nj.gov/dep/cleanvehicles/>. Note that other PEV data sources exist, which may present different estimates.

Table 1 below provides data on the types of vehicles being used in Woodbridge, as of July 2017. This data serves as an important baseline both in terms of tracking growth in ownership and forecasting future PEV demand in the township.

Table 1. Vehicle Population in Woodbridge Township, July 2017¹³

	PHEV	BEV	Total Vehicles	Percentage of Total
Woodbridge	47	23	95,080	0.07%

PEVs make up 0.07 percent of total vehicles within Woodbridge. By comparison, PEVs represent 0.16 percent of Middlesex County's market share, though neither area is significantly far off the national PEV penetration rate, which is less than 1 percent.

Providing adequate charging infrastructure can help accommodate and encourage increased use of PEVs. The DOE's Alternative Fuels Data Center (AFDC) Station Locator¹⁴ provides data on charging infrastructure availability across the country.

As of October 2017, New Jersey had 216 public charging locations (14 Level 1, 186 Level 2, and 49 DC fast charging stations), with a combined total of 513 charging outlets (note that some locations have more than one charger type). There are an additional 45 private access locations with Level 2 charging stations, many of which are at Nissan dealership service departments.

Table 2 below includes the operational charging stations in Woodbridge, according to the AFDC Station Locator, as of October 2017. The stations are also shown on the demand maps beginning with [Figure 3](#). Not shown in the table or on the maps, as they are not yet operational, are eight chargers being installed at the Wawa located just off Route 9 South near the New Jersey Turnpike.

Table 2. Charging Infrastructure in Woodbridge, October 2017

Charging Station Host/Name	Address	Accessibility	Charging Type	Charging Stations		
				L1	L2	DC Fast
Metropark	33 S Wood Ave	Public	Public		4	
Bayshore Recycling	75 Crows Mill Rd	Private	Workplace		2	
Sansone Nissan	90 US Route 1	Public	Public		1	
Sansone Nissan	90 US Route 1	Private	Fleet (Service)		1	
Siemens	170 Wood Ave S	Private	Workplace/Fleet		2	

¹³ PEV counts provided by NJDEP, based on registration data from the Motor Vehicle Commission (NJMVC). Woodbridge Township totals include vehicles registered in ZIP codes 07001 (Avenel), 07064 (Port Reading), 07067 (Colonia), 07077 (Sewaren), 07095 (Woodbridge), 08830 (Iselin), 08832 (Keasbey), 08840 (Menlo Park Terrace), and 08863 (Fords).

¹⁴ U.S. DOE, Alternative Fueling Station Locator, <http://www.afdc.energy.gov/locator/stations/>.

Barriers to Increased Plug-in Electric Vehicle Use

While there are significant benefits to increased PEV use, certain barriers exist which could limit the market's expansion.

- Vehicle Cost** — Upfront vehicle cost is likely one of the largest barriers to widespread PEV use. Battery costs comprise the largest percentage of a PEV's price; however, that cost has been decreasing per unit of energy and will continue to do so as manufacturers achieve additional technological breakthroughs and economies of scale in the future. Incentives are available at the federal and state levels to help reduce vehicle costs.

- Charging Station Build-out and Range Anxiety** — The majority of PEV charging occurs at residential locations when drivers plug in their vehicles after finishing a trip. The distance of some trips require additional charging — either at work or around town when visiting shops, restaurants, and other destinations. While public charging station network development can help with this (particularly DC fast charging for long-distance trips), the perceived lack of charging infrastructure may contribute to “range anxiety,” the fear that a vehicle may leave a driver stranded because it runs out of charge before reaching the intended destination.

Key Consideration: Charging Infrastructure Costs

The high costs of the infrastructure to provide publicly accessible charging infrastructure make it difficult to earn a profit because the commodity (i.e., electricity) being sold is comparatively inexpensive. While highly dependent upon specific site conditions, publicly accessible installations of Level 2 charging infrastructure can cost in excess of \$10,000; whereas DC fast charger installations can cost more than \$150,000. A [2015 National Academies Consensus Study Report](#) states that the high cost of installing public charging stations and the minimal revenue obtained from providing electricity present challenges for developing business models for profitable charging stations.

There are several challenges

associated with the deployment of publicly accessible charging infrastructure including funding, siting, permitting, and operational costs. On the municipal side, permitting and inspection processes can be a barrier. These issues are addressed further below and recommendations to overcome these barriers are included in [Section 3](#).

- Consumer Awareness** — The introduction of new technologies such as PEVs requires continuous outreach to consumers to deliver messaging that highlights PEV availability and benefits, including long-term cost savings as well as environmental, health, and community benefits. Furthermore, it is important to communicate the direct financial and nonfinancial benefits to drivers including tax credits, grants, and the PEV driving experience (e.g., fast acceleration and quiet vehicle operation) and the differences associated with fueling from the grid rather than from a gas station.

Market Outlook in Woodbridge Township

As part of PEV readiness planning, it is important to understand the existing deployment of PEVs and charging infrastructure, as well as the market outlook, including factors such as who is buying PEVs, what type of PEVs are likely to be purchased, and projected market growth. As highlighted in [Section 3](#), tracking the market using available data and through partnerships at the local, regional, and state level are means by which the township can stay informed and in touch. The type of PEVs that are on the roads and the locations in which they are registered can help characterize the demand for the different types of charging and applications (such as residential, workplace, and public charging). For instance, a market that is dominated by BEVs is likely to need more DC fast charging than a market that is dominated by PHEVs because BEV charging demands will likely be higher as a result of the larger batteries. This section provides a summary of the potential rate of PEV adoption in the township and areas within where PEV demand might be highest.

Forecasted Plug-in Electric Vehicle Populations in Woodbridge

For the purposes of this plan, residential PEV ownership forecasts in Woodbridge Township were projected over a planning horizon from 2016-2030. Projecting PEV ownership at a local level beyond 2030 is not practical given the rapidly changing nature of the technology, demographics, land use changes, and local economic conditions. The forecasts are meant to guide the planning process, to help support deployment of PEV infrastructure, and to guide local policy and regulatory changes as appropriate.

Three PEV projections for Woodbridge Township were developed based on varying assumptions around adoption trends. Table 3 summarizes the approach used to forecast PEVs in low and high usage scenarios. It also includes a GHG stretch scenario in which the state meets the emissions reductions set forth in the New Jersey Global Warming Response Act.¹⁵

¹⁵ Public Law 2007, c.112, N.J.S.A 26:2C-37

Table 3. PEV Forecast Scenario Descriptions

Scenario	Description
Low	Reflects usage trends comparable to the Reference Case in the Energy Information Administration's (EIA) Annual Energy Outlook (AEO) 2016, ¹⁶ adjusted slightly for increased potential indicated in the Mid-Atlantic region.
High	Assumes that PEV usage rates in Woodbridge will be consistent with the Zero Emission Vehicle (ZEV) mandate in place for New Jersey, ¹⁷ with a fair-share assumption (i.e., that ZEV deployment will occur in the state on a population-weighted basis in the long-term).
GHG Stretch	The PEV strategy of the NJTPA Regional GHG Mitigation Plan calls for a 60 percent market share of PEVs by 2040 to meet state goals. The GHG stretch scenario assumes that PEV adoption rates will be slightly lower than the plan, with a 50 percent market share by 2040.

A more detailed description of the forecasting methodology, as well as corresponding graphs, are provided in [Appendix B](#). The results of these three forecast scenarios are as follows:

- Low Scenario: Approximately 4,250 PEVs on the road in Woodbridge in 2030 (2,000 PHEVs and 2,250 BEVs).
- High Scenario: 12,000 PEVs on the road in 2030 (8,500 PHEVs and 3,500 BEVs).
- GHG Stretch Scenario: About 75,000 EVs on the road in Woodbridge by 2040.

To provide context, forecasts project that total light-duty vehicles will increase by about 10-12 percent in Woodbridge by 2030, with about 140,000 vehicles of all types registered. The forecasts indicate that PEVs will comprise 6-17 percent of registered vehicles in Woodbridge by 2030, compared to the current 0.07 percent. PEV market penetration will also increase across the region, with perhaps a larger number of PEVs driven by people working in and visiting the municipality. This will likely increase demand for charging infrastructure, positioning Woodbridge to be an important contributor to a regional network supporting and reinforcing PEV market growth opportunities.

It is worth noting that the AEO is the source of adoption trends for the low case. The EIA is generally conservative in its electrification outlook, and the outlook does not force compliance with regulations like the ZEV program. Despite these limitations, the AEO is a useful source because it is transparent and typically consistent with national-level assessments. Further, it is updated annually, allowing Woodbridge Township and others to review updates to the outlook from one year to the next. The EIA's 2017 AEO is considerably more bullish on BEVs than the 2016 version. This type of update and change to the forecast can help planning processes and reinforces the notion of a flexible planning process than a deterministic one.

¹⁶ U.S. EIA, AEO 2016, [https://www.eia.gov/outlooks/aeo/pdf/0383\(2016\).pdf](https://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf), August 2016.

¹⁷ ZEV programs aim to increase sales of ZEVs, which include PEVs and fuel cell electric vehicles, by requiring that some portion of vehicle manufacturer sales in the state be ZEVs. More information on New Jersey's ZEV mandate is available on the NJDEP website at <http://www.nj.gov/dep/cleanvehicles/LEV.pdf>.

Forecasted Charging Infrastructure Demand in Woodbridge

As part of this plan, a charging infrastructure demand analysis was conducted to broadly identify the areas within Woodbridge that are most likely to see an increased demand for charging infrastructure. This analysis complements the vehicle forecasting discussed above, and introduces an important geographic component that can guide municipal policy and investments to meet the increased demand for charging infrastructure. [Appendix C](#) includes a detailed methodology of the charging infrastructure demand analysis.

The analysis uses key PEV ownership indicators and regional travel patterns to identify areas where there is potential demand for charging infrastructure. Woodbridge Township can use these results to identify areas where charging station deployment is projected to have the greatest potential to be cost effective, as chargers located in areas where PEV drivers are most likely to travel will be utilized more. Research by Idaho National Laboratory demonstrated that charging equipment deployed as a result of a planning process, similar to this plan, experienced nearly 90 percent greater utilization (as measured by charging events per week) compared to charging equipment deployed in a sporadic, unplanned manner.¹⁸ However, it is important to note that the results of the demand analysis should not exclude areas from charging as their demographics evolve.

There are four primary types of charging to consider:

- **Residential Charging** – Highlights areas that will likely experience high demand for residential charging. Since residential charging takes place at home, these are locations in which likely PEV owners live. Residential charging is limited to Level 1 and Level 2 charging infrastructure. Today, the average PEV driver charges at home about 70-90 percent of the time. Most residential charging occurs at Level 1, as it typically does not require any additional investment on the part of the PEV owner. Level 2 charging is more common at residences for BEVs compared to PHEVs, especially those vehicles with ranges above 150 miles.
- **Multi-Unit Dwelling Charging** – Highlights areas in the region that will likely experience high demand for residential charging and have high incidence of multi-family units. Like residential charging, MUD charging is expected to be a combination of Level 1 and Level 2 charging. The market for MUD charging is in very early stages, and it is unclear which level of charging is most appropriate for this application.
- **Workplace Charging** – Highlights areas that will likely experience high demand for workplace charging, particularly areas where likely PEV owners work and vehicles are parked for several hours during the day. Level 1 and Level 2 charging are appropriate for workplace charging; ultimately, the appropriate level of charging is something that should be dictated by the facilities management, funding, and demand.
- **Public Charging** – Highlights areas that will likely experience high demand for public charging (i.e., other non-home or non-work charging), also referred to as opportunity charging. This includes areas where likely PEV owners shop, dine, and travel for recreational activities. Level 1,

¹⁸ Idaho National Laboratory, *How Does Utilization of Non-Residential EVSE Compare Between those Installed in Oregon in Planned versus Unplanned Locations?*, <http://avt.inl.gov/pdf/EVProj/UtilizationOfNonResEVSEInstallationVsPlan.pdf>. April 2015.

Level 2, and DC fast charging are all options for public charging, with dwell times (i.e., how long are drivers likely to be parked) and local site conditions (e.g., accessibility to sufficient electrical power) the most important factors in determining which strategy is appropriate.

The resulting analysis illustrates charging demand. Areas shown as warmer colors represent higher demand for charging while the cooler colored areas rank lower for charging demand. Each separate area is a traffic analysis zone (TAZ). The rankings and corresponding colors are based on the TAZ's demand score relative to the entire NJTPA region. For example, a TAZ ranked high (red) on the workplace charging demand map means that area scored in the top 5 percent for workplace charging demand across the NJTPA region. Similarly, a TAZ with a public/opportunity charging ranking of low (blue) scored among the bottom 40 percent for public charging in the region. Additional information about these percentiles can be found in [Appendix C](#).

Residential Charging

The infrastructure demand analysis is based on vehicle registration data and key socio-economic indicators that are positively correlated with PEV ownership, such as income, hybrid vehicle ownership rates, and property characteristics.

Figure 3 presents the results of the residential charging demand analysis. Since most PEV charging takes place at home, the map indicates the areas where likely PEV adopters live. Throughout Woodbridge, there is modest potential for PEV ownership, with the higher likelihood of PEV ownership manifesting in the more affluent neighborhoods made up of mostly single-family homes. This aligns with the socio-economic indicators of income and property characteristics. The Colonia section is representative of higher residential charging demand, as residents typically have higher incomes and own their homes. Fords also appears as a section with relatively high demand for residential charging.



Colonia (top) and Fords (bottom) residences

Residential charging demand is the most market-driven of the four charging types, as the number of chargers installed at residences throughout Woodbridge Township will grow as more PEVs are purchased or leased. [Section 3](#) includes recommendations to support the growth of residential charging in Woodbridge, primarily through consumer education and outreach.

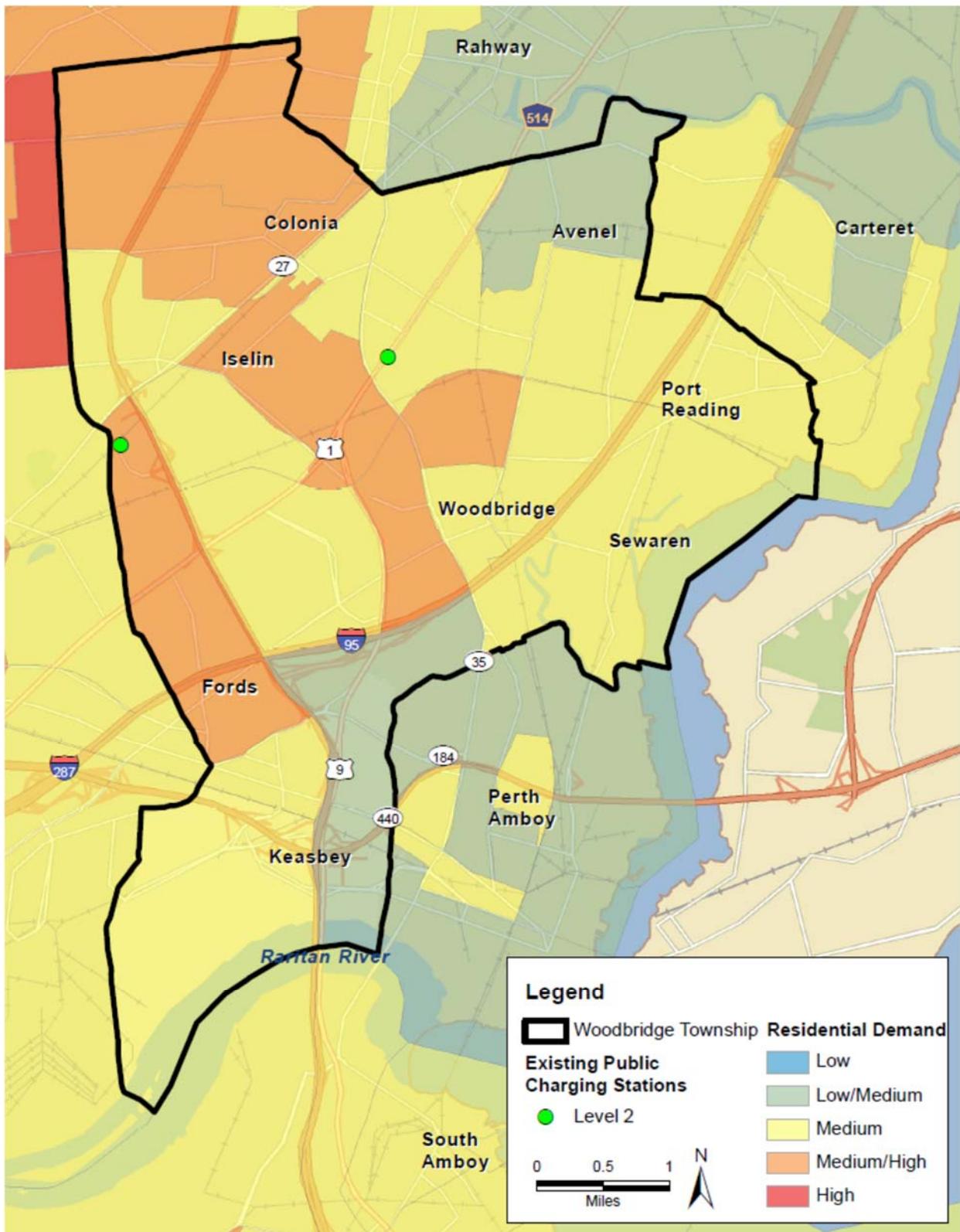


Figure 3. Residential Charging Demand Ranking

Multi-Unit Dwelling Charging

Figure 4 presents the results of the MUD charging demand analysis. These areas will likely experience high demand for individual or shared charging infrastructure in condominium and housing developments as well as apartment buildings. For Woodbridge, MUD charging demand is shown to be the highest surrounding and to the north of Woodbridge Center, driven by existing properties, such as Woodbridge Center Plaza. As expected, residential neighborhoods such as Colonia and Avenel appear as low demand for MUD charging.

The high MUD demand in Keasbey correlates with Hillside Gardens, a property of Landmark Companies, south of New Brunswick Avenue. A conversation with a representative of Landmark Companies confirmed the company has not recognized much demand for PEV charging at older, garden-style apartments. However, townhome owners have expressed some interest.

Future demand for MUD charging will be driven by new developments and significantly renovated buildings that may draw higher income tenants who view PEV charging as an attractive amenity. [Section 3](#) includes recommendations specific to MUD charging, including outreach to property managers to gauge demand.

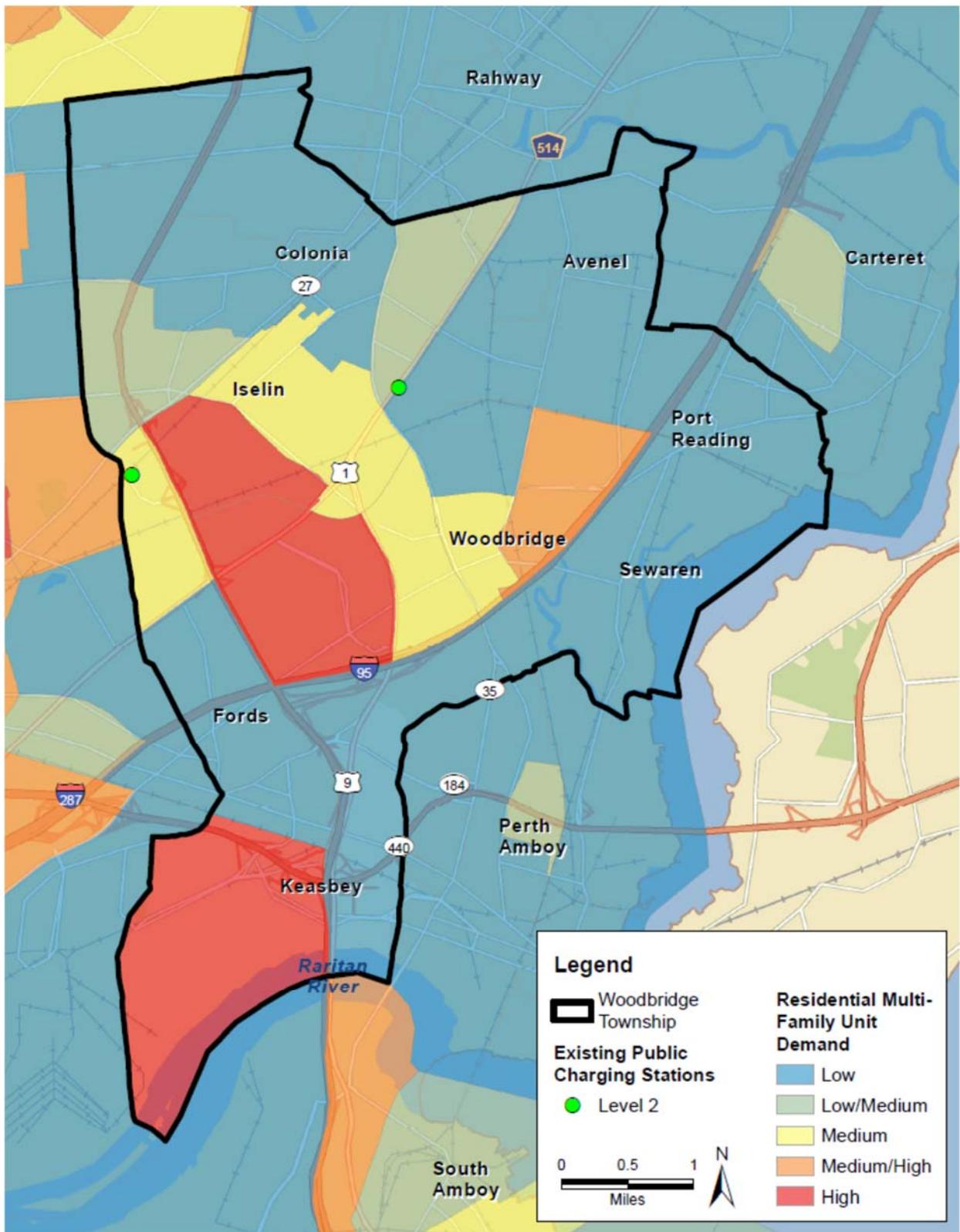


Figure 4. MUD Charging Demand Ranking

Workplace Charging

Figure 5 presents the results of the workplace charging demand analysis for Woodbridge. The employment centers of Woodbridge, and the destination for many home-based work trips, appear as having the highest demand for workplace charging. These include Woodbridge Center, Woodbridge Corporate Plaza, and Metropark. In contrast, the Colonia area, which ranked medium/high for residential charging demand, has a much lower workplace demand as a result of the workplace charging analysis, as that is not a workplace destination for likely PEV owners.

The presence of several employers in Keasbey, including Wakefern Food Corporation, might suggest the workplace charging demand should be even greater than the medium/high ranking in that area. Note, however, that the basis of the siting analysis is the likelihood that a household will own a PEV, combined with where those people work. The medium/high workplace demand for Keasbey suggests the employees traveling there are not as likely to purchase PEVs compared to other employment centers, though this may change in the future. Each employer should assess the current and projected demand from their employees to determine whether chargers are a good investment. Bayshore Recycling, also based in Keasbey, was able to leverage grant funding to install chargers for employee use. [Section 3](#) includes specific recommendations to support workplace charging, primarily through employer outreach.



Woodbridge Corporate Plaza

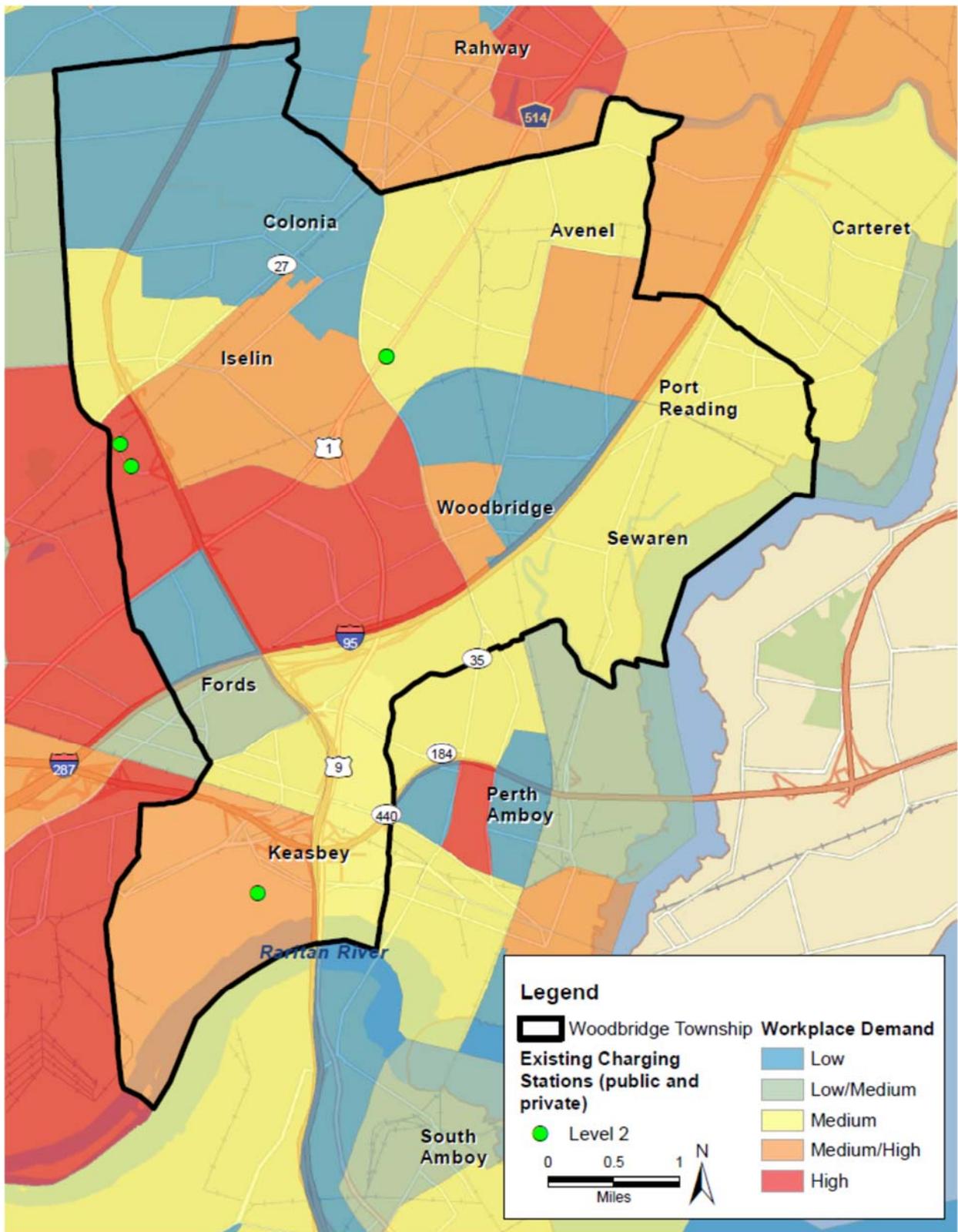


Figure 5. Workplace Charging Demand Ranking

Public Charging

Public charging, also referred to as opportunity charging, covers a wide range of potential charging situations (or opportunities) for a PEV driver away from home or work. Unlike residential and workplace charging, where vehicles are parked for long enough that they achieve a significant charge even with Level 1 charging, public charging will take place at locations where drivers are parked for varying times; therefore, it is important to consider the level of charging the stations offer. Table 4 shows the recommended charging method based on the available charging time at different venues.

Table 4. Available Charging Time and Recommended Charging Level for Different Venues¹⁹

Typical Venue	Available Charging Time	Charging Level (Primary/Secondary)
Shopping Centers	0.5–2 hours	Level 2/DC Fast
Other (e.g., stand-alone retail)	< 1 hour	Level 2/DC Fast
Street/Meters	1–2 hours	Level 1/Level 2
Parking Garages	2–10 hours	Level 2/Level 1
Hotels/Recreation Sites	8–72 hours	Level 2/Level 1

Public charging will consist of predominantly Level 2 and DC fast stations, as it is more convenient for drivers to spend less time charging their vehicles.²⁰ The Woodbridge public charging analysis focuses primarily on Level 2 charging infrastructure. Figure 6 shows the location of areas that are likely to experience high demand for public charging— these are locations where likely PEV owners shop, dine, and visit for recreational activities. In Woodbridge, the demand for public charging is greatest surrounding Woodbridge Center and the stand-alone retail locations that include Wegmans and Lowe’s Home Improvement. [Section 3](#) includes specific recommendations to support the deployment and use of public charging infrastructure.



Woodbridge Center Mall

¹⁹ Source: ICF

²⁰ The Association of Electrical and Medical Imaging Equipment Manufacturers (NEMA), “EVSE: Powering the Electric Vehicle.” <https://www.nema.org/Products/Documents/nema+evse+presentation+for+communities.pdf>. Accessed February 1, 2017.

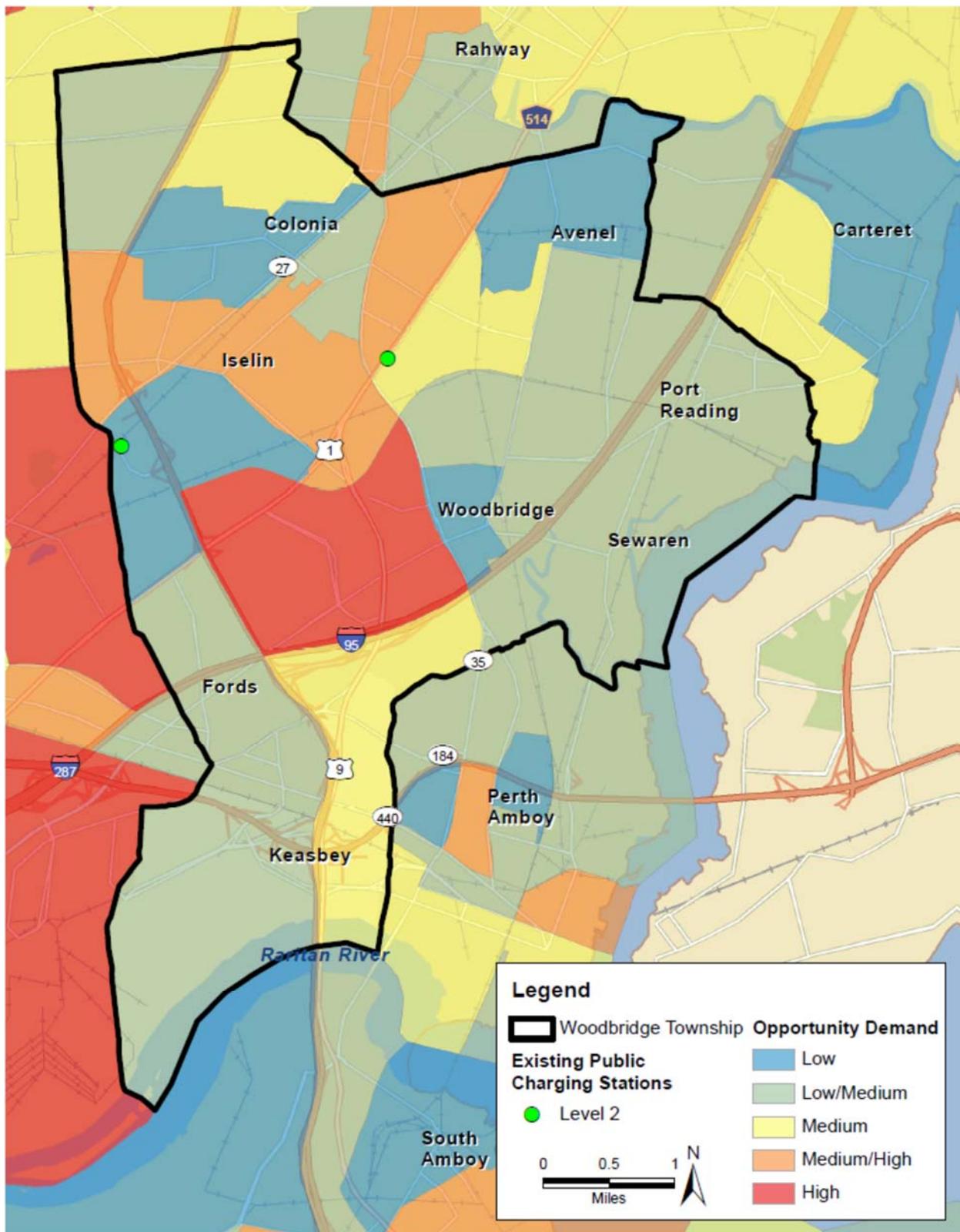


Figure 6. Public Charging Demand Ranking

While not a focus of the public charging analysis, DC fast charging is present in North Jersey and is seeing a great deal of growth in the Mid-Atlantic and across the country. DC fast charging is particularly well-suited for long-distance travel along corridors, as it provides a greater charge in a shorter period of time and correlates with the gas station way of fueling. This corridor approach has become the foundation of numerous infrastructure deployment efforts, such as the Express Charging Corridors Initiative,²¹ and other private partnerships.

In late 2016, the U.S. Federal Highway Administration (FHWA) designated approximately 55 Interstate corridors as Alternative Fuel Corridors.²² I-95 is a designated corridor, specifically for PEV charging, from Maine to Washington, DC, including the portion running through Woodbridge Township. Both DC fast chargers and Level 2 chargers were considered during FHWA's review process for the initial designations. While this designation does not guarantee funding for projects, it may give I-95 and other Alternative Fuel Corridors priority for future funding. The FHWA also intends to provide support by facilitating cooperation and collaboration between states and within regions through convenings beginning in 2018.

High Opportunity Zones for Public and Workplace Charging

It can be challenging to select locations for public charging stations. Workplaces and homes typically have dedicated parking spaces for each worker or resident, vehicles spend the majority of time at work or at home, and commute trips are long, which means PEVs can often use a charge when they arrive at work or home. It is therefore easy to determine the right amount of charging stations at workplaces and homes; ideally these locations have at least one charger for every two PEVs. By contrast, demand for public charging, which currently accounts for less than 10 percent of all charging, is much more sporadic, and in locations where parking is either undersupplied (e.g., a bustling downtown commercial center) or oversupplied (e.g., a big-box retail store on a weekday morning). Furthermore, public charging can be expensive or labor-intensive to install, since charging stations may be in the public right-of-way, far from electrical panels, or in locations where adding a charging space means also adding a parking space in order to meet minimum parking requirements. Though public chargers can send a message to residents and others considering purchasing a PEV that charging is available, those charging stations can also end up as high-profile failures if they are underutilized or consistently occupied by non-charging vehicles.

Although public charging only accounts for a small share of the market today, this will likely change over time with increased access to DC fast charging. National and corridor-based infrastructure deployment efforts, such as Electrify America, are likely to increase opportunities for DC fast charging, or utilities may seek to support market expansion. Together, these types of market developments may help increase access to charging for MUD residents or enable more inter-regional travel, thereby increasing the share of public charging.

All that said, public charging is a key component to PEV readiness and deployment. For this reason, it is important to be thoughtful in placing such charging infrastructure. In addition to looking at where demand for charging is likely to be located, an effective public charging analysis identifies high

²¹ For more information, see ChargePoint's press release at <https://www.chargepoint.com/about/news/bmw-volkswagen-and-chargepoint-announce-completion-electric-vehicle-express-charging/>, as well as various news articles.

²² For more information about the FHWA Alternative Fuel Corridors, see https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/.

opportunity zones where the environment supports successful charging stations. These zones are often busy commercial areas with high demand for parking and ample turnover, which is conducive to well-utilized, highly-visible chargers. They can also be redevelopment areas or areas with public land uses where local governments have more control over development and therefore greater ability to place charging stations in the right location.

The high opportunity zone analysis for Woodbridge leveraged municipal zoning data to identify the commercial areas, redevelopment areas, and public land uses that could serve as an initial set of high opportunity zones. The second step was to overlay the high opportunity zones with the demand maps for workplace and public charging, confirming that the zones aligned with the demand analysis. Woodbridge Township municipal staff reviewed the zones and provided input to help eliminate areas that may not be suitable, due to factors such as redevelopment in process. Figure 7 identifies the resulting high opportunity zones, both for public charging and workplace charging.

The high opportunity areas for public charging are Woodbridge Center, the Woodbridge Community Center, the Route 1 corridor, extending through the township, and the Amboy Avenue/Route 35 corridor in central Woodbridge. Station Village in Avenel²³ is under construction (as of October 2017) and another public charging infrastructure development opportunity. For workplace charging, high opportunity areas are the office buildings near the Metropark Station, the Woodbridge Corporate Plaza, the Route 9 corridor between the Turnpike and Route 1, and Main Street/Route 514 from Route 9 to the Woodbridge Municipal Building.



Metropark Station

There are other zones in Woodbridge that are not yet developed but may provide infrastructure installation opportunities in the future, particularly if redevelopment occurs. These include the area south of the New Jersey Turnpike and Woodbridge Avenue, as well as along New Brunswick Avenue, west of Route 9.

[Section 3](#) includes specific recommendations for how Woodbridge Township can use this analysis to focus effort and investment in a way that will support public and workplace charging infrastructure.

²³ See the redevelopment plan at <http://www.twp.woodbridge.nj.us/DocumentCenter/Home/View/774>.

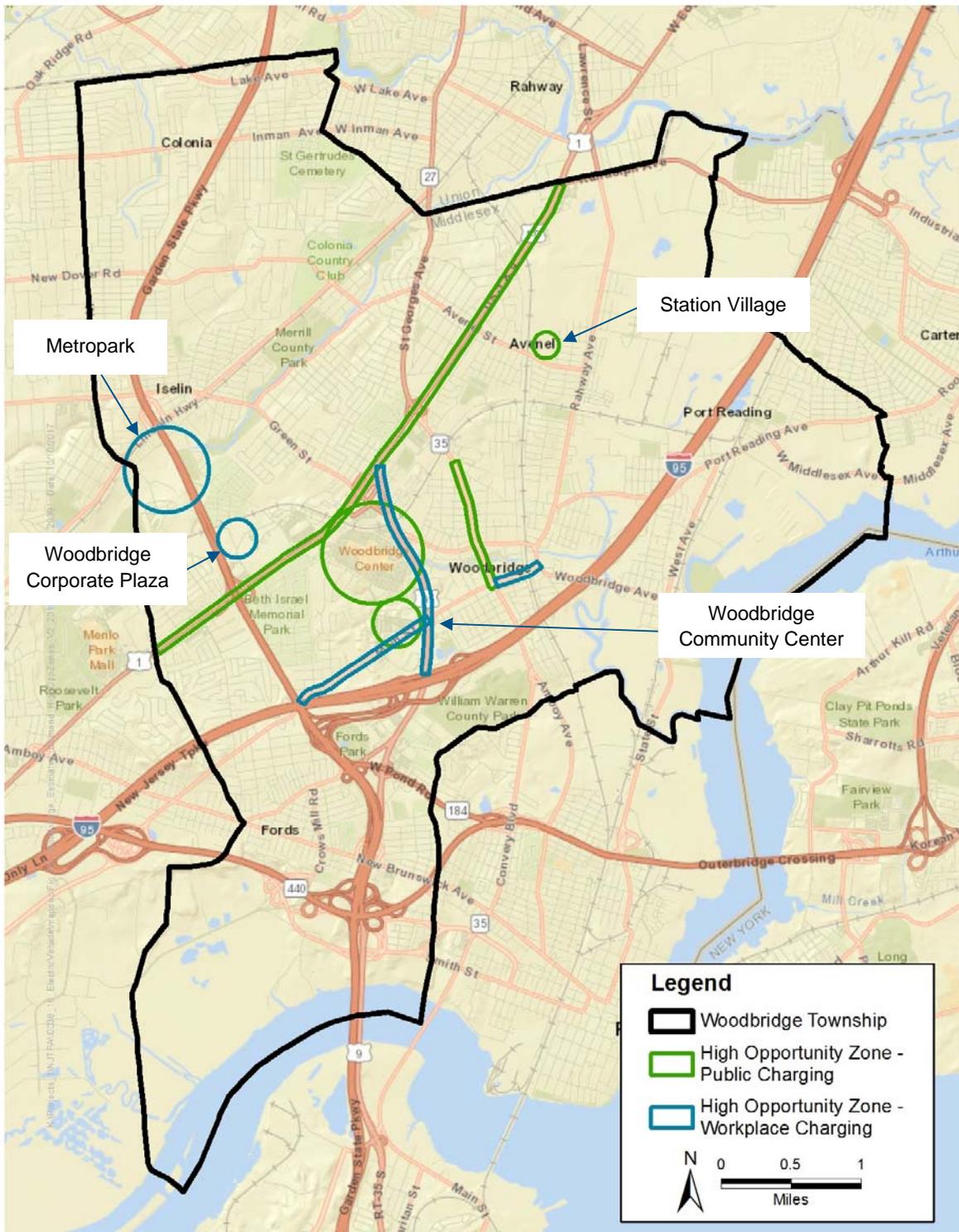


Figure 7. High Opportunity Zones – Public and Workplace Charging

Regulations

Regulations and policies at the municipal, state, and federal levels can play a role in facilitating increased PEV use. Regulations that can support the deployment of PEV charging infrastructure include building, electrical, and zoning codes; parking rules; permitting processes; and incentives.²⁴ This section provides an overview of Woodbridge’s community plans as they relate to facilitating AFVs, PEVs in particular. It also addresses Woodbridge’s local zoning regulations and analyzes their potential to affect PEV charging station installation, including sections on parking, site plans and site development, and environmental performance standards (noise, air quality, etc.). The relevant language and provisions related primarily to PEVs are described below. Regulatory information specific to NGVs and natural gas fueling infrastructure can be found in [Section 2](#).

Local Community Plans

Local community plans are forward-looking documents that both define a community’s vision for the future and respond to anticipated future conditions with strategies and related actions. Community plans can proactively facilitate and encourage AFV use. They can do so by establishing policies that encourage inclusion of PEV charging infrastructure in new development or that support charging stations as a key element of the local transportation system.

Woodbridge Township has several relevant long-range plans that consider transportation, which contain some language supportive of AFV use:

Sustainable Community Plan and Climate Action Plan, Woodbridge Township, New Jersey (2010, Greener by Design): This plan addresses a diverse and comprehensive range of energy conservation and climate change topics. It includes some targeted recommendations to:

- Retrofit existing vehicles or purchase new vehicles for the municipal vehicle fleet so that 25 percent will utilize alternative fuels or be flex fuel capable by 2015.
- Develop a pilot PEV car-sharing program.
- Install public PEV charging stations.
- “Identify and support pilot alternative fuel, car-sharing, and electric vehicle projects for businesses and residents, to encourage actions that can reduce the global warming impact of transportation.”

It also notes the intent, through the Woodbridge Energy Consortium, to explore using alternate energy sources for PEV charging stations.

Master Plan, Woodbridge Township, Middlesex County (2009, Heyer, Gruel & Associates): This plan discusses sustainability issues, including energy usage and sources of energy. It does not, however, directly discuss opportunities for PEVs or charging infrastructure.

²⁴ Note that incentives are addressed in more depth in the Incentives and Funding section below

Greenable Woodbridge, Green Buildings and Environmental Sustainability Plan Element (2012, Woodbridge Department of Planning and Development): This plan has a chapter on energy efficiency, which notes the need to decrease greenhouse gas emissions and reduce fossil fuel consumption by automobiles. It focuses on energy conservation and energy efficient buildings. A recommended pilot program for PEV car-sharing is listed as an action item.

Zoning and Parking Codes

Through zoning codes, design standards, and parking rules, local governments have the opportunity to ensure both that there are sufficient charging opportunities to meet projected PEV demand and that PEV parking spaces are effectively designed and regulated to accommodate charging vehicles. Zoning codes can allow, encourage, or require appropriate placement of charging infrastructure in certain land use designations. Zoning code provisions, design standards, and parking rules can also specify requirements for design and installation, signage, accessibility, fees, time limits, lighting, and maintenance.

Local zoning provides for the direct implementation of land use policy in a community by setting standards and guidelines for land development. While PEV charging stations are generally not considered independent land uses in and of themselves, they have implications for site function and character. In terms of site functionality, they are a distinct element of the parking supply, impacting site circulation, including pedestrian circulation and safety and handicap access. Infrastructure for charging PEVs is, therefore, an important element of site planning and design in terms of location, scale, and relationship to overall site use. Consequently, it is to a community's advantage to address charging infrastructure in the course of zoning language in general and parking requirements and site plan review in particular. Zoning also offers an opportunity to include incentives for site design as a tool to encourage accommodations for PEV use.

Relevant policies are as follows:

Woodbridge Zoning Code: In terms of Land Use and Development, parking requirements are set forth in Article III – Zoning Standards. Though this section provides standards for the amount of required parking spaces, there are no specific requirements regarding AFV equipment, such as charging stations. Additionally, there are no PEV charging station requirements for Site Plans or on the Green Buildings Checklist (Article IV, § 150-84).

The Woodbridge Planning and Development Office manages the zoning permit process for the township. There are no impediments to AFV usage or AFV infrastructure in development. A PEV charging station would not be considered as a specific type of regulated land use and so no requirement to indicate them on a development plan exists. If a site plan includes charging station spots within the parking area, then the township would have an opportunity to review them; otherwise not.

However, any proposed utilities, including those in support of PEV charging stations, must be shown on a site plan. The main approval process applicable to AFV infrastructure would be permits for electrical, fire, etc., whose application contents and process time requirements are set out in state law.

Permitting and Inspection

Streamlined permitting and inspection processes are key to PEV planning. These processes can help expedite the installation of charging stations at appropriate locations, provide the service at a reasonable cost to consumers, and maintain the safety of consumers and the public.

The New Jersey Clean Cities Coalition (NJCCC) has worked with the New Jersey Department of Community Affairs (NJCA), the agency that oversees the statewide code, to clarify and, where possible, streamline the permitting process for PEV charging stations. In 2011-2012, NJCA published an article, “*Electric Vehicle Charging Stations – What you need to know,*” which is the most recent guidance available from the state on the installation of PEV charging stations at residential locations. The article includes Table 5 showing when construction permits and inspections are required for the installation of PEV charging infrastructure.

Table 5. New Jersey Permit Requirements for Charging Stations²⁵

Project	Permit Required	Inspection Required	Classification
Existing outlet is sized correctly but plug configuration is not compatible with equipment plug necessitating the replacement of the outlet to one with proper configuration.	No	No	Ordinary Maintenance NJAC 5:23-2.7(e)3 http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
Upgrade circuit breaker and wire to higher rating (15 amp to 20 amp)	Yes ¹	Yes ²	Minor Work NJAC 5:23-2.17A http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
Vehicle charging system being installed that requires new 120 or 240 volt outlet or an electrical line that will be directly connected to the system.	Yes ¹	Yes ²	Minor Work NJAC 5:23-2.17A http://www.state.nj.us/dca/divisions/codes/codreg/ucc.html
1 - The issuance of a construction permit is not required before the work may proceed. However, the owner or electrical contractor acting on behalf of the owner must notify the local code enforcing agency before the work begins. Also, a permit application must be filed and must be delivered in person or by mail within five business days from the date of oral notice.			
2 - An inspection must be performed within 30 days of the request for inspection and is based upon what is visible at the time of the inspection with the certificate of approval stating so.			

²⁵ NJCA, *Electric Vehicle Charging Stations – What you need to know,* http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

Another NJDCA article provides more detailed information on permitting for residential PEV charging stations: *“Electric Vehicle Charging Stations – Installation and Permit Requirements”* (in NJDCA’s Construction Code Communicator, Vol. 23, Number 1, Spring 2011). NJDCA provides contacts for additional information regarding the installation of PEV charging stations: NJDCA, Division of Codes and Standards, Code Assistance Unit at (609) 984-7609.

In June 2011, NJDCA announced the results of its review of applicable state codes and regulations and determined that installation of residential PEV charging equipment is considered “minor work”, i.e., the homeowner or contractor need only provide verbal notification to the local code enforcement agency prior to starting the installation and submit the permit application within five days of notification, so they do not have to wait up to three weeks for permit approval.

The challenges associated with local permitting and inspection of PEV charging infrastructure vary depending on the type of property at which the infrastructure will be located. For PEV charging, factors include whether it is at a single-family residence, at a MUD, or a commercial property. Since the majority of demand for PEV charging infrastructure is likely to be at privately owned residences and workplaces, local governments can support successful large-scale deployment of PEVs by being prepared to handle increased volumes of permit requests for charging infrastructure installations in an efficient and safe manner.

The main approval process applicable to AFV infrastructure installation is the issuance of permits relative to the building code, and sub-codes relating to electrical, fire, etc., whose application contents and process requirements are set out in state law. New Jersey municipalities are responsible for administering and enforcing the state codes through state-mandated permitting and inspection processes.

Woodbridge has not yet developed processes for administering building codes or electrical subcodes specific to the installation of PEV charging infrastructure. The list below summarizes key permitting process characteristics for Woodbridge Township:

- **Time to Issue Permit:** 20 days maximum for construction code review unless the project is considered minor work (which includes residential PEV charging installation)
- **Permit Fee:** Dependent on sub-code and installation type
- **Permit Availability:** Over the counter only
- **Permit Staff Training:** None specific to AFV infrastructure

Building Codes

Building codes contain safety standards and specifications that guide new construction and renovations. NJDCA, specifically the Division of Codes and Standards, establishes and enforces statewide building codes—referred to as the Uniform Construction Code (UCC). There are two major opportunities to create building codes that support PEV deployment. The first is to specify standards for PEV charging infrastructure in the building code to ensure that any charging station installations are safe and accessible. The second is to require pre-wiring for charging stations to lower the cost of future installations. Pre-wiring refers to the practice of providing sufficient basic infrastructure, such as

conduits, junction boxes, outlets serving garages and parking spaces, adequate wall or lot space for future charging infrastructure, and adequate electrical panel and circuitry capacity, to meet anticipated future charging demand.

Municipalities like Woodbridge are limited to the statewide UCC, and are therefore not in a position to take a more progressive approach to building codes as they are related to PEVs or other issues. Some municipalities have taken steps to advocate for UCC updates that incorporate PEVs where appropriate and feasible.

Incentives and Funding

There is a variety of financial support at the federal, state, and local levels for individuals and local fleets interested in investing in PEVs and charging infrastructure. These include financial incentives, such as tax credits, vehicle rebates, and insurance discounts, as well as non-financial incentives, like high occupancy vehicle (HOV) lane access. This section provides an overview of each primary form of financial support as well as who the funding is available for (consumers, businesses, non-profits, and/or public entities may be eligible for any given program).

Additional funding opportunities and incentives may emerge in the future, such as state-level programs funded through the Volkswagen Clean Air Act Settlement and auto manufacturer partnerships to offer vehicle purchase price discounts. The New Jersey Department of Environmental Protection (NJDEP) has established a website to provide more information for New Jersey.²⁶

Volkswagen Clean Air Act Settlement

The Volkswagen (VW) Settlement established two funding sources that may result in AFV deployment and infrastructure support in and around Woodbridge Township.

- ZEV Investment Plan: VW, through a newly formed entity called Electrify America, will install, operate, and maintain ZEV infrastructure nationwide, initially focusing on 11 major metropolitan areas. The New York City metro area, which includes Woodbridge Township, will receive the following benefits:
 - Level 2 charging installation at MUDs, workplaces, and public sites
 - DC fast charging facility installation on highway and other transportation corridors
 - Education and outreach that builds or increases public awareness of ZEVs
- Environmental Mitigation Trust: The State of New Jersey is eligible to receive and use approximately \$72 million in funding. While the specific program in New Jersey has yet to be established or implemented, these funds could be used to replace polluting diesel equipment with cleaner vehicles, including local freight trucks, transit buses, school buses, shuttle buses, and refuse trucks. A certain portion of these funds could also be used to install PEV charging stations.

For more information, see www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement.

²⁶ See <http://www.state.nj.us/dep/vw/>.

Incentives for Vehicle Purchasers

Vehicle purchase incentives typically help to reduce the upfront cost of a qualified PEV, either at the point-of-sale or later. Other variations of vehicle purchase incentives include cost reductions, fee waivers, and other special privileges associated with the vehicle. Some utilities, for example, offer reduced charging rates for eligible PEV drivers. Table 6 provides an overview of the available incentives for PEV purchasers in New Jersey.

Table 6. Incentives for PEVs

Type	Incentive/Program	Funder/ Administrator	Eligible Entities	Timeline	Incentive Summary
Federal	Plug-In Electric Drive Vehicle Tax Credit	IRS	Individuals, businesses, government entities	Available, deadline not specified; phases out based on sales	\$2,500-7,500, depending upon battery capacity. Tax credit can be combined with state level rebates.
Federal	Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Federal Highway Administration	State DOTs, MPOs, local governments, transit agencies	As funds are available	The CMAQ program provides funding (via DOTs and MPOs, including the NJTPA) for eligible transportation projects that contribute to air quality improvement and congestion relief. Publicly owned AFVs, such as PEVs, are eligible for CMAQ funding; however, vehicles must provide a dominant transportation function.
State	ZEV Tax Exemption	NJ Division of Taxation	Individuals, businesses	Timeline not specified	ZEVs sold, rented, or leased in New Jersey are exempt from state sales and use tax. This exemption is not applicable to partial ZEVs, including HEVs.
State	HOV Lane Exemption and Toll Discount	NJ Turnpike Authority (NJTA)	Individuals, businesses, government entities	Expires September 30, 2019	The NJTA allows qualified PEVs to travel in the HOV lanes located between Interchange 11 and Interchange 14 on the New Jersey Turnpike. The NJTA offers a 10 percent discount on off-peak New Jersey Turnpike and Garden State Parkway toll rates through NJ EZ-Pass for drivers of vehicles that have a fuel economy of 45 miles per gallon or higher and meet the California Super Ultra Low Emission Vehicle standard.

Incentives for Charging Infrastructure Deployment

Incentives and financing options are available to help defray the costs of deploying charging infrastructure. Some programs aim to reduce or eliminate the cost of eligible equipment (e.g., Level 2 charging station) while others provide funding for equipment and installation costs. Table 7 includes an overview of the available incentives for PEV charging infrastructure deployment in New Jersey.

In addition, programs such as the NJDEP NJ Charging Challenge provide special recognition to employers making their workplaces PEV ready.²⁷

²⁷ For more information, see www.drivegreen.nj.gov/programs.html.

Table 7. Incentives for PEV Charging Infrastructure

Type	Incentive/ Program	Funder/ Administrator	Eligible Entities	Timeline	Incentive Summary
Federal	Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Federal Highway Administration	State DOTs, MPOs, local governments, transit agencies	As funds are available	The CMAQ program provides funding (via DOTs and MPOs, including the NJTPA) for eligible transportation projects that contribute to air quality improvement and congestion relief. PEV charging infrastructure may be eligible for CMAQ funding.
Federal	Low and Zero Emission Vehicle Research, Demonstration, and Deployment Funding	Federal Transit Administration	Local, state, and federal government entities; public transportation providers; private and non-profit organizations; and higher education institutions	Not specified	Financial assistance is available for research, demonstration, and deployment projects involving low or zero emission public transportation vehicles. Funding may cover up to 80% of project costs, with a required 20% non-federal cost share requirement. Eligible vehicles must be designated for public transportation use and significantly reduce energy consumption or harmful emissions compared to a comparable standard vehicle.
State	Workplace Charging Station Grants	NJDEP and New Jersey Board of Public Utilities (NJBPU)	Businesses, nonprofits, government entities	As funds are available	Reimbursement grants are offered on a first-come, first-served basis for the cost and installation of eligible charging stations at workplaces, government and educational facilities, nonprofits, and parking facilities. Funding up to \$250 is available for each Level 1 charging stations installed and up to \$5,000 for each Level 2 charging stations installed. Current funding has been allocated as of January 2017, though interested applicants may be put on a waitlist in anticipation of additional funding.
Utility	Workplace Charging Station Incentives	PSE&G	Businesses, nonprofits, government entities	As funds are available	PSE&G provides free charging stations to companies in their service territory for the purpose of workplace charging. Chargers are available on a first-come, first-served basis to companies that secure a commitment from at least five employees who will use a PEV for their commute. PSE&G will own the chargers and collect usage data.
Nonprofit	Sustainable Jersey Small Grants	Sustainable Jersey	Municipal governments	As funds are available	Grants are available to help municipalities achieve progress toward Sustainable Jersey certification and general sustainability. Eligible projects must align with actions for which municipalities could score points toward certification, such as "Make Your Town Electric Vehicle Ready" and "Public Electric Vehicle Charging Infrastructure."

2 Natural Gas Vehicles and Fueling Infrastructure

Overview

While PEVs primarily serve the light-duty consumer market, the NGV industry targets the medium- and heavy-duty fleet sectors. Following an initial surge in NGV interest in the mid- to late-1990s, natural gas fueling infrastructure increased steadily from approximately 750 stations across the country in 2007 to more than 1,800 in 2016.²⁸ The use of natural gas as a vehicle fuel grew by 75 percent in that same period.²⁹ Incentives and investment from industry have been important drivers for this growth. Natural gas only accounts for 3 percent of transportation fuel (based on energy content).³⁰ Additional development of this market is focused on strategic deployment of NGVs in appropriate fleets. For example, nationwide, CNG vehicles account for 35 percent and 55 percent of the transit bus and refuse truck markets, respectively.^{31,32}

The deployment potential for natural gas vehicles is mainly linked to the medium- and heavy-duty truck fleet market sectors. For instance, as part of the American Recovery and Reinvestment Act, the NJCCC led a statewide public/private partnership — including Clean Energy, Atlantic County Utilities Authority, Waste Management of New Jersey, Atlantic City Jitney Association, Central Jersey Waste & Recycling, and others — that put more than 300 NGVs on the road in refuse and shuttle bus applications, and included the development of six CNG fueling stations. There are significant market barriers to more widespread use of natural gas in the transportation sector. These are not unique to any particular township or municipality. Rather, they are a function of issues outside the purview of local governments.

Vehicles and Infrastructure in New Jersey and Woodbridge

Given that the primary market sectors for NGVs are medium- and heavy-duty vehicles, municipal NGV readiness planning is more limited than the consumer focus of PEVs. That said, NGV readiness involves close coordination with the gas utility; adopting policy language that will support natural gas (and, more broadly, alternative) fueling stations; creating a regulatory framework for NGV fueling infrastructure; and possibly incentivizing or requiring NGVs. Several locations across New Jersey, for example, have provided bid preferences for municipal contractors (e.g., trash collection) who use natural gas or other AFVs.

According to the most recent report by the NJCCC,³³ there are just over 1,000 light- and heavy-duty NGVs in New Jersey. Although this list is not exhaustive, it represents a robust estimate of the NGVs registered statewide. Of the vehicles reported, more than 85 percent are heavy-duty vehicles; and of

²⁸ U.S. DOE, U.S. Alternative Fueling Stations by Fuel Type, <http://www.afdc.energy.gov/data/10332>. Accessed April 3, 2017.

²⁹ U.S. Energy Information Administration (EIA), U.S. Natural Gas Vehicle Fuel Consumption, <https://www.eia.gov/dnav/ng/hist/n3025us2m.htm>. Accessed April 3, 2017.

³⁰ U.S. EIA, Energy Use in Transportation, http://www.eia.gov/energyexplained/?page=us_energy_transportation. Accessed April 3, 2017.

³¹ NGVAmerica, Transit, <http://www.ngvamerica.org/vehicles/for-fleets/transit/>. Accessed April 3, 2017.

³² NGVAmerica, Refuse, <http://www.ngvamerica.org/vehicles/for-fleets/refuse/>. Accessed April 3, 2017.

³³ U.S. DOE, 2016 Transportation Technology Deployment Report: NJCCC, March 2017.

those heavy-duty vehicles, more than 50 percent are refuse or transit vehicles. More granular data, specifically at the municipal level, is not readily available. The NJDEP provides NGV estimates, but the counts are inclusive of propane vehicles.³⁴

Of the 28 CNG fueling stations in New Jersey as of October 2017, 13 are accessible to the public and 15 are meant for private (i.e., fleet only) use. There are no liquefied natural gas (LNG) fueling stations in New Jersey.³⁵

Barriers to Increased Natural Gas Vehicle Use

Deploying NGV technology offers numerous benefits as compared to gasoline and diesel vehicles, including emissions reductions and improved air quality. However, there are substantial barriers to NGV implementation that impede progress towards more significant market growth. Understanding the key barriers below can help municipalities and fleet owners plan wisely and act accordingly.

Low Gas Quality for Transportation Applications

Natural gas in common carrier pipelines has a variety of end uses — space heating, industrial processes, electricity generation, and as a transportation fuel (after compression). Natural gas quality in the pipeline transmission system can vary depending on a number of factors. In the northern PSE&G territory, including Woodbridge Township, there have been gas quality issues linked to the presence of refinery gas in the pipeline, a function of an agreement between PSE&G and the Bayway Refinery (Phillips 66) in Linden, New Jersey. Furthermore, during periods of peak gas demand (i.e., extremely cold winter days), PSE&G often supplements its natural gas supply by adding propane to the distribution system. Both of these issues hinder the use of pipeline natural gas as a transportation fuel since higher quality gas is required for combustion in heavy-duty CNG vehicles. Similarly, the combustion engines in CNG vehicles are not designed to manage the potential blend of propane and natural gas.

As of September 2017, PSE&G no longer accepts Bayway Refinery gas into its system.³⁶ However, it is unclear if this alone will resolve the gas quality issue hampering NGV adoption in the region.

Lack of Incentives

Although there are certain applications of NGVs that provide attractive payback periods compared to their diesel counterparts (after accounting for fuel and operational savings), the incremental cost of purchasing an NGV compared to a diesel or gasoline vehicle remains an impediment to increased use. Part of this is due to the lack of sustained state incentives for the purchase of cleaner-burning NGVs. Across the country, states are encouraging increased use of AFVs and AFV infrastructure through incentives, such as vouchers, rebates, and grants. In addition, many jurisdictions allow preferences in public procurements for those bidders that use, or pledge to use, AFVs in executing their contract. Funding resulting from the VW Environmental Mitigation Trust mentioned previously may be used for

³⁴ NJDEP, Natural Gas Vehicle Distribution, <http://www.nj.gov/dep/cleanvehicles/Alt-Fuel%20Vehicles%20&%20Stations%20-%20Natural%20Gas.pdf>. Accessed October 20, 2017.

³⁵ U.S. DOE, Alternative Fuels Data Center, Station Locator, <http://www.afdc.energy.gov/locator/stations/>.

³⁶ Kenny Esser, PSE&G, via email communication, September 6, 2017.

NGVs and fueling infrastructure, depending on the state's implementation approach. The NJBPU has also provided grants for commercial NGVs in specific counties, including Middlesex County.³⁷

Fuel Price Differential

The increase in accessible supply of natural gas in the 2010-2011 timeframe contributed to a significant price differential between diesel and natural gas. Because NGVs have a higher incremental cost due to the expense of specialized fuel systems and fuel tanks, the payback period is greatly dependent upon the lower cost of natural gas relative to diesel and gasoline. While the low price of diesel has extended this payback period, as diesel prices rise, the price differential will help improve deployment potential. The diesel fuel tax increase in New Jersey, enacted in October 2016, gives a further advantage to NGVs. One clear economic advantage of natural gas is the relative price stability, which is an important factor to consider for a fleet manager or business owner. The commodity price for natural gas makes up a relatively small portion of the price for CNG at the pump. For example, an increase of \$1.50 per million British thermal units (MMBtu) in the cost of natural gas translates to only a \$0.25 increase per diesel gallon equivalent (DGE) at the pump. Diesel, on the other hand, suffers price spikes because the raw commodity makes up a much larger portion of the price at the pump. Although the price of natural gas is much more stable than that of petroleum fuels, the price differential is often not sufficient to offset the higher upfront cost. Absent incentives and improved accessibility to fueling infrastructure, truck owners and fleets have been reluctant to convert to CNG vehicles.

Market Outlook in Woodbridge

The NGV market outlook in Woodbridge is inextricably tied to the three barriers outlined above. Further, these three issues are linked to market forces beyond the purview of municipal governments: Local governments like Woodbridge Township have no control over gas quality (this is under the purview of the gas utility); resource constraints at the local level limit the ability of municipalities to incentivize NGVs to spur adoption; and lastly, local governments have no influence over commodity energy prices. Until these issues are addressed by other market actors, Woodbridge, and communities like it, will likely be best served by relying on local partners, such as the NJCCC, for relevant information and updates.

Potential for Renewable Natural Gas

Renewable natural gas (RNG) is produced over a series of steps — namely collection of a feedstock (such as waste or manure), delivery to a processing facility for biomass-to-gas conversion, gas conditioning, compression, and injection into a common carrier pipeline. RNG can be combusted to generate on-site electricity and be used to fulfill renewable energy goals and requirements. Over the last several years, however, there has been considerable growth in the use of RNG in the transportation sector. This is linked in large part to the U.S. Environmental Protection Agency's (EPA) determination in 2013 that RNG

³⁷ NJBPU. CNG Vehicle Grant Program. <http://www.nj.gov/bpu/commercial/cng.html>. Accessed October 23, 2017.

is an eligible fuel under the federal Renewable Fuel Standard (RFS).³⁸ Feedstocks for RNG include, but are not necessarily limited to landfill gas, municipal solid waste, animal manure, agricultural residue, and forestry or forest product residues.

The introduction of RNG into the transportation sector has the potential to allay some of the local and regional concerns linked to the GHG emissions and other potential environmental impacts from fossil natural gas use. The GHG footprint of RNG is linked to the feedstock, location of the facility relative to the end user, and the type of vehicle in which the fuel is used. RNG from landfill gas, for instance, reduces GHG emissions by about a factor of two to three when compared to conventional diesel fuel on a lifecycle basis. RNG from animal manure can reduce GHG emissions even more by capturing methane — a GHG pollutant with 25 times the global warming potential of carbon dioxide — that would have otherwise been vented into the atmosphere.

The NGV industry and the RNG industry are advocating around the prospects of pairing the low carbon fuel with a recently certified engine for medium- and heavy-duty vehicles from Cummins Westport, the ISL G 8.9 liter engine. This engine is appropriate for many applications in the goods movement sector, including short and regional haul applications, as well as in refuse hauling applications. This engine received certification from the EPA at levels 90 percent lower than the current standard for nitrogen oxide (NOx) emissions of 0.20 g/bhp-hr.³⁹ In other words, pairing RNG with the so-called low NOx engine has the potential to reduce criteria pollutant emission reductions, reduce GHG emissions, and decrease petroleum consumption.

Regulations

This section provides an overview of Woodbridge's community plans as they relate to facilitating AFVs in the community and to identify any language that supports the use of AFVs — NGVs in particular. It also reviews provisions in Woodbridge's local zoning regulations for their potential to affect installation of AFV infrastructure, such as parking, site plans and site development, and environmental performance standards (noise, air quality, etc.). While most of the relevant language and provisions are related primarily to PEVs (described in [Section 1](#)), there is also some regulatory language that applies more broadly to AFVs, including NGVs and natural gas fueling infrastructure.

Local Community Plans

Local community plans are forward-looking documents that both define a community's vision for the future and respond to anticipated future conditions with strategies and related actions. Community plans can proactively facilitate and encourage AFV use. They can do so by establishing policies that support AFV fueling stations as a key element of the local transportation system.

³⁸ In 2015 the EPA determined that RNG from landfill gas (LFG) is eligible to generate renewable identification numbers (RINs; the currency of the federal RFS program) in the category labeled as cellulosic biofuels or D3 RINs. These are the highest value RINs in the RFS market.

³⁹ The NOx emission standards for engines are established in units of grams of pollutant per brake horsepower hour (g/bhp-hr).

Woodbridge Township has two relevant long-range plans that consider transportation, which contain some language supportive of AFV use:

Sustainable Community Plan and Climate Action Plan, Woodbridge Township, New Jersey (2010, Greener by Design): This plan addresses a diverse and comprehensive range of energy conservation and climate change topics. It includes some targeted recommendations to:

- Retrofit existing vehicles or purchase new vehicles for the municipal vehicle fleet so that 25 percent will utilize alternative fuels or be flex fuel capable by 2015.
- “Identify and support pilot alternative fuel, car-sharing, and electric vehicle projects for businesses and residents, to encourage actions that can reduce the global warming impact of transportation.”

Master Plan, Woodbridge Township, Middlesex County (2009, Heyer, Gruel & Associates): This plan discusses sustainability issues, including energy usage and sources of energy. It does not, however, directly discuss opportunities for AFVs or fueling infrastructure.

Greenable Woodbridge, Green Buildings and Environmental Sustainability Plan Element (2012, Woodbridge Department of Planning and Development): This plan has a chapter on energy efficiency, which notes the need to decrease greenhouse gas emissions and reduce fossil fuel consumption by automobiles.

Zoning Codes

Local zoning provides for the direct implementation of land use policy in a community by setting standards and guidelines for land development. Fueling stations for NGVs can be complex, particularly those with public accessibility. Natural gas fueling stations are often included with other large scale fueling facilities or complexes in terms of defined land uses and would be considered part of both allowable uses and site design for those facilities. Infrastructure for fueling NGVs is, therefore, an important element of site planning and design in terms of location, scale, and relationship to overall site use. Consequently, it is to a community’s advantage to address AFV infrastructure in the course of zoning language in general and parking requirements and site plan review in particular. Zoning also offers an opportunity to include incentives for site design as a tool to encourage accommodations for AFV use. Relevant Woodbridge Township policies are as follows:

Woodbridge, New Jersey Zoning Code: In terms of Land Use and Development, parking requirements are set forth in Article III – Zoning Standards. Though this section provides standards for the amount of required parking spaces, there are no specific requirements regarding AFV equipment, such as NGV fueling stations.

The Woodbridge Planning and Development Office manages the zoning permit process for the township. There are no impediments to AFV usage or AFV infrastructure in development. An NGV fueling station would not be considered as a specific type of regulated land use and so no requirement to indicate them on a development plan exists. Similarly, no site plan or subdivision approvals would be needed specifically for AFV infrastructure.

However, any proposed utilities, including those in support of an NGV fueling stations, must be shown on a site plan. The main approval process applicable to AFV infrastructure would be permits for electrical, fire, etc., whose application contents and process time requirements are set out in state law.

3 Recommendations and Steps to Implementation

This section recommends actions Woodbridge Township can take in order to facilitate AFV use and meet the future infrastructure demands.

Each recommendation correlates with the demand for charging or fueling infrastructure discussed throughout the previous sections of this plan. In the case of PEVs, recommendations are distinguished by their role in residential charging, MUD charging, workplace charging, and public charging. The recommendations are similarly distinguished by planning areas — general plans and policies, building codes, zoning and parking codes, permitting and inspection, and fleet planning. Furthermore, for each recommendation, a lead organization or stakeholder has been identified, distinguishing largely between local government, regional agencies, and utilities.

The time horizon for the recommended actions is 10 years, with actions that may be ongoing, as well as those to be implemented in the near-term (1-2 years), medium-term (3-5 years), and long-term (6-10 years). Woodbridge Township and its stakeholders should refer to their AFV readiness goals as they determine which activities are priorities now and in the future.

Several recommendations appear multiple times, though with different steps to implementation depending on the targeted infrastructure. These recommendations include the identification of grants and other funding opportunities, and conducting targeted outreach to install charging infrastructure at high-priority locations.

Stakeholder input has helped to shape the recommendations in this section. During the interactive portion of Woodbridge’s second SAC meeting, participants provided input on and discussed a series of strategies that could be included in the readiness plan. This exercise aimed to:

- Broaden stakeholders’ understanding of the strategies available to enhance AFV readiness;
- Gather feedback on the AFV strategies that may be best suited to the community; and
- Help determine priority areas and areas of emphasis to be highlighted in the Woodbridge readiness plan.

Stakeholders considered five groups of strategies, described in detail below. Prior to voting, participants were asked to briefly evaluate the strategies based on the following three criteria as they pertained to Woodbridge:

Technical Assistance Resources

New Jersey is home to several established organizations that are well-versed in AFVs, community planning, sustainability, and other topics relevant to AFV readiness. These groups can provide technical assistance to support many of the recommended activities. They include:

New Jersey Clean Cities Coalition – a fuel neutral, nonprofit organization promoting partnerships that advance the use of alternative fuels. See www.njcleancities.com.

Sustainable Jersey – a nonprofit organization supporting community sustainability efforts through tools, training, and incentives. See www.sustainablejersey.com.

- The strategy is/strategies are feasible.
- The strategy/strategies could be implemented in a timely fashion.
- The strategy/strategies could be effective at increasing AFV opportunities in the community.

The Woodbridge SAC input can be summarized as follows:

1. Conduct Community Education and Outreach – Most stakeholders thought these strategies generally met all three criteria, as education and outreach comes naturally to Woodbridge as a municipal champion for sustainability.
2. Adopt Community-wide Policies – Stakeholders agreed these strategies generally met all three criteria, and Woodbridge is already taking steps to encourage PEV infrastructure in particular.
3. Facilitate Municipal Infrastructure and/or Public-Private Collaboration – Stakeholders were mixed in their opinions, confirming these strategies meet most criteria. A key challenge is the high demand for parking in Woodbridge.
4. Amend the Zoning Code to Include Requirements or Incentives for AFV Infrastructure – Stakeholder responses indicated these strategies may meet some, all, or none of the criteria, depending on the strategy and implementation. The township is supportive of zoning code amendments that encourage AFV infrastructure, and is already doing what they can to provide incentives for AFV infrastructure development on a case-by-case basis
5. Modify Approval Processes – Stakeholders indicated these strategies could meet two or three of the criteria, as the Woodbridge permitting and approval process is already quite streamlined.

The priorities, opportunities, and challenges identified and discussed helped determine the recommendations presented in this section.

Whenever possible, recommendations point to specific resources that are available to help guide and assist the township's implementation. See the examples mentioned throughout this section, as well as [Appendix E](#), which is a collection of PEV readiness resources developed by or in partnership with the DOE. The forthcoming NJTPA guidebook on AFV readiness will serve as a key resource for Woodbridge Township and other municipalities throughout North Jersey.

General Market Support

Due to the myriad considerations involved in PEV adoption — consumer behavior, gasoline pricing, vehicle pricing, etc. — deployment will be linked to factors beyond the purview of local and regional governments, utilities, and other stakeholders. Similarly, NGV adoption is closely linked to fuel prices and vehicle cost. However, Woodbridge Township has an opportunity to support infrastructure development through planning, coordinating education and outreach efforts, collaborating with utilities, and leading by example. Table 8 highlights the recommendations that will provide general market support to AFVs.

Table 8. General Recommendations to Support the Market for Woodbridge AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Create cross-jurisdictional opportunities for sharing lessons learned	Ongoing	Woodbridge Township in partnership with neighboring municipalities
	Update the PEV infrastructure demand analysis	Ongoing	Woodbridge Township
	Collaborate with PSE&G to share market information	Ongoing	Woodbridge Township, PSE&G
	Conduct community education and outreach to increase awareness about the benefits of AFVs and the role they can play in decreasing transportation costs and achieving environmental goals	Near-term	Woodbridge Township
	Establish design criteria for AFV infrastructure	Near-term	Woodbridge Township
	Integrate AFV readiness into local planning efforts, including general plans and climate action plans, to support AFV infrastructure development	Near- to medium-term	Woodbridge Township
Permitting & Inspection	Educate permitting, inspection, and first responders in AFV station basics	Near-term	Woodbridge Township
Fleet Planning	Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities for fleet AFVs	Medium-term	Woodbridge Township
	Provide technical assistance and training to local fleet managers	Medium-term	Woodbridge Township

General Plans & Policies

Create cross-jurisdictional opportunities for sharing lessons learned

The NJTPA region encompasses many local governments, each with its own challenges and experiences with AFV adoption. Woodbridge stands to benefit from sharing best practices and lessons learned from stakeholders. Successful collaboration and information-sharing will require Woodbridge to invest the time and resources necessary to actively engage with its neighbors, and creating and sustaining a network of stakeholders who work on AFV-related issues will help strengthen AFV readiness in both the municipality and throughout the region. Sustainable Jersey provides one such forum, and Woodbridge is

already a leader in their participation. The township can leverage Sustainable Jersey’s network and engage with the Middlesex County Hub, a group of green team and environmental commission members, as well government, business, and community leaders. This group and Woodbridge Township can potentially learn from each other and support efforts going forward.

There are two broader initiatives of which Woodbridge and its partners should be aware related to AFVs and AFV readiness, namely:

- At the state level, ChargeEVC was recently formed as a coalition of car manufacturers, technology companies, utilities, consumer advocates and non-governmental organizations to promote PEV use in New Jersey.
- The NJCCC formed the New Jersey Natural Gas Vehicle Workgroup committee. Participating members include representatives from gas distribution utilities, vehicle and engine manufacturers; fuel infrastructure providers; transit, refuse haulers and other fleet users of natural gas; and others interested in increasing and strengthening the deployment of low-emission NGVs throughout New Jersey.

Both initiatives provide Woodbridge with a means to stay updated on developments and opportunities related to complementary activities at the state and regional level, such as alternative fuel corridor planning and utility rate filings.

Update the PEV infrastructure demand analysis

The goal of a demand analysis is to help guide and coordinate future PEV charging infrastructure placement efforts based on anticipated or projected demand for charging infrastructure. The demand analysis included in this plan combines various parameters such as characteristics of PEV ownership and usage, land use, and regional travel patterns. As these characteristics change over time, Woodbridge Township can work with the NJTPA, the NJDEP, and other stakeholders to regularly update (every three to five years) the analysis with the latest vehicle registration, demographic, and travel demand data so the results remain current and relevant in the context of the likely demand for residential charging, workplace charging, MUD charging, and public charging.

Redevelopment and other projects may result in new parking facilities, so this development should also be considered as part of the ongoing analysis and planning process.

AFV Registration Data

The NJDEP maintains AFV registration data, coordinating with the NJMVC to provide updated statistics twice a year (January and July). A spreadsheet containing this data is available upon request by sending an email to drivegreen@dep.nj.gov, using the subject line “Vehicle Registration Data Request.”

Collaborate with PSE&G to share market information

Woodbridge can take a leading role in the support of PEVs and charging infrastructure by collaborating with the local utility to share relevant market information. This can occur in a variety of ways. For instance, Woodbridge is a step ahead of many neighboring municipalities with its approval processes, as the permitting application process is relatively streamlined and efficient. One area that could improve the permitting system even further would be for Woodbridge to integrate it with a notification protocol

for PSE&G. This would help the utility understand where PEVs are being deployed and how they are being charged and plan accordingly.

Moving forward, Woodbridge can seek more proactive ways to engage and collaborate with PSE&G. The regional impacts on the electrical grid (in terms of greater demand for electricity as more vehicles are charging) will likely be negligible for many years. However, unmanaged charging station installations and increased regional PEV ownership in specific areas could negatively affect local electrical distribution systems. One of the primary causes of concern for PEVs is clustering of the load associated with vehicle charging. Utilities generally have a transformer replacement program to regularly target transformers that have reached the end of their useful life or have been identified as grossly overloaded. However, the adoption of PEVs may occur faster in some areas, thereby potentially altering the utility's transformer replacement program target areas and schedule.

Woodbridge Township should maintain open lines of communication with the utility as it evaluates its electricity distribution infrastructure and provide insights wherever helpful. When PSE&G upgrades or adds distribution infrastructure, it should consider potential PEV charging demand impacts as part of the analysis and, where possible, make strategic and cost-effective investments. The township can assist in this process by providing valuable perspective and advanced notice regarding anticipated PEV clustering, new construction, and DC fast charging corridors along the way.

Conduct community education and outreach to increase awareness about the benefits of AFVs, PEVs in particular, and the role they can play in decreasing transportation costs and achieving environmental goals

Woodbridge should develop and distribute educational resources that target the range of relevant audiences: residents, multi-family building owners, employers, fleet owners and managers, and commercial and other developers. Residents of multi-family units are often overlooked for targeted awareness and education activities related to PEVs because it is not often within a resident's power to install charging infrastructure. The township should therefore consider creating materials to inform developers and/or property managers about the benefits and costs of installing



Woodbridge Farmers' Market

AFV fueling infrastructure during construction as well as the overall benefit of providing the spaces. Additionally, Woodbridge should consider developing resources that target younger residents, such as student drivers, to teach them about AFV options, particularly PEVs. Even basic information about how much it costs to fuel a PEV can be helpful to start the conversation with any audience.⁴⁰ Housing all of these resources in one place online will also enable residents to seek out the information on demand beyond active outreach events.

Executing this recommendation would require some financial resources and staff time to prepare materials, conduct outreach, and maintain the online resource database, but it would be possible to

⁴⁰ One simple yet useful tool is the U.S. DOE's eGallon calculator, which shows the cost of fueling a PEV compared to a similar gasoline vehicle. See <https://energy.gov/maps/egallon>.

build off of existing material and distribution channels, like Greenable Woodbridge.⁴¹ It would be relatively low cost to build upon existing outreach efforts and could be highly impactful over the long-term. Should the township choose to distribute materials in person, established community events and regular gatherings, such as the Farmers' Market, provide low-cost access to residents and businesses.

Separate recommendations introduced later in this section provide additional detail about more targeted education and outreach specific to MUD, workplace, and public charging.

Establish design criteria for AFV Infrastructure

Adopting AFV infrastructure design guidelines that address the many unique considerations associated with them can go a long way to help charging station and fueling station hosts determine the best configuration for their installations and ensure that installations are safe, follow industry-recommended standards, and are consistent with other community development goals.

The New Jersey code includes a streamlined permitting process and definitions for PEV charging stations, which Woodbridge could adapt based on local conditions. Design guidelines will likely vary depending upon the configuration of parking and upon the context in which parking is located, so Woodbridge will likely need to create multiple sets of PEV parking guidelines that apply to a variety of scenarios.

At a minimum, charging station design criteria should address the following issues:

- Minimum dimensions of PEV parking spaces
- Parking configurations, including guidance on whether it is preferable to locate chargers in perpendicular, parallel, or angled parking spaces, and on the location of wheel stops, guard posts, and signage
- Adopted technical standards that apply to PEV charging stations
- Regulatory signage and signs directing drivers to available PEV parking
- Area lighting
- Clearances, including minimum clearances around chargers to maintain access to controls, as well as on adjacent walkways to maintain pedestrian access. Pedestrian clearance guidelines should include recommendations for keeping sidewalks and walkways clear of cords and cables. Clearance recommendations should also address needs for snow plowing during the winter months.
- Landscaping
- Location relative to other spaces, adjacent land uses, and electrical infrastructure. For example, guidance on locating on-street parking could include language such as “the last space on the block in the direction of travel will usually minimize cord management issues, and places user closer to crosswalks and curb ramps.”
- Additional considerations that apply in overlay zones, such as flood control zones

⁴¹ See Greenable Woodbridge: Alternative fuels, <https://www.youtube.com/watch?v=RvmleitKgwI&feature=youtu.be>.

- Design of disabled access spaces, including requirements for the number of spaces in areas that must be accessible in areas with multiple PEV parking spaces and design standards for accessible spaces.

Integrate AFV readiness into local planning efforts, including general plans and climate action plans, to support AFV infrastructure development

Woodbridge Township is already a leader in the area of environmental sustainability. The next step of this leadership is to extend this support explicitly to AFVs, PEVs in particular, by integrating readiness policies and goals into local planning efforts, including general plans, regional transportation plans, sustainable community strategies, or similar documents that require or encourage PEV charging and natural gas fueling. Woodbridge has done this in its *Sustainable Community Plan and Climate Action Plan* and should continue to incorporate AFV-specific actions and metrics in future plans. The township should also consider incorporating this readiness plan and follow-up efforts into its Sustainable Jersey participation, both for recognition and to provide an example to other municipalities.

Taking steps to amend municipal general plans and codes to encourage PEV deployment can be an important step in building consensus among policymakers and the public to support more specific PEV readiness implementation measures. The exact policies that local governments choose to include can range from broadly encouraging increased adoption of PEVs to requiring charging stations at specific land uses or sites where local agencies see development opportunities or anticipate high demand for charging. These policies can also help pave the way to fund plans and capital projects that accelerate the deployment of PEVs. The incremental cost of PEV readiness planning is lower if it is part of a larger-scale effort. For example, tying PEV readiness to local policies can make it easier to allocate different funding streams toward PEV plans and projects. Similar to its inclusion of AFV and PEV actions in the existing climate action plan, Woodbridge should continue to identify opportunities to incorporate explicit language that encourages PEV and charging infrastructure deployment, as well as natural gas. Refer to [Appendix D](#) for example language relevant to pre-wiring and redevelopment plans.

Permitting & Inspection

Educate permitting officials, inspection officials, and first responders on the basics of AFV station installation

Providing permitting staff with basic information about PEV charging stations and installations will help them process permits more efficiently and ensure staff can provide property owners with additional information about safety practices and other requirements. Similarly, inspectors would benefit from access to factual information and relevant details specific to Woodbridge (e.g., public charging locations) since they interface with residents, businesses, and others. The township may consider organizing an educational session focused on codes, safety, standards, site assessments, electric load calculations, permitting processes, and utility notification. Training first responders will ensure that safety procedures are in place in the case of any AFV or fueling/charging station-related emergencies.

The township could work with organizations such as the Electric Vehicle Infrastructure Training Program (EVITP)⁴² to organize training sessions on charging station installations and outreach to share local best practices among staff. Woodbridge should also collaborate with neighboring communities, the county, the NJTPA, and others to create an ongoing region-wide schedule of training and outreach events so that stakeholders can stay informed on educational opportunities across the region.

Fleet Planning

Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities for fleet AFVs

The township's Sustainable Community Plan and Climate Action Plan includes an ongoing action, "Continue to convert the municipal fleet to alternative fuel sources." Past vehicle purchases have included fuel-efficient HEVs and the use of biodiesel, demonstrating the township's interest in sustainable technologies and fuels. The township (led by the Department of Public Works) should develop a municipal fleet management plan that connects and builds upon these activities and goals. A



Woodbridge Town Hall

comprehensive fleet management plan will provide a framework for considering how NGVs and PEVs might be incorporated into the Woodbridge fleet, particularly as older vehicles are being retired. The fleet management plan should pull together relevant goals and activities (e.g., Sustainable Jersey Green Fleet actions) and include meaningful metrics for measuring progress toward goals. If the township decides to procure vehicles, it should be aware of aggregated purchase options for both vehicles and infrastructure, including the Mid-Atlantic Region initiative under Fleets for the Future as well as EV Smart Fleets.⁴³

Provide technical assistance and training to local fleet managers

Fleet managers often require assistance navigating and weighing the various considerations associated with AFV ownership as compared to conventional vehicle ownership. Local governments can take part in trainings offered by Clean Cities coalitions, such as the NJCCC. Beyond providing educational materials, Woodbridge Township could also organize technical assistance and training workshops in collaboration with the NJTPA and other partners.

⁴² For more information, see <http://evitp.org/training/>.

⁴³ For more information, see <http://www.fleetsforthefuture.org/> and <http://evsmartfleets.com/>.

Residential Charging

In the near- to mid-term, most PEV charging will occur at drivers’ residences. Today, for instance, about 70-90 percent of charging occurs at home. Furthermore, the majority of residential charging occurs at Level 1 charging, which is particularly attractive because it requires little to no consumer investment. However, as the market evolves, there are a variety of factors that will likely increase the need for more investments in residential charging. For instance, as batteries in vehicles become larger and as utilities seek to play an increased role in managed charging, higher level charging equipment will likely be required. As a result, Woodbridge Township should monitor and coordinate with PSE&G and other relevant agencies on the electricity demands and potential impacts to the local grid. Table 9 includes this and other key actions the township can take to help support the expansion of residential charging.



Sewaren residential neighborhood

It is worth restating that residential charging demand is very market-driven, so Woodbridge Township’s role in increasing this demand will be limited, allowing the township to focus its efforts on MUD, workplace, and public charging.

Table 9. Recommendations to Support Residential Charging for Woodbridge AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
Permitting & Inspection	Produce guidance documents outlining permitting requirements for residential PEV charging station installations	Near-term	Woodbridge Township
Building Codes	Work with the state to amend the building code to require PEV station readiness in new single-family developments	Medium-term	Woodbridge Township
General Plans & Policies	Collaborate with PSE&G to facilitate necessary electricity distribution infrastructure upgrades	Ongoing	Woodbridge Township

Permitting & Inspection

Produce guidance documents outlining permitting requirements for residential PEV charging station installations

Providing information to local residents about the requirements to permit their residential charging station installation will both make the installation/permitting process more accessible and streamline the process. Woodbridge Township should consider developing a permitting checklist that helps applicants through the process and post it online for easy access. While this will require some staff time

and resources up front, the time savings down the road will be significant, and NJDCA's "Electric Vehicle Charging Stations – What you need to know" can serve as a starting point for the checklist.⁴⁴

Building Codes

Work with the state to amend the building code to require PEV station readiness in new single-family developments

Amendments to the UCC can only be made at the state level. Therefore, Woodbridge Township should consider coordinating with other municipalities to work with the state to amend the building code to require that new single-family residential developments with off-street parking include pre-wiring for PEV charging station installations. The township should also collaborate with its neighboring municipalities to work with the state to amend the New Jersey State Residential Site Improvement Standards (RSIS) to apply this requirement to property redevelopment.

General Plans & Policies

Collaborate with PSE&G to facilitate necessary electricity distribution infrastructure upgrades

Although sales of PEVs are forecasted to grow, regional impacts on the electrical grid (in terms of greater demand for electricity as more vehicles are charging) will likely be negligible for many years. However, unmanaged charging station installations and increased regional PEV ownership in specific areas could negatively affect local electrical distribution systems.

One of the primary causes of concern for PEVs is clustering of the load associated with vehicle charging. Utilities generally have a transformer replacement program to regularly target transformers that have reached the end of their useful life or have been identified as grossly overloaded. However, the adoption of PEVs may occur faster in some areas, thereby causing gaps in the information that utilities would generally use to inform their replacement programs. Utilities need to know where the vehicles are being used and how they are being charged (e.g., Level 1 vs. Level 2) so that they can evaluate whether the local distribution system is adequate to serve PEV charging needs. One simple, but not always utilized, solution to this potential challenge is for utilities to establish a clear notification protocol so that utilities are aware of new chargers being added to the grid.

⁴⁴ NJDCA, *Electric Vehicle Charging Stations – What you need to know*, http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

Multi-Unit Dwelling Charging

Most PEV charging is likely to occur at home. However, with approximately 30 percent of Woodbridge residents living in MUDs without dedicated garages like single-family homes, the purchase of a PEV may not make sense without easy access to charging. Further, MUD owners and management companies will need to respond to tenant interest as the number of PEVs on the road increases. The recommendations in Table 10 represent the key actions the township can take to help address current and future demands for MUD charging.

Much of the opportunity to expand charging infrastructure at MUDs will be through new developments or possibly as part of renovations to upgrade existing buildings. The established garden-style apartment complexes, for example, are less likely to have demand for charging given the socio-economic characteristics of the average tenant. MUD decision makers are not likely to pursue PEV charging infrastructure unless residents express an interest or the management company recognizes charging as an amenity to attract tenants. Therefore, it will be necessary for Woodbridge to be proactive with regard to targeted outreach and education.

Table 10. Recommendations to Support MUD Charging for Woodbridge AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Conduct targeted outreach to MUD managers and developers to install chargers at high-priority locations	Near-term	Woodbridge Township
	Collaborate with MUDs to create and implement policies that allow residents to install PEV charging infrastructure	Medium-term	Woodbridge Township

General Plans & Policies

Conduct targeted outreach to MUD managers and developers to install chargers at high-priority locations

Because there are limited opportunities for Woodbridge Township to install publicly-accessible charging infrastructure on public land, it is important for local landowners to contribute to the charging network. In Woodbridge, MUDs are therefore particularly high priority targets. Property owners and developers, and home owner associations (HOA) can have a tangible impact on PEV deployment in the region by providing charging for multi-family residents. In the case of MUDs, decision makers will need to consider the logistics of providing charging equipment, including who pays for the electricity and charging station upkeep, how to determine resident access/parking space sharing between resident PEV owners, and particular zoning and permitting considerations. They will also need to understand the approval process for new development versus existing development installations, and what activities would require a permit/approval from the Woodbridge Planning Board versus being done independently. Woodbridge Township can facilitate this discussion by providing targeted outreach and educational materials that address the specific questions and challenges these communities will face in the context of PEV and charging station deployment.

Woodbridge Township is proactive in its environmental and sustainability outreach, so it would be feasible and require little additional cost to build upon that foundation by developing a variety of

situation- or user-specific PEV materials for distribution. Strategic outreach can take additional time, but it can also be highly impactful since publicly accessible charging in the township may be particularly challenging to establish. The MUD demand map provided in [Section 1](#) (Figure 4) will be helpful as Woodbridge Township prioritizes target developments and areas. The township should also make educational information available to companies developing new or enhancing existing MUDs. See the resources in [Appendix E](#), particularly the link to an AFDC web page providing case studies, guidelines, and other information.

Collaborate with MUDs to create and implement policies that allow residents to install PEV charging infrastructure

Woodbridge has many residents that own or rent property in MUDs, where they might have a dedicated parking space but do not technically own the property on which they park. This presents unique challenges for PEV owners seeking to access a charging station at their home. Given the proportion of Woodbridge’s population that might face such issues, the township can have a very tangible impact on PEV deployment by working with multi-family developments to develop policies that allow residents to install PEV charging infrastructure or provide shared charging for residents. Refer to [Appendix D](#) for an example of “right to charge” language. The township might also consider accompanying these policies with education materials for landlords about the benefits (i.e., added property value) of providing PEV charging infrastructure for tenants.

Workplace Charging

The PEV charging infrastructure market has focused considerable attention on workplace charging—through funding, outreach, and pilot programs. Although most PEV charging occurs at home, and is expected to for the next several years, PEVs are still parked for many hours as part of regular commuting. The availability of charging as part of a regular commute can help increase the electric vehicle miles traveled by PHEVs, while also helping demonstrate to potential drivers that there is sufficient infrastructure to maintain driving habits in a BEV (i.e., overcome range anxiety). Table 11 highlights the key recommendations to help meet the demand for workplace charging, as well as private fleet AFV adoption, as part of Woodbridge’s AFV readiness planning.

Table 11. Recommendations to Support Workplace Charging for Woodbridge AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Identify AFV grants and other funding opportunities for workplace charging infrastructure development	Ongoing	Woodbridge Township
	Conduct targeted outreach to employers to install chargers at high-priority locations	Near-term	Woodbridge Township, KMM
Fleet Planning	Provide educational resources to local fleet managers regarding AFV and infrastructure deployment	Near-term	Woodbridge Township, KMM
Permitting & Inspection	Produce guidance documents outlining permitting requirements for commercial PEV charging station installations	Near-term	Woodbridge Township
Zoning & Parking Ordinances	Amend zoning codes to encourage or incentivize PEV charging stations or pre-wiring in new commercial developments	Medium-term	Woodbridge Township

General Plans & Policies

Identify AFV grants and other funding opportunities for workplace charging infrastructure development and other opportunities

Woodbridge Township can play an important role in accelerating regional AFV adoption by helping stakeholders identify and pursue grant funding, both for AFVs and for workplace and fleet fueling/charging infrastructure. Table 6 and Table 7 (in [Section 1](#)) summarize available incentives for PEVs and charging infrastructure, respectively. Each opportunity varies in terms of eligibility and timelines, though several are suitable for employers and fleets in Woodbridge.

In terms of electrification, Woodbridge has significant commuter and workplace traffic, meaning the township can maximize the number of electric miles traveled by identifying grant funding opportunities for the purchase and installation of workplace charging stations. Woodbridge is a particularly strong candidate for grant funding if it can show that it has identified particular facilities that are well suited for charging stations because of its historical record championing sustainability. For example, Bayshore Recycling received a \$5,000 grant from the NJDEP to install workplace charging at their facility.⁴⁵ The high opportunity zone map in [Section 1](#) (Figure 7) provides Woodbridge employers with a starting point to identify specific areas best suited for workplace charging. This analysis is backed by the workplace charging demand illustrated in Figure 5.



Workplace charging at Bayshore Recycling
Photo courtesy of Bayshore Recycling

While PEVs and charging infrastructure apply to the broader population, natural gas technology is still predominantly applicable only to fleets since commercially available vehicles are medium- to heavy-duty. A number of

⁴⁵ Woodbridge Township Stakeholder Advisory Committee Meeting, March 29, 2017.

fleets operate in and around Woodbridge, and the township can also have an impact on the region's shift to alternative fuels by supporting the implementation of NGVs and natural gas fueling stations. Area fleets may be interested in funding for NGVs and natural gas fueling stations, should it become available in the future. Woodbridge Township can point fleet managers and other stakeholders to the NJCCC and other organizations closely tracking funding solicitations and other incentives.

Funding could also be used for workshops, trainings, outreach campaigns, and events that support workplace charging and fleet use of AFVs. These may be specific to Woodbridge, or coordinated with other municipalities in the region to conserve costs and increase the reach and impact. Depending on resource availability, Woodbridge might also consider participating in an information sharing process in order to assist – and receive assistance from – neighboring municipalities in these efforts. Organizations such as Sustainable Jersey are in an ideal position to facilitate information sharing among engaged municipalities.

Conduct targeted outreach to employers and commercial developers to install chargers at high-priority locations

Building on the previous recommendation, Woodbridge Township should leverage the high opportunity zones and workplace charging demand maps in [Section 1](#) (Figure 7 and Figure 5, respectively) as resources to target workplace charging station development outreach. Because there are limited opportunities for Woodbridge Township to install publicly-accessible charging infrastructure on public land, it is important for local landowners to contribute to the charging network. In Woodbridge, employers are high-priority targets, particularly those that may have sustainability goals or initiatives. Commercial property owners and developers can have a tangible impact on PEV deployment in the region by providing charging for employees. Employers will need to gauge demand (current and future) and consider the logistics of providing charging equipment, including the etiquette for moving vehicles once the charging session is complete. They will also need to understand the approval process for new development versus existing development installations, and what activities would require a permit/approval from the Woodbridge Planning Board. Woodbridge Township can facilitate this discussion by providing targeted outreach and educational materials that address the specific questions and challenges employers may face in the context of PEV and charging station deployment.

Woodbridge Township has already been proactive in its environmental and sustainability outreach, so it would be very feasible and require little additional cost to build upon that foundation by developing a variety of situation- or user-specific PEV materials for distribution. Strategic outreach can take additional time, but it can also be highly impactful since publicly accessible charging in the township may be particularly challenging to establish. This is an area in which KMM can serve a key role, reaching out to its network of employers to provide factual and relevant information. The workplace charging demand map provided in [Section 1](#) (Figure 5) will be helpful as Woodbridge Township prioritizes target employers and areas. The township should also make educational information available to companies developing new or enhancing existing commercial properties.

Fleet Planning

Provide educational resources to fleet managers

Public and private fleets can provide opportunities for AFV introduction. However, fleets often require assistance navigating and weighing the various considerations associated with AFV ownership as compared to conventional vehicle ownership. For this reason, information sharing can encourage investment in AFVs among corporate and government fleets alike.

Woodbridge Township should consider providing educational resources (e.g., toolkits or guidebooks) to fleet managers and employers to educate them regarding the total cost of AFV ownership, operating considerations, and fueling/charging station installation costs and guidelines. In particular, Woodbridge will need to educate the purchasing officer and should consider developing a comprehensive fleet management plan that incorporates AFV technology. As mentioned above, the township can also work with KMM to effectively reach employers in the area.

In the case of electrification, since most PEVs available today are passenger cars, Woodbridge's near-term focus should include fleets with light-duty vehicle applications. As more medium and heavy-duty PEV technology develops, Woodbridge can provide additional resources that draw upon best practices and lessons learned from local and regional case studies of fleets deploying such vehicle models. The opposite is true with NGVs: most natural gas technology is available for medium- and heavy-duty vehicles. Woodbridge should therefore focus on fleets with these applications in the near-term, which may include shuttle buses/vans and trash collection and recycling fleets that serve commercial entities throughout the municipality. Should light-duty NGVs become more readily available in the future, the township can provide additional resources that draw upon best practices and lessons learned in light-duty scenarios in order to support further expansion of the technology.

Permitting & Inspection

Produce guidance documents outlining permitting requirements for commercial PEV charging station installations

Providing information to employers and other site hosts about the requirements to permit charging station installation will streamline the process. To streamline processes that support AFV infrastructure development, the township does not require a site improvement plan for PEV charging station installations. Clearly stating this point, online or in other documentation, will help educate commercial developers and employers. Woodbridge Township could consider developing a permitting checklist that details the process and post it online for easy access. While this will require some staff time and resources up front, the time savings down the road will be significant, and NJDCA's "Electric Vehicle Charging Stations – What you need to know" can serve as a starting point for the checklist.⁴⁶ The NJTPA could also provide support in this area by creating a template for municipalities to use.

⁴⁶ NJDCA, *Electric Vehicle Charging Stations – What you need to know*, http://www.state.nj.us/dca/divisions/codes/publications/pdf_other/homeowners_guide_electric_vehicles_charging_stations.pdf. Accessed April 3, 2017.

Zoning & Parking Ordinances

Amend zoning codes to encourage or incentivize PEV charging stations in new commercial developments

Zoning codes, if developed thoughtfully, can facilitate PEV and charging infrastructure deployment. Woodbridge Township should consider amending zoning codes to encourage or incentivize pre-wiring or charging station installations at new commercial developments (e.g., office buildings serving multiple employers), including guidance on identifying locations for and installing charging stations in such settings. Ideally, guidance should specify the number of chargers or pre-wired spaces to be provided at new developments of different sizes and land-use types. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed.

Public Charging

Public charging refers to away-from-home charging that does not occur at the workplace, and is part of a non-work trip. These stations are typically accessible to the public or specific drivers, and as noted previously can include Level 1, Level 2, and DC fast charging. Public charging typically takes place at locations where drivers are parked for varying times; the actual demand for public charging is difficult to predict. In some regards, the likely utilization of public charging infrastructure will vary considerably depending on factors including but not limited to driving patterns and the fee charged. Although there is an opportunity for public entities to provide public charging at recreational and other sites, this plan assumes that site hosts will generally be private or commercial entities working with a PEV charging infrastructure provider. Site hosts may be keen to support public charging infrastructure for a variety of reasons, including demonstrating a commitment to sustainability, attracting new visitors to a site, or increasing the time that visitors spend at a site.

As the demand for public charging becomes clearer, it is important that Woodbridge Township provide technical and policy support where possible, and seek opportunities to conduct targeted education and outreach. Table 12 below highlights the key recommendations for consideration by Woodbridge as they relate to public charging.

Table 12. Recommendations to Support Public Charging for Woodbridge AFV Readiness

Action Area	Recommendation	Timeframe	Responsible Stakeholders
General Plans & Policies	Identify AFV grants and other funding opportunities for infrastructure development	Ongoing	Woodbridge Township
	Conduct targeted outreach to landowners to install chargers at high-priority locations	Near-term	Woodbridge Township, KMM
	Pursue public-private partnerships to fund publicly accessible charger installations	Near-term	Woodbridge Township
Zoning & Parking Codes	Establish preferential parking policies for PEVs	Medium-term	Woodbridge Township
	Amend parking codes to regulate the use of PEV charging spaces	Medium-term	Woodbridge Township
	Amend zoning codes to encourage or incentivize PEV charging stations or pre-wiring in new commercial developments	Medium-term	Woodbridge Township

General Plans & Policies

Identify AFV grants and other funding opportunities for fueling infrastructure development

Woodbridge Township can play an important role in accelerating regional AFV adoption by helping to identify grant funding, including for the purchase and installation of public fueling infrastructure. Table 6 and Table 7 (in [Section 1](#)) summarize the available incentives for PEVs and charging infrastructure, respectively. Each opportunity varies in terms of eligibility and timelines. Some are opportunities Woodbridge Township can apply for to fund public charging infrastructure or to purchase AFVs for the municipal fleet. Others are more suitable for private businesses in Woodbridge to expand the use of AFVs and the network of supporting infrastructure.

Woodbridge and its businesses should actively seek support in developing a robust charging station network that will ensure visitors and residents can access nearby charging options. This will both ease range anxiety and maximize the number of miles driven in electric mode. The high opportunity zone map in [Section 1](#) (Figure 7) provides Woodbridge Township with a starting point to identify specific areas of the best suited for public charging. This analysis is backed by the public charging demand illustrated in Figure 6.



Woodbridge Community Center

As an example, the Woodbridge Community Center is one location where the township might consider installing public charging infrastructure, if funding support is available. It is located near an area of high public charging demand and would also serve Woodbridge residents, including those located in a MUD and unable to charge at home. While other municipal parking lots may provide additional opportunities for charging, these lots are already in high demand and may be subject to redevelopment at some point in the future.

Conduct targeted outreach to landowners to install chargers at high-priority locations

Building on the previous recommendation, Woodbridge Township should leverage the high opportunity zone and public charging demand maps in [Section 1](#) (Figure 7 and Figure 6, respectively) as resources to target outreach. Because there are limited opportunities for Woodbridge Township to install publicly-accessible infrastructure on public land, it is important for local landowners to contribute to the charging network. In Woodbridge, retailers, in addition to workplaces and MUDs, are particularly high-priority targets. Property owners, developers, and other decision makers at these locales can have a tangible impact on PEV deployment in the region by providing charging for residents and visitors. KMM is in a position to bring businesses to the table, leveraging their regional network. PEV charging stations can be amenities that help draw customers, and ultimately, pose opportunities to grow the local economy through increased visitor traffic and community spending.

To streamline processes that support AFV infrastructure development, the township does not require a site improvement plan for PEV charging station installations. Clearly stating this point in guidance documents or other educational materials will help developers and potential site hosts better understand the steps involved in infrastructure development. Woodbridge Township has already been proactive in its sustainability outreach, so it would be very feasible and require little additional cost to build upon that foundation by developing a variety of situation- or user-specific PEV materials for distribution. Strategic outreach can take additional time, but it can also be highly impactful since publicly accessible charging in the township may be particularly challenging to establish. Woodbridge Township could also share this information using a combination of print materials (to be distributed at events, in local venues like the library, MUD central offices, and other destinations around town) and digital materials that people can access online or via email newsletters.

Pursue public-private partnerships to fund publicly accessible charger installations

Also related to the previous two recommendations, the township should consider working with improvement districts and partnering with businesses that have a local presence (e.g., Amazon); retail centers; and multi-family developments to finance such installations. Woodbridge Center may provide opportunities, as well as retail areas of Downtown Woodbridge.



Retail plaza in downtown Woodbridge

partnerships, there are display advertising opportunities for companies that sponsor charging stations. In both this case and that of partnerships with business improvement districts, the township will need to provide information supporting the business case for installing PEV charging stations, including customer attraction, dwell time, etc. Prospective station hosts should consider the potential increased revenue, as well as upfront costs.

Zoning & Parking Codes

Establish preferential parking policies for PEVs

Woodbridge Township should consider offering additional incentives for drivers to purchase PEVs, by creating dedicated parking spaces or waiving parking fees for these vehicles. This may be a particular challenge for Woodbridge because of the high demand for public parking in the area. However, if Woodbridge provides PEV parking that exceeds immediate demand, the township can consider specifying interim regulations that allow conventional vehicles to use these spaces in order to avoid under-utilization.

Amend parking codes to regulate the use of PEV charging spaces

After establishing policies and strategies to encourage the deployment of PEVs, the next step for Woodbridge Township is to amend parking ordinances to specify the regulations that apply to parking spaces designated for PEVs. The goal of these amendments is to ensure that PEVs have unobstructed access to PEV charging and to ensure the township can recoup the costs of publicly charging at the stations it owns and operates.

When designating PEV parking, Woodbridge should consider applicable definitions, restrictions, enforcement policies, time limits, and fees. In general, it is a best practice to restrict the use of PEV charging stations to vehicles that are actively charging to ensure that the equipment is available for drivers who need them. For example, the City of Raleigh's Code of General Ordinances requires that vehicles parked in designated PEV spaces be connected to the charging station or be subject to a \$50 fine.⁴⁷ See [Appendix D](#) for an example ordinance from Montclair Township.

Amend zoning codes to encourage or incentivize PEV charging stations in new commercial developments

Zoning codes can facilitate (or, if not developed thoughtfully, prevent) PEV and charging infrastructure deployment. Woodbridge Township should consider amending zoning codes to encourage or incentivize pre-wiring or charging station installations at new commercial developments, including guidance on identifying locations for and installing EV charging stations in such settings. Ideally, guidance should specify the number of chargers or pre-wired spaces to be provided at new developments of different sizes and land-use types. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed.

⁴⁷ City of Raleigh, NC, *Raleigh City Ordinance 11-2174(c) Electric Vehicle Parking FAQs*, <http://www.raleighnc.gov/content/PWksParkingMgmt/Documents/EVParkingFAQ's.pdf>. Accessed April 10, 2017.

Appendix A. Acronyms

Acronym	Stands For
AC	alternating current
AFV	alternative fuel vehicle
AEO	Annual Energy Outlook
AFDC	Alternative Fuels Data Center
BEV	battery electric vehicle or all-electric vehicle
CNG	compressed natural gas
DC	direct current
EIA	U.S. Energy Information Administration
EVSE	electric vehicle supply equipment
GHG	greenhouse gas
HEV	hybrid electric vehicle
MUD	multi-unit dwelling
NGV	natural gas vehicle
NJBPU	New Jersey Board of Public Utilities
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJTPA	North Jersey Transportation Planning Authority
PEV	plug-in electric vehicle
PHEV	plug-in hybrid electric vehicle
SAC	stakeholder advisory committee
TAZ	traffic analysis zone
TMA	Transportation Management Association
UCC	Uniform Construction Code
ZEV	zero emission vehicle

Appendix B. Plug-in Electric Vehicle Forecasting Methodology

For the purposes of this plan, residential PEV ownership forecasts for Woodbridge were projected over a planning horizon from 2016-2030. PEV projections for Woodbridge were developed as a range based on varying assumptions around adoption trends. Estimates of new vehicle sales included in this plan were developed using the following assumptions:

- The total annual sales of light-duty vehicles in New Jersey has been about 550,000 to 600,000 over the last several years, based on data from the National Automobile Dealers Association.
- New sales in Woodbridge are proportional to the share of total vehicles in Woodbridge relative to the entire state.
- New vehicle sales increase at a rate similar to the forecasted new vehicle sales reported by the Energy Information Administration (EIA) in the Reference Case of the Annual Energy Outlook (AEO) 2016, for the Middle Atlantic Region.⁴⁸

The increased deployment of PEVs coincides with increased deployment of more efficient conventional vehicles, driven largely by federal fuel economy and tailpipe greenhouse gas (GHG) emissions standards. Broadly speaking, the total stock of vehicles on the road is forecast to increase by about 10-12 percent between 2015 and 2030, and the stock of conventional vehicles is going to become more efficient, with efficiencies ranging from 40-50 miles per gallon (up from an average of around 25-30 miles per gallon today).

The table below summarizes the approach used to forecast PEVs in Woodbridge in low and high adoption scenarios. It also includes a GHG stretch scenario in which New Jersey meets the emissions reductions set forth in the New Jersey Global Warming Response Act.

⁴⁸ U.S. DOE Energy Information Administration, *Annual Energy Outlook: 2016*, [http://www.eia.gov/outlooks/aeo/pdf/0383\(2016\).pdf](http://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf). August 2016.

PEV Forecast Scenario Descriptions

Scenario	Description
Low	Reflects adoption trends comparable to the Reference Case in the EIA's AEO 2016, adjusted slightly for increased potential indicated in the Middle Atlantic region. ⁴⁹
High	Assumes that PEV adoption rates in Woodbridge will be consistent with the ZEV mandate in place for New Jersey, ⁵⁰ with a fair-share assumption (i.e., that ZEV deployment will occur in the state on a population-weighted basis in the long-term).
GHG Stretch	The PEV strategy of the NJTPA Regional GHG Mitigation Plan calls for a 60 percent market share of PEVs by 2040 to meet state goals. The GHG stretch scenario assumes that PEV adoption rates will be slightly lower than the plan, with a 50 percent market share by 2040.

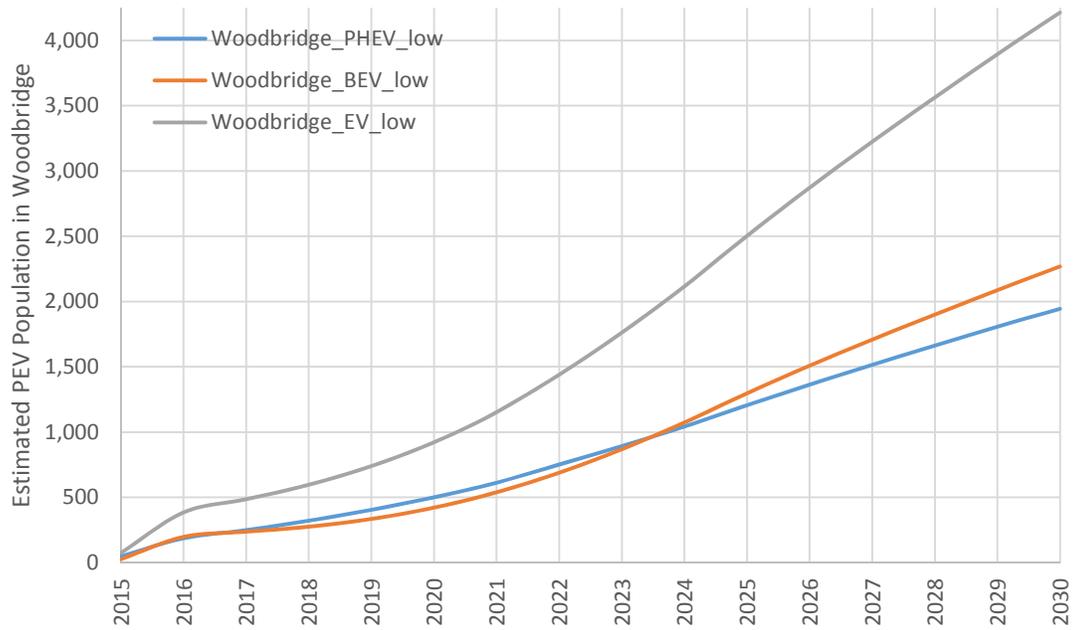
The figures that follow present the three PEV demand scenarios for Woodbridge based on the forecast descriptions in the table above. In the low scenario, approximately 4,250 PEVs are expected to be on the road in Woodbridge in 2030 (2,000 PHEVs and 2,250 BEVs). In the high scenario, the forecast is 12,000 PEVs on the road (8,500 PHEVs, and 3,500 BEVs). The GHG stretch scenario yields about 75,000 EVs on the road by 2040 in Woodbridge. To provide context, total light-duty vehicles are expected to increase by about 10-12 percent in Woodbridge by 2030, with a population of about 140,000 vehicles. The forecasts indicate that PEVs will make up to 6-17 percent of the vehicle fleet by 2030.

Additionally, note that the shape of each of the curves in the low scenarios and the shape of each of the curves in the high scenarios are similar. This is because both scenarios come from the same root functions, modified slightly based on the characteristics assumed in each case.

⁴⁹ AEO forecasting is typically used as a base for forecasts because it provides the benefit of transparency and consistency with national-level assessments. Further, the amount of data that is required to conduct a locally specific forecasting exercise is generally prohibitive. Lastly, the data are something that can be updated annually and modified by stakeholders easily, rather than relying on some proprietary methodology.

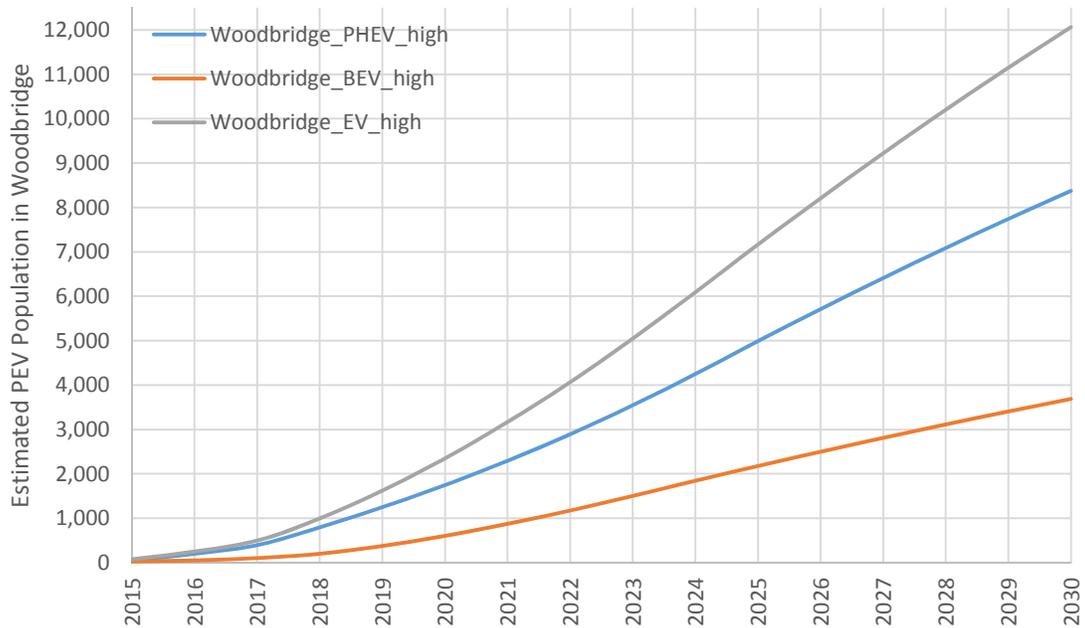
⁵⁰ ZEV programs aim to increase sales of ZEVs, which include PEVs and fuel cell electric vehicles, by requiring that some portion of vehicle manufacturer sales in the state be ZEVs. More information on New Jersey's ZEV mandate is available online at <http://www.nj.gov/dep/cleanvehicles/LEV.pdf>.

Low Scenario



Forecasted PEV Adoption in Woodbridge Township, Low Scenario

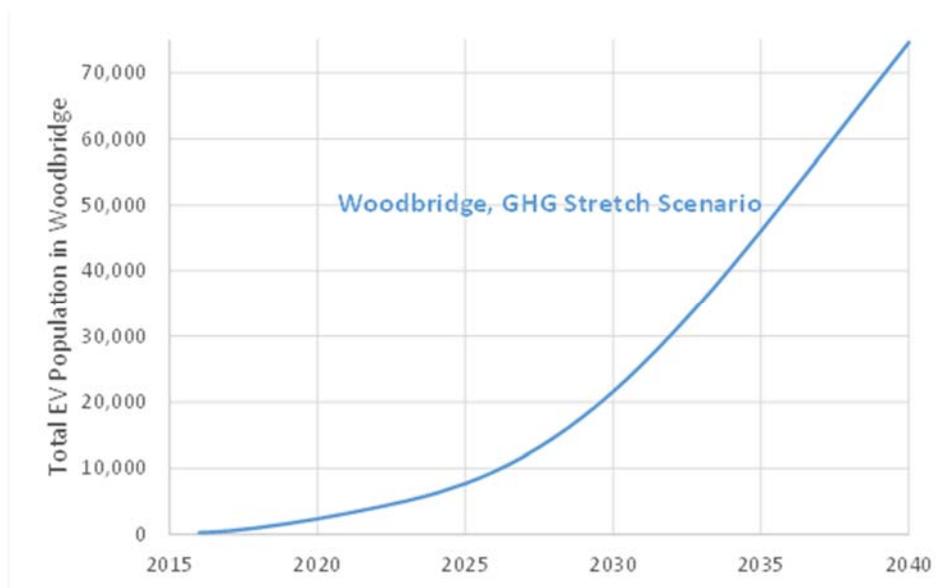
High Scenario



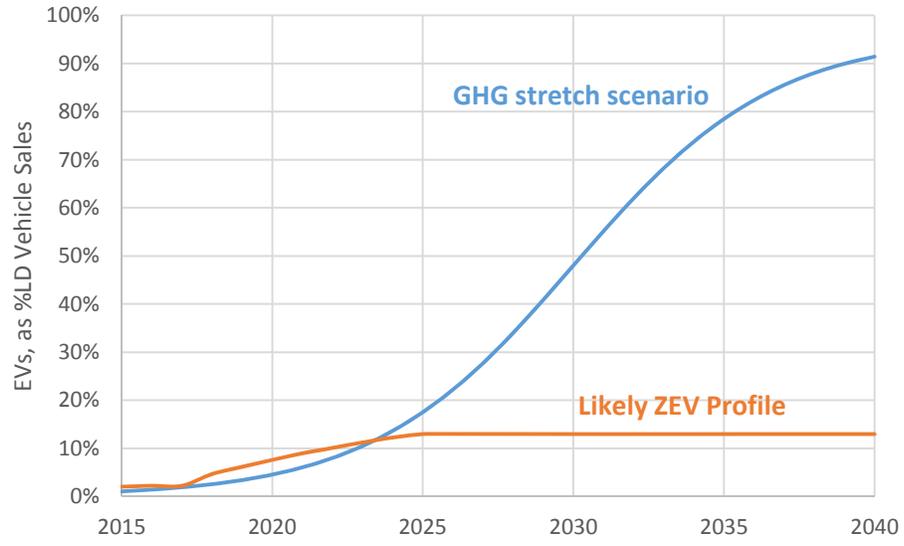
Forecasted PEV Adoption in Woodbridge Township, High Scenario

GHG Stretch Scenario

The New Jersey Global Warming Response Act requires a statewide reduction in emissions of 80 percent from a 2006 emissions baseline by 2050. In the NJTPA Regional GHG Mitigation Plan, a PEV strategy is included with the myriad strategies designed to reduce GHG emissions from on-road transportation. The EV Plan Implementation and Clean Fuels strategy calls for a 60 percent market share of PEVs by 2040. This level of penetration of PEVs by 2040 would effectively require PEVs to capture 50 percent of all new vehicle sales by 2028, and increase rapidly to greater than 90 percent of new vehicle sales by 2040. The GHG stretch scenario assumes PEVs will capture 50 percent of the light-duty market by 2040. The first figure below compares the GHG stretch scenario with the likely compliance outlook for the ZEV program, which plateaus post-2025. As shown in the second figure below, the ZEV program will help PEVs with an initial trajectory, but much higher sale volumes will be needed post-2025 to achieve a 50 percent market share by 2040. In fact, in order to achieve the 50 percent market share by 2040, PEVs will have to make up 80 percent of new sales by 2035 and 90 percent by 2040.



Forecasted PEV Adoption in Woodbridge Township, GHG Stretch Scenario



GHG Stretch Scenario vs Likely ZEV Profile

Appendix C. Charging Infrastructure Demand Forecasting Methodology

Overview

The infrastructure demand analyses are largely based upon the foundational data points of the NJTPA region's current and likely PEV ownership.⁵¹ Socio-economic data were extracted from the 2014 American Community Survey (five year estimates). These data are available at the Census Block Group (CBG) level and include income, tenure or property ownership, and dwelling type. The analysis also relies on vehicle registration, particularly of HEVs.⁵² The key socio-economic indicators used to develop the charging infrastructure siting analysis were:

- **Income.** Market research on early adopters of PEVs suggests that households with higher incomes are more likely to purchase a PEV. Because these vehicles tend to have higher upfront costs, income can be a limiting factor and individuals with a low income might not be able to afford the upfront cost of a PEV. Furthermore, higher income households generally buy a disproportionate share of new vehicles across all market segments and vehicle types.
- **HEV Ownership.** There can be long-term fuel savings associated with HEV (and PEV) ownership, which is one of the main reasons some might invest in such a vehicle. However, research shows that households who value the non-economic (e.g., environmental) benefits of HEVs are more likely to purchase PEVs, particularly in the early adoption phases. Many HEV owners have shown a willingness to pay to reduce gasoline use that goes beyond the economic benefits of using an HEV. A Ford Motors representative noted that typical Focus Electric buyers have purchased HEVs in the past.⁵³ Research from the University of California, Davis (UC-Davis) supports this assumption: 68.3 percent of PEV owners surveyed either own or have owned an HEV and locations of HEV owners correlate with locations of PEV owners.⁵⁴
- **Property Ownership.** Households who own their property are more likely to purchase a PEV than those who rent, according to market research by Nissan and Chevrolet and surveys by UC-Davis and California's Clean Vehicle Rebate Project recipients. Home ownership reduces both financial and non-financial barriers to charging infrastructure deployment.

⁵¹ There are multiple overlapping geographies considered in the charging infrastructure siting analysis. For instance, vehicle ownership data are provided at the ZIP code level; socio-economic indicators are provided at the CBG level; and trip data are generated for TAZs. These overlapping geographies can lead to uncertainty in the analysis; however, the analysis typically relies on values as percentages rather than absolute numbers. Through iterative analyses in other jurisdictions, the consultant team (ICF) has found that this approach minimizes uncertainty. Furthermore, this makes the analysis less sensitive to changes on a time scale less than a year. For instance, if a municipality obtains PEV ownership at six-month intervals, and seeks to update the analysis, it is unlikely it will observe substantive changes in the results.

⁵² Data provided by the NJDEP, based on NJMVC registration data.

⁵³ Mike Tinsky, Associate Director, Sustainability and Vehicle Environmental Matters, Vehicle Electrification and Infrastructure, Ford Motor Company. Phone interview, April 9, 2012.

⁵⁴ Gil Tal, Michael Nicholas, Justin Woodjack, Daniel Scrivano, Tom Turrentine, Plug-in Hybrid and Electric Vehicle Research Center of the Institute of Transportation Studies, University of California, Davis. Plug-In Vehicles in the San-Diego Region: A Spatial Analysis of the Demand for Plug-In Vehicles. Presented by Gil Tal, May 9, 2012, at EVS 26, Los Angeles, CA.

- Dwelling Type.** Dwelling type (e.g., single-family detached, single-family attached, or multi-unit dwelling) can help indicate PEV ownership. Consumers with a single-family detached home generally have fewer barriers to PEV adoption as they usually have access to a garage or driveway. Consumers living in MUDs are more likely to encounter barriers to installing chargers (e.g., limited space for infrastructure installation, home owners' association restrictions, installation costs for trenching, additional metering requirements, power availability).⁵⁵

The charging infrastructure demand analysis leverages origin-destination trip tables from the NJTPA, which indicate the number of trips from an origin traffic analysis zone (TAZ) to a destination TAZ.⁵⁶ Trip types include home-based work (HBW), home-based other (HBO), and non-home non-work (NHNW) trips.

The readiness plan includes the mapped results of each infrastructure demand analysis – residential, MUD, workplace, and public/opportunity charging. Each map includes five levels of shading, based on the percentile of each TAZ's score relative to the entire NJTPA region, and ranked as shown in the table below.

Scoring	Percentile	Demand
1	0—40%	Low
2	40—60%	Low/Medium
3	60—80%	Medium
4	80—95%	Medium/High
5	95—100%	High

Residential Charging

The residential charging demand analysis (associated with both HBW and HBO trips) relies exclusively upon socio-economic data for each TAZ. This data determined a General Residential Charging (ResGeneral) Score, which is directly correlated with residential charging infrastructure demand. As such, no trip data was incorporated into this assessment.

The socio-economic indicators explained above were scored with different weighting factors, which were linked to survey and market research of PEV owners and based heavily on California's extensive PEV ownership data. These factors contributed to a ResGeneral Score:

$$ResGeneral\ Score = \sum \alpha Income, \beta HEV_Ownership, \gamma Tenure, \delta DwellingType,$$

where

$$\alpha + \beta + \gamma + \delta = 1.$$

Each weighting factor was based on the level of correlation associated with PEV ownership to date, and each factor is skewed towards the first two parameters: income and HEV ownership. The latter two factors – tenure and dwelling type – were used to differentiate amongst areas with higher potential.

⁵⁵ Graham, R.L., J. Lieb, J. Sarnecki, R. Almazan, B. Neaman. Wise Investment in Electric Vehicle Charging Infrastructure through Regional Planning. EVS26 International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium, 2012.

⁵⁶ The socio-economic data are scored at the CBG-level and the trip data are available at the TAZ level. NJTPA staff provided a look-up table linking each CBG with a TAZ.

The most critical parameter in this infrastructure demand analysis is income, which accounts for 60 percent of the scoring. To integrate this factor, CBGs were scored against one another by comparing the share of different income groups. This provides more granularity to the analysis than simply comparing median incomes.

The second most prominent parameter in the analysis is HEV ownership, which accounts for 30 percent of the scoring. This analysis compared the percent of HEVs owned in each CBG against the percent of HEV ownership in that CBG's municipality and against the entire state of New Jersey. CBGs scored higher in the analysis if they had HEV ownership higher than the state median.

The tenure parameter represents the rate of home ownership relative to the median rate of home ownership for the state of New Jersey. Based on survey data and PEV market research, home ownership as a percent of the number of residential units available in a given area are short- to mid-term indicators for PEV ownership but are less effective indicators over the long-term. For this reason, the tenure parameter accounts for 5 percent of the total score. Additionally, these parameters were used exclusively to differentiate amongst areas with better than median income and HEV ownership profiles. In other words, if an area did not have a higher than median income but did have a higher than median rate of home ownership, the home ownership factor would not impact the ResGeneral Score. However, for areas with a similar median income or HEV ownership profile, a higher rate of home ownership would yield a higher ResGeneral Score.

For the final parameter, dwelling type, areas were scored based on the rate of single-family units relative to the median rate of single-family units. This parameter also accounts for 5 percent of the total score and a higher rate of single-family units yields a higher ResGeneral Score.

Multi-Unit Dwelling Charging

This analysis includes a new metric to estimate the likely demand for charging at MUDs. This metric was developed by using the same approach as outlined previously for the residential charging estimates, however, the value of the weighting factor for dwelling type, δ ,⁵⁷ and the structure of the scoring were modified to favor areas with above median income, above median hybrid ownership, and a high share of MUDs (instead of a higher rate of single family units).

Workplace Charging

To forecast the likely demand for workplace charging infrastructure, the results of the residential demand analysis were combined with regional travel demand data to determine the TAZs within Woodbridge Township that have the highest number of trips originating from TAZs with the highest likelihood of PEV ownership. The analysis relied upon an output matrix from the NJTPA's travel model, referred to as origin-destination trip tables for home-based work trips. The trip originating from TAZ_o was multiplied by the score determined in the residential analysis, *ResGeneral Score*_o. The likelihood of

⁵⁷ The weighting factor for dwelling type was increased to 25 percent from 5 percent, and the weighting factors for income and hybrid ownership were decreased to 50 percent and 20 percent, respectively. These changes are more subjective than the analysis behind the residential siting analysis, and it is important to update these values as the demand for charging at MUDs is better understood.

workplace charging is simply correlated with the number of trips concluding at the workplace destination TAZ_D. The letters O and D represent origin and destination.

Public Charging

In the long run, public charging will consist of predominantly Level 2 and DC Fast charging, with Level 2 being the charging type most feasible for Woodbridge Township to install and support. For this reason, the forecast for public charging focuses on Level 2 charging, using a methodology similar to the workplace charging analysis. However, instead of multiplying the ResGeneral Score by HBW trips, it is multiplied by HBO trips, which served as a proxy for public charging.

Appendix D. Municipal Policy Examples

PEV Parking Ordinance

Chapter 230: Parking Lots

Article I: Parking Permits

[Adopted 4-15-1980 by Ord. No. 80-12 as Art. I of Ch. 161A of the 1979 Code]

§ 230-3.1 Reserved parking for recharging electric vehicles.

[Added 8-12-2013 by Ord. No. O-13-42]

A. It shall be unlawful for any person to park or leave standing a vehicle in a stall or space designated for the recharging of electric vehicles unless the vehicle is connected for electric charging purposes.

B. It shall be unlawful for any person to obstruct, block, or otherwise bar access to parking stalls or spaces described in Subsection A except as provided in Subsection A.

C. Notice of reserved parking for recharging of electric vehicles shall be posted on a sign not less than 17 inches by 22 inches in size with lettering not less than one inch in height that clearly and conspicuously states the following: "Unauthorized vehicles not connected for electric charging purposes may be towed away at owner's expense. Towed vehicles may be reclaimed at designated towing facility or by calling Montclair Police Department - 973-744-1234." The sign shall be posted in both of the following locations:

- (1) Immediately adjacent to, and visible from, the stall or space.
- (2) In a conspicuous place at each entrance to the parking facility.

New Construction Pre-Wire Requirement

New York City requires that newly constructed and upgraded parking garages and open lots include the necessary hardware for charging infrastructure in at least 20 percent of the parking spaces. See the General Administrative Provisions for Construction Codes, Section 28-101.4.3, as well as the Building Code, Sections 406.2.11 and 406.7.11 (<https://www1.nyc.gov/site/buildings/codes/2014-construction-codes.page>).

Redevelopment Plan Language

Montclair, NJ Seymour Street Redevelopment Plan,

<http://www.montclairnjusa.org/dmdocuments/SEYMOUR-Rdv-Plan-FINAL.pdf>

ELECTRIC CAR-CHARGING FACILITIES: All parking facilities within the Redevelopment Area shall include at a minimum two electric car charging stations as well as the infrastructure necessary to support additional car charging facilities to accommodate future demand. The car-charging facilities shall be the responsibility of the redeveloper.

“Right to Charge” Language

While it exists at the state level, rather than as a municipal ordinance, California’s “right to charge” policy is summarized as follows:

A common interest development, including a community apartment, condominium, and cooperative development, may not prohibit or restrict the installation or use of electric vehicle supply equipment (EVSE) in a homeowner's designated parking space. These entities may put reasonable restrictions on EVSE, but the policies may not significantly increase the cost of the EVSE or significantly decrease its efficiency or performance. If installation in the homeowner's designated parking space is not possible, with authorization, the homeowner may add EVSE in a common area for their use. The homeowner must obtain appropriate approvals from the common interest development association and agree in writing to comply with applicable architectural standards, engage a licensed installation contractor, provide a certificate of insurance, and pay for the electricity usage associated with the EVSE. Any application for approval should be processed by the common interest development association without willful avoidance or delay. The homeowner and each successive homeowner of the parking space equipped with EVSE is responsible for the cost of the installation, maintenance, repair, removal, or replacement of the station, as well as any resulting damage to the EVSE or surrounding area. The homeowner must also maintain a \$1 million umbrella liability coverage policy and name the common interest development as an additional insured entity under the policy. If EVSE is installed in a common area for use by all members of the association, the common interest development must develop terms for use of the EVSE. (Reference [California Civil Code](#) 4745 and 6713)

Source: <http://www.afdc.energy.gov/laws/9579>

Appendix E. Plug-in Electric Vehicle Community Readiness Resources

This information was adapted from a collection of resources compiled by the DOE's Clean Cities program, focusing on tools, documents, websites, and other information available via DOE's Office of Energy Efficiency and Renewable Energy.

[DOE EV Everywhere Electric Vehicles: Stakeholder Solution Center](#)

States and Municipalities

States and municipalities are key players in increasing PEV readiness. The best way for states and municipalities to improve their PEV readiness is to partner with their [local Clean Cities coalition](#), which can connect them to specific regional resources and other relevant stakeholders.

- [Plug-in Electric Vehicle Readiness Scorecard](#): Hosted on the DOE's Alternative Fuels Data Center, the Scorecard allows communities to assess their readiness, receive feedback about ways to improve, read about best practices, and record progress.
- [Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects](#): This guide, which is on the DOE Clean Cities' website, summarizes the best practices in streamlining permitting processes, revising codes, training emergency personnel, developing incentives, and educating the public based on the experiences of 16 PEV readiness projects across the country.
- [Reports from the Clean Cities' EV Community Readiness Projects](#): These are individual reports and community readiness plans from each of the projects, hosted on the Clean Cities' website. (See list of projects in chart, below).
- [Zoning, Codes and Parking Ordinances](#): This page on the DOE's Alternative Fuels Data Center links to relevant NIST codes for electric vehicle charging.
- [Handbook for Public Charging Station Hosts](#): This handbook on the DOE's Alternative Fuels Data Center provides an overview for what cities hosting public charging stations need to know before installation.
- [Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools](#): Published by the Transportation and Climate Initiative, this guide provides information on the steps to create, administer, and amend planning processes, rules and regulations, including in zoning, parking, and permitting.
- [EV-Ready Codes for the Built Environment](#): This guide, published by the Transportation and Climate Initiative, provides an overview of building and electrical codes as relating to PEVs, as well as providing recommendations specific to jurisdictions in the Northeast and Mid-Atlantic.
- Training on PEVs for First Responders through the [National Alternative Fuels Training Consortium](#) and the [National Fire Protection Association](#) provides essential education to firefighters, police officers, EMTs and others that may need to respond to accidents involving PEVs.
- [Drive Electric Vermont Case Study](#): This case study examines the opportunities and barriers to enabling small and midsize communities to partake in the PEV market and benefit from the economic and environmental advantages of the vehicles.

Employers

Providing charging at the workplace can encourage employees to purchase PEVs, be an attractive employee benefit, and maximize all-electric miles driven by PEV owners. The EV Everywhere [Workplace Charging Challenge](#) was a DOE program to encourage and recognize employers providing workplace charging.

- [Resources to Install and Manage Workplace Charging](#)
- [Handbook for Workplace Charging Hosts](#)

Fleets

Like consumers, fleets can benefit from the low operating costs and other benefits associated with PEVs. [Local Clean Cities coalitions](#) can help fleets decide which technologies and models will be most appropriate to meet their needs.

- [Handbook for Fleet Managers](#): This handbook on the DOE's Alternative Fuels Data Center provides fleet-specific information on the basics of PEVs, including issues like maintenance and charging.
- [Plug-in Electric Light, Medium and Heavy-Duty Vehicle Search](#): This tool on DOE's Alternative Fuels Data Center provides information on PEVs that can be filtered by class/type and manufacturer.
- [AFLEET Tool](#): Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation Tool allows fleet managers to calculate the cost of ownership, petroleum use, greenhouse gas emissions, and air pollutant emissions of alternative fuel vehicles.

Electrical Contractors and Inspectors

The installation of residential, workplace and public charging is essential to establishing a PEV market.

- [Electric Vehicle Infrastructure Training Program](#): This program provides training and certification at community colleges and electrical training centers across the United States for people installing electric vehicle supply equipment for residential and commercial markets.
- [EVSE Residential Charging Installation Video](#): A series of segments on the Clean Cities TV YouTube channel walk electricians through the basics of installing PEV charging infrastructure in homes, including an overview of the equipment, the relevant National Electrical Codes, inspection, and best practices.

Utilities

Through a partnership with the Edison Electric Institute, DOE is developing a suite of tools for utilities to support the use of PEVs.

- [The Utility Guide to Plug-in Electric Vehicle Readiness](#): A guide from the Edison Electric Institute, this document covers structuring your company to support PEVs, adding PEVs to utility fleets, enhancing the customer experience, working with state and local governments, and managing the electrical grid with PEVs.
- [Utilities Power Change](#) – This case study showcases how New Jersey's Public Service Electric and Gas Company, and Southern Company's unit Georgia Power are launching workplace charging programs for their commercial customers.

Additional Resources

[At A Glance: Electric-Drive Vehicles](#)

[Charging Plug-In Electric Vehicles in Public](#)

[Charging Plug-In Electric Vehicles at Home](#)

[Resources for Electrical Contractors and Inspectors](#)

[Developing Infrastructure to Charge Plug-In Electric Vehicles](#)

[Plug-In Electric Vehicle Deployment Policy Tools: Zoning, Codes, and Parking Ordinances](#)

[Signage for Plug-In Electric Vehicle Charging Stations](#)

[Plug-In Electric Vehicle Handbook for Consumers](#)

[Workplace Charging: Charging Up University Campuses](#)

[Electric Vehicle Charging for Multi-Unit Dwellings](#) (webpage with links to resources and case studies)

[Massachusetts Plug-in Electric Vehicle and Charging Infrastructure Case Study](#)

[Rolling Down the Arizona EV Highway](#) (case study)

[San Diego Prepares for Electric Vehicles in Multi-Unit Dwelling Communities](#) (text version and video)

[Houston Energizes Deployment of Plug-In Electric Vehicles](#) (case study)

[Seattle Rideshare Fleet Adds EVs, Enjoys Success](#) (case study)

[Alternative Fuels Data Center Publications](#) (search by keyword for additional resources)

Appendix F. Additional Information on Parking

Woodbridge Township's Revised General Ordinances (as amended to 12-31-2015; <http://clerkshq.com/default.ashx?clientsite=Woodbridge-nj>) includes parking regulations set out in Chapter VII, "Traffic," which regulates parking lots and off-street parking. Chapter II, Article XIX, 2-49 "Parking Utility," gives Woodbridge the authority to manage parking lots and other parking spaces, specifically on Main Street, New Brunswick Avenue, Oak Tree Road, and Avenel Street. However, no reference to this utility is found online and not mentioned during meetings with township staff. At the moment, these chapters do not reference AFVs but could be altered to designate parking spaces for AFVs and create regulation for enforcement of such areas. For example, penalties for parking a motor vehicle in a restricted parking space are governed by ordinance 7-4, "General Penalty." While there is no language regarding alternative fueled vehicles, ordinance 7-4 can be tailored in the future to penalize non-AFV parking in AFV spaces. Additionally, time limits on parking are governed by ordinance 7-12, which can apply time limits to parking of AFVs.

Other ordinances that may not have a direct impact on AFVs, but should be noted, are residential parking permits, parking at recreational parks, cemetery parking, and rent control. Several areas and streets require parking permits for residential areas, as required by ordinance 7-17. Requirements regarding parking, standing or stopping of any motor vehicle in any township park is found under ordinance 14-1.5 and is restricted during certain hours. Cemetery parking requirements, which specify the number of public parking spaces, may or may not have an effect on AFVs, are governed by 32-1.13 "Access Roads; Parking Requirements." None of the cited ordinances contain requirements for AFV parking, but may be added in the future. It should also be noted that under Chapter XX, "Rent Control," an installation of PEV charging stations may be considered a capital improvement subject to related ordinances in said chapter and may create an obstacle in creating AFV parking areas. Additionally, there are opportunities to implement AFV infrastructure in Special Improvement Districts. Under Chapter XXXIII, one of the highlighted areas of concerns for a Special Improvement District is parking in order to increase the safety or attractiveness of the District. The District is given the power to provide special parking arrangements for the District, which can be catered specifically for AFVs.

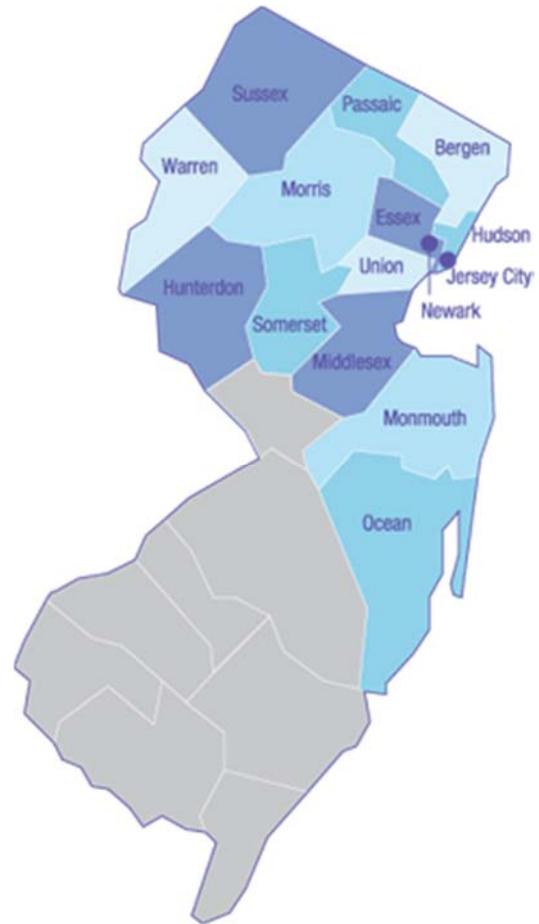
Appendix G. Regional Planning Area

The NJTPA regional planning area consists of 13 counties within North New Jersey; Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, and Warren; and its two largest cities, Newark and Jersey City. The region spans 4,200 square miles, about half of the state's land area. It is the fourth largest MPO in the nation in terms of population, serving more than 6.7 million people and over 3.1 million jobs.⁵⁸

The region has a robust multi-modal transportation network, including 26,000 miles of roads, 255 local and express bus routes, and 13 commuter/light rail lines with 228 stations, and 18 ferry routes from 19 piers.⁵⁹ Situated between New York and Philadelphia, the area is a regional corridor for both intra- and inter-state transportation. According to the American Community Survey (ACS), 34 percent of regional residents work outside their county of residence and 14 percent work outside of the state. The ACS found that the majority (70 percent) of commuters report driving alone, a rate that is significant but lower than most major metropolitan areas. In 2015, the region had 149.1 million miles of vehicle travel.⁶⁰

The NJTPA's regional transportation plan – Plan 2045: Connecting North Jersey – outlines the principles that guide project selection and provide policy and planning direction.⁶¹ These include:

- **Help Northern New Jersey Grow Wisely** — Transportation investments should encourage economic growth while protecting the environment and minimizing sprawl in accordance with the state's Smart Growth plan, Energy Master Plan, and environmental plans.
- **Make Travel Safer** — Improving safety and security should be explicitly incorporated in the planning, design, and implementation of all investments.
- **Fix It First** — The existing transportation system requires large expenditures for maintenance, preservation, and repair, and its stewardship should be the region's highest priority.



NJTPA Region

⁵⁸ NJTPA, Plan 2045: Connecting North Jersey, <https://apps.nitpa.org/plan2045>.

⁵⁹ New Jersey Transit, *Facts at a Glance – Fiscal Year 2016*, <http://www.njtransit.com/pdf/FactsAtAGlance.pdf>.

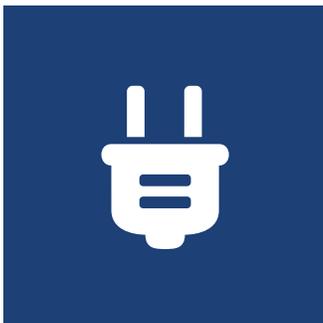
⁶⁰ New Jersey Department of Transportation, *New Jersey's Roadway Mileage and Daily VMT by Functional Classification Distributed by County*, http://www.state.nj.us/transportation/refdata/roadway/pdf/hpms2015/VMTFCC_15.pdf.

⁶¹ NJTPA, Plan 2045: Connecting North Jersey, <https://apps.nitpa.org/plan2045>.

- Expand Public Transit — Investment to improve the region’s extensive transit network should be a high priority, including strategic expansions to serve new markets.
- Improve Roads but Add Few — Road investments should focus on making the existing system work better and road expansion should be very limited without compromising the tremendous accessibility provided by the existing highway system.
- Move Freight More Efficiently — Investments should be made to improve the efficiency of goods movement because of its importance to the region’s economy and quality of life.
- Manage Incidents and Apply Transportation Technology — Investments should be made to improve information flow, operational coordination, and other technological advances that can make the transportation system work smarter and more efficiently.
- Support Walking and Bicycling — All transportation projects should promote walking and bicycling wherever possible.
- Increase Regional Resiliency — Investments should be made to mitigate risks associated with sea level rise, extreme weather, homeland security, and other potential threats. Investments should consider criticality of infrastructure, vulnerability, and level of risk.

While the expansion of transit and smart land-use planning work to reduce single occupant travel, the adoption of AFVs within the region will help reduce the environmental impact of the remaining vehicle trips by reducing oil consumption and transportation-related emissions, thus supporting the NJTPA’s goal of protecting the environment.

Appendix D: AFV Readiness Guidebook



Alternative Fuel Vehicle Readiness

A Guidebook for Municipalities

December 2017



About the NJTPA

The NJTPA is the federally authorized Metropolitan Planning Organization for 6.7 million people in the 13-county northern New Jersey region. Each year, the NJTPA oversees more than \$2 billion in transportation improvement projects and provides a forum for interagency cooperation and public input. It also sponsors and conducts studies, assists county planning agencies, and monitors compliance with national air quality goals.

Alternative Fuel Vehicle Readiness: A Guidebook for Municipalities

Disclaimer

This publication was prepared with funding from the North Jersey Transportation Planning Authority (NJTPA) and the Federal Highway Administration (FHWA). This document is disseminated under the sponsorship of the NJTPA and FHWA in the interest of information exchange. The NJTPA and FHWA assume no liability for its contents or use thereof.

Acknowledgements

This guidebook was developed for the NJTPA by a consultant team consisting of ICF, Greener by Design, and Fitzgerald & Halliday, Inc.

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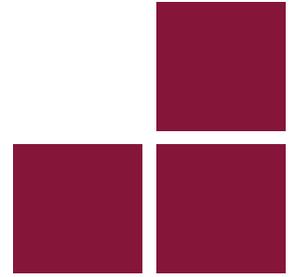
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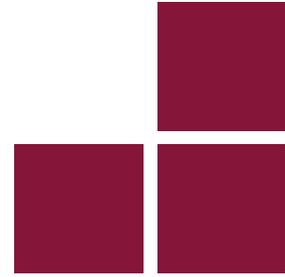
List of Acronyms

Acronym / Abbreviation	Stands For
AC	alternating current
AFV	alternative fuel vehicle
AFDC	Alternative Fuels Data Center
BEV	battery electric vehicle or all-electric vehicle
CNG	compressed natural gas
DC	direct current
DOE	U.S. Department of Energy
FFV	flexible fuel vehicle
FCEV	fuel cell electric vehicle
FHWA	Federal Highway Administration
GHG	greenhouse gas
HEV	hybrid electric vehicle
LNG	liquefied natural gas
MPO	metropolitan planning organization
MUD	multi-unit dwelling
NGV	natural gas vehicle
NJBPU	New Jersey Board of Public Utilities
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJTPA	North Jersey Transportation Planning Authority
PEV	plug-in electric vehicle
PHEV	plug-in hybrid electric vehicle
TMA	Transportation Management Association
ZEV	zero emission vehicle



Introduction





Introduction

Transportation emissions from fossil fuels are the single largest source of air pollution in New Jersey. Reducing this emissions source is integral to improving public health and meeting the state's greenhouse gas (GHG) reduction goals, as GHGs are formed from the combustion of fossil fuels, largely gasoline and diesel. Consequently, state agencies and other key players are focused on developing policies and incentives facilitating alternative fuel vehicle (AFV) use within New Jersey.

The New Jersey Board of Public Utilities (NJBPU) and New Jersey Department of Environmental Protection (NJDEP) have been particularly active through their infrastructure development efforts and programs. Metropolitan Planning Organizations (MPOs), such as the North Jersey Transportation Planning Authority (NJTPA), and non-profit organizations, such as the Sustainability Institute at the College of New Jersey (Sustainable Jersey), are also actively promoting the use of AFVs in the state.

Municipalities can play an important role in spurring the adoption of AFVs. Some key ways that municipalities support increased AFV use include:

- Encouraging AFV infrastructure development (primarily charging stations) through planning and policy changes
- Setting an example through AFV use in their own fleet and municipal contractor fleets
- Disseminating information about AFVs and infrastructure through stakeholder and public outreach

Local readiness planning efforts can accelerate the shift away from reliance on conventional fuels to AFVs. Through an inclusive, local planning process, readiness plans help develop an understanding of the market in

a given municipality; identify stakeholders; determine current barriers, opportunities, and regulations related to AFV use; and develop an action plan to help support AFV market growth. Readiness plans can offer a roadmap by identifying the barriers to widespread deployment of infrastructure and vehicles, and outlining actions that will reduce or eliminate these barriers. Readiness plans also include actionable recommendations for municipal officials, local stakeholders, and the others interested in expanding the use of AFVs.

As part of its efforts to support AFVs, the NJTPA partnered with three pilot municipalities – Montclair Township in Essex County, Town of Secaucus in Hudson County, and Woodbridge Township in Middlesex County – to develop local readiness plans that encourage the widespread use of AFVs, with a focus on plug-in electric vehicles (PEVs) and natural gas vehicles (NGVs). Based on input from a variety of stakeholders, each readiness plan included a comprehensive set of strategies that a municipality can implement to become PEV and NGV ready.

Incorporating lessons learned from the individual community readiness plans, this guidebook is for all municipalities in New Jersey to design and conduct AFV readiness planning efforts in their own communities. Both the guidebook and the readiness plans were prepared in

keeping with the policies of Plan 2045: Connecting North Jersey to improve mobility, protect the environment, and take advantage of technology developments.

This guidebook highlights best practices for municipalities implementing AFV infrastructure and supportive policies. The guidebook defines and characterizes alternative fuel options as outlined in the box below. For each, it describes the benefits and challenges associated with the fuel or vehicle technology. Finally, the guidebook includes recommended actions municipalities can take to advance AFVs.

While regional deployment efforts and local lessons learned are included, this document is not meant to be a location-specific readiness plan. Instead, it outlines planning efforts the municipality can take to get ready for AFVs.

Each municipality is unique, and will be starting from a different place with varying needs and priorities. This document is designed to be general enough to assist any community, while also offering suggestions and recommendations specific enough for individual municipalities to put into practice.

Municipalities will benefit from taking a comprehensive approach to AFV readiness planning and this guidebook includes the information and direction necessary to do so. Specifically, this document provides guidance to:

- Establish a stakeholder committee or working group
- Set goals and integrate them into existing municipal plans
- Understand existing conditions and opportunities related to vehicle deployment, infrastructure development, regulatory climate, and potential funding sources
- Conduct assessments, analyses, and forecasts on the consumer and fleet markets for AFVs
- Identify gaps and understand barriers to deployment, including charging at multi-unit dwellings (MUDs), workplaces, and public locations

It also provides best practices on recommended actions for:

- Zoning and parking
- Permitting and inspection
- Stakeholder engagement
- Targeted education and outreach

Alternative Fuel Vehicles

This guidebook covers the following vehicle and fuel types:



Plug-in electric vehicles (PEVs) are powered – at least in part – by an electric motor using energy stored in a battery. Most commonly found in the light-duty market, these vehicles have zero tailpipe emissions and can offer lifetime financial savings over traditional gasoline vehicles.



Natural gas vehicles (NGVs), primarily medium- or heavy-duty vehicles such as commercial trucks, are powered by natural gas, either in compressed or liquefied form. Benefits include life cycle emission reductions and less fuel price volatility.



Propane vehicles are mostly used in light-duty pick-up and medium-duty vehicles. Fleets, in particular, benefit from reduced fuel prices and emissions.



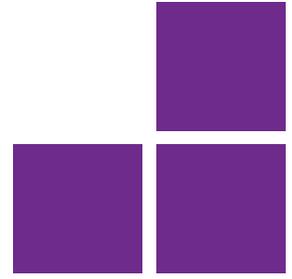
Hydrogen fuel cell electric vehicles (FCEVs), specifically light-duty models, are just beginning to enter the market. Like PEVs, these vehicles have zero tailpipe emissions and are more efficient than conventional vehicles.



Ethanol is a liquid renewable fuel, currently found in over 97% of gasoline in the United States. E85 – an ethanol-gasoline blend containing 51%-83% ethanol – can only be used in flexible fuel vehicles (FFVs).



Biodiesel is another renewable fuel that is commonly blended with diesel for use in heavy-duty diesel vehicles, often without any engine modification.



Who Should Use this Guidebook and How?



Who Should Use this Guidebook and How?

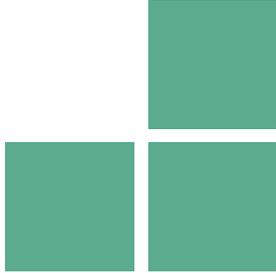
For the purposes of this guidebook, the term “municipality” includes boroughs, townships, cities, towns, and villages as defined under New Jersey State law. While AFV planning may happen at a broader level (i.e., by county, state, or region), this guidebook is written primarily for municipal policy makers and staff, including elected officials, planning and zoning staff and boards, parking authorities, environmental commissions, and business improvement districts.

A broad audience can benefit from the information provided in this guidebook, including county and regional government personnel; public and private fleet managers; local fueling station operators; and others.

The guidebook consists of the following sections:

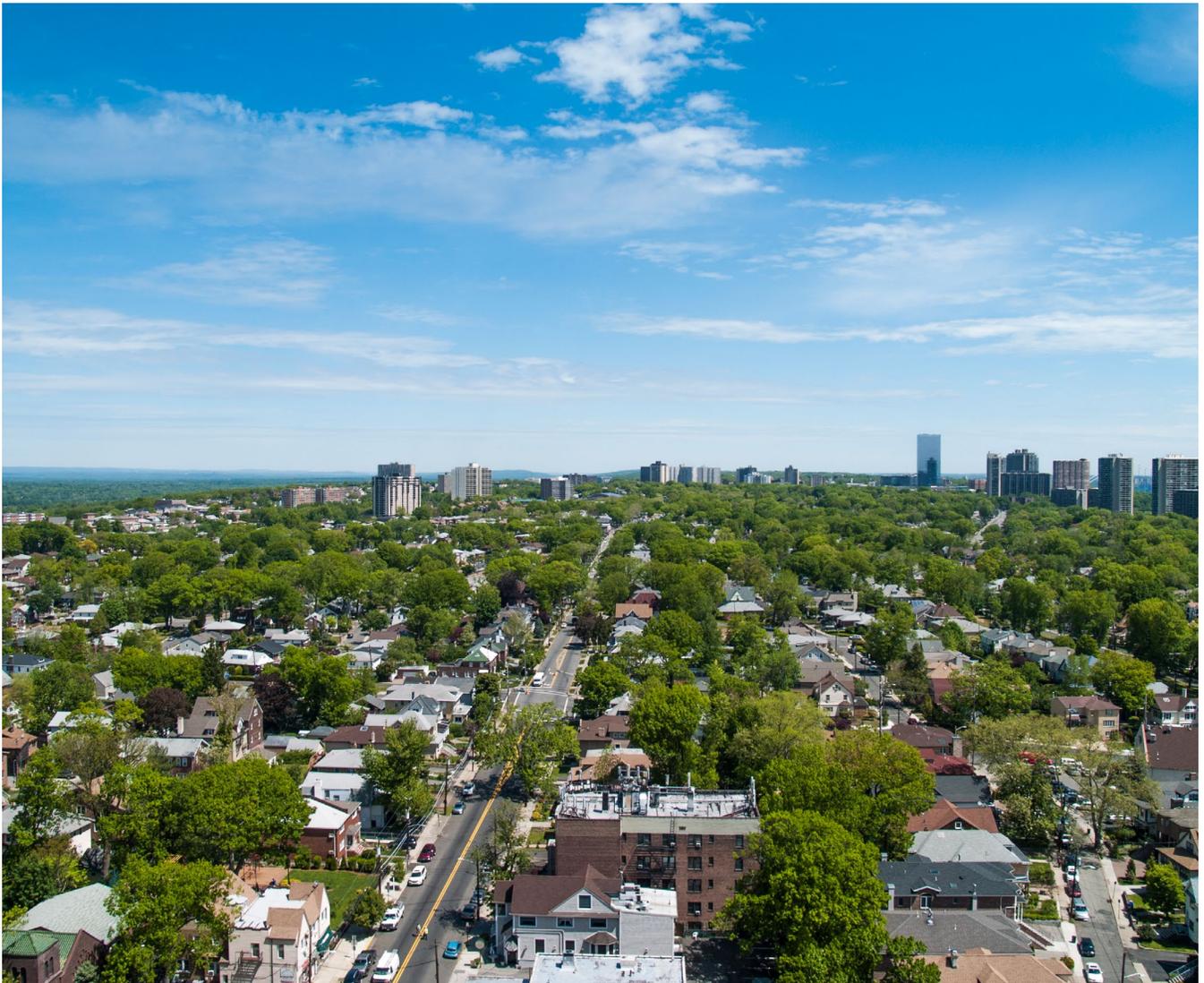
- 1. Why Take Action?** Provides a framework by introducing the benefits of being AFV ready, as well as the state and federal actions that support AFV readiness in New Jersey.
- 2. What are AFVs and What do they Require?** Summarizes each alternative fuel type, vehicle, fueling infrastructure, and other considerations.
- 3. What Does it Take to Become AFV Ready?** Focuses on the steps to develop a readiness plan, including key recommendations.





SECTION 1

Why Take Action?



Why Take Action?

The number of PEVs is on the rise in New Jersey and nationally, with annual U.S. PEV sales reaching 200,000 in 2017. Consumers and fleets alike recognize the environmental, economic, and other benefits of these vehicles, and the market share is expected to continue to increase in the coming years. Municipalities need to be ready for this significant shift in transportation technology, specifically the fueling infrastructure needs. Not only will communities want to capitalize on the benefits outlined below, local governments also play an important role in ensuring that the deployment of fueling infrastructure is not impeded by zoning and parking regulations, building codes, and inspection processes. Some municipalities will want to go even further to install PEV charging at municipal facilities, offer incentives for residents and businesses, or conduct education and outreach efforts. AFV readiness planning is the first step in understanding the infrastructure needs of the community and the actions necessary to achieve them.

Benefits of AFVs

Reduce fossil energy use and support a healthy environment. More miles driven in AFVs means less petroleum consumption, resulting in public health benefits through improved local air quality and reduced GHG emissions. PEVs have no tailpipe emissions. Even when considering well-to-wheel emissions, which account for emissions from the electricity source used to charge the vehicle, PEVs are generally cleaner than conventional vehicles. New Jersey has a relatively low-carbon electricity supply compared to most states, as nearly all power is supplied by natural gas and nuclear energy, meaning that PEV operation results in fewer GHG emissions than their conventional counterparts. Use of alternative fuels can also increase communities' resilience in emergency situations, providing a much-needed diversification of the fuel supply and increasing options should there be a fuel disruption.

Contribute to economic development. AFVs can spur economic benefits for the municipality in the form of cost savings for residents, reduced fleet maintenance costs, and job creation through the installation of public fueling stations.

Proactively anticipate and prepare for future demand. Although the magnitude of AFV growth is uncertain, the region is likely to become a primary market for PEVs. In fact, New Jersey has already seen significant growth in the number of PEVs on the road, increasing by approximately one-third from mid-2016 to mid-2017.¹ If a municipality begins preparing for this growth now, it will be better



positioned to serve current and future residents and visitors.

Attract residents, visitors, and businesses. Marketing a municipality as “AFV friendly” could appeal to multiple audiences. AFV adopters may view the municipality as an eco-friendly and tech-savvy destination of choice. Additionally, more AFV fueling infrastructure could increase tourism by decreasing range anxiety;² AFV tourists on road trips along the East Coast would be more likely to stop and spend time in municipalities where they can refuel or recharge. Companies and fleets with a sustainability-oriented mission may also establish a local presence as a result.

¹ Estimate using PEV registration data from the NJDEP, comparing counts as of August 2016 and July 2017.

² Range anxiety is the fear that a PEV battery will not provide sufficient mileage to reach the consumer's destination(s) and will run out of fuel (i.e., electricity) before there is an opportunity to recharge.

Demonstrate leadership. Proactively planning for and encouraging AFV usage will set a municipality apart as a leader in the field. Being ahead of the coming “electric car revolution” and encouraging the use of AFVs in the

municipal and contractor fleets will allow the municipality to play an active role in developing best practices and setting the standards that others look to for inspiration.

State and Federal Actions Supporting AFV Readiness in New Jersey

Transportation is a regional issue, and opportunities and challenges should be evaluated regionally. This section examines what is being done regarding AFVs on the state and federal levels in terms of planning, policy, legislation, and regulation, as well as which stakeholders are supporting AFV readiness. This section reflects actions taken through the end of 2017, but federal, state, and regional efforts to advance AFV deployment will likely evolve over time.

STATEWIDE PLANNING

State energy planning activities (e.g., the December 2015 New Jersey Energy Master Plan Update) call on New Jersey to expand efforts promoting the use of AFVs, and to continue to develop policies and incentives facilitating AFV use.

The New Jersey Board of Public Utilities (NJBPU) is the state agency with authority to oversee the regulated utilities, such as electricity. The NJBPU sets electric tariffs, including off-peak rates that are an important element of PEV adoption because they can help to minimize negative impacts on the distribution system. In recent years, the NJBPU also approved various NGV tariffs for gas distribution companies, approved a pilot program for New Jersey Natural Gas to build three NGV fueling stations, and provided grants for commercial NGVs in specific counties.³ In 2017, the NJBPU released a report that addresses the expected increase in the availability of PEVs on the road

Transportation is New Jersey’s largest source of air pollution and is also the fastest growing contributor to New Jersey’s GHG emissions.



and associated opportunities and challenges facing regulators and electric utility companies.⁴

The New Jersey Department of Environmental Protection (NJDEP) also has a strong role in promoting the use of cleaner AFVs. Through the “[It Pay\\$ to Plug In](#)” program, the NJDEP supported PEV use by providing rebates for workplace charging infrastructure throughout the state. The NJDEP is also responsible for administering New Jersey’s Low Emission Vehicle (LEV) and Zero Emission Vehicle (ZEV) regulations.

STATE INCENTIVES AND REGULATORY ACTIONS

The New Jersey State Legislature has implemented policies and incentives to encourage the use of AFVs, as well as the deployment of the corresponding fueling infrastructure. The U.S. Department of Energy’s (DOE) Alternative Fuels Data Center (AFDC) [Laws and Incentives](#) database includes summaries of relevant state (and federal) incentives, laws, and regulations. These include the ZEV sales and use tax exemption and the ZEV sales requirements, as well as the incentives mentioned above.

³ NJBPU, CNG Vehicle Grant Program, <http://www.nj.gov/bpu/commercial/cng.html>. Accessed October 23, 2017.

⁴ NJBPU and The Regulatory Assistance Project (RAP), “Getting From Here to There: Regulatory Considerations for Transportation Electrification,” <http://nj.gov/bpu/pdf/reports/RAP-NJ-BPU-electricvehicles-policymemo-may2017.pdf>. May 2017



FEDERALLY-DESIGNATED CORRIDORS

The Federal Highway Administration (FHWA) designated alternative fuel corridors along certain portions of New Jersey’s I-80 and I-95 corridors in late 2016. Portions of these corridors are considered to be “signage-ready” for certain alternative fuels (i.e., routes where alternative fuel is already available on or near the highway and are now eligible to feature the associated signage) and “signage-pending” corridors (i.e., routes that will need additional build-out of infrastructure to be considered signage-ready). In 2017, the NJDEP submitted an application to the FHWA to designate I-78, I-287, and I-295 as PEV charging corridors in an effort to expand the network of alternative fuel corridors in the state. To learn more about the federal designated corridors, visit the FHWA [Alternative Fuel Corridors](#) website.

SUPPORTING STAKEHOLDERS

In addition to state programs and policies, public-private partnerships, MPOs, and nonprofit organizations also play

a key role in the advancement of AFVs. In New Jersey, the following organizations have been among the most prominent in this regard:

- **MPOs** are federally designated and federally funded transportation planning organizations that identify and execute transportation projects and initiatives in their areas. New Jersey has three MPOs – the [NJTPA](#), the [Delaware Valley Regional Planning Commission](#) (DVRPC), and the [South Jersey Transportation Planning Organization](#) (SJTPO). MPOs provide technical guidance and assistance for municipal AFV readiness planning, including access to transportation demand models and data.
- **[Transportation Management Associations \(TMAs\)](#)** are non-profit organizations that partner with employers and governments to reduce traffic congestion and improve air quality through commuter programs and services, including education and outreach efforts promoting AFVs. Seven TMAs operate in the NJTPA region, including: EZ Ride, TransOptions, Ridewise of Raritan Valley, Keep Middlesex Moving (KMM), HART Commuter Information Services (HART), Greater Mercer TMA, and Hudson TMA.
- **[Sustainable Jersey](#)** is a non-profit organization that administers a certification program for municipalities in New Jersey that want to “go green.” The NJTPA collaborated with Sustainable Jersey on the development of two action items, or recommended measures, to facilitate increased use of PEVs: Make Your Town Electric Vehicle Friendly and Public Vehicle Charging Infrastructure. There are also Green Fleets actions: Fleet Inventory and Purchase AFVs. Sustainable Jersey provides tools, training, and other types of support to communities as they pursue these actions.
- **[New Jersey Clean Cities Coalition \(NJCCC\)](#)** is a statewide DOE-designated non-profit coalition exclusively focused on promoting public-private partnerships related to the development and use of AFVs and the appropriate related infrastructure. The fuel-neutral coalition brings together stakeholders to address these issues by providing education, securing grant funding, and overcoming challenges. Notably, the NJCCC led the New Jersey Compressed Natural Gas (CNG) Refuse Trucks, Shuttle Buses, and Infrastructure Project, a DOE-funded AFV deployment program.⁵

⁵ U.S. DOE, American Recovery and Reinvestment Act, Clean Cities Project Awards, http://www.afdc.energy.gov/uploads/publication/arra_cc_project_awards.pdf. August 2016.

What are AFVs and What Do They Require?



What are AFVs and What Do They Require?

There are a variety of AFV options available for both consumers and fleet operators. The pages that follow provide an overview of each fuel type, including information on emissions, fuel economy, cost, regulatory issues, and typical applications. While all of these fuels and AFVs may not currently be available in the NJTPA region, it is important to understand each option to accurately plan for them.



Photo by John De La Rosa, NREL 34236

Following each overview is additional information on the alternative fuel type, including how it is used in vehicles, what type of fueling infrastructure is needed, market conditions in New Jersey, and barriers to adoption. Municipalities have the ability to tackle many of these barriers using the information provided in this guidebook. All fuels listed are considered alternative fuels under the federal Energy Policy Act of 1992.⁶ For information

on available AFV makes and models, see the AFDC [Alternative Fuel and Advanced Vehicle Search](#). To identify fueling locations in or near a municipality, visit the AFDC [Alternative Fueling Station Locator](#). This database is updated on an ongoing basis and includes operational and planned stations. The AFDC also has a [Case Study database](#) with information about fleets that have adopted AFVs, including those in New Jersey.

⁶ U.S. DOE AFDC, Alternative Fuel Definition, <https://www.afdc.energy.gov/laws/391>. Accessed October 20, 2017.

Alternative Fuel Types and Considerations

Electricity

DESCRIPTION

- Plug-in electric vehicles (PEVs) include all-electric or battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).
- BEVs such as the Nissan Leaf and Tesla models operate completely on rechargeable battery power.
- PHEVs such as the Chevy Volt, can be charged from the grid or run on the internal combustion engine (ICE).
- PEV charging stations are classified by the rate at which the batteries are charged

EMISSIONS

- Lower life cycle (well-to-wheels) GHG emissions, especially in regions that use low-polluting energy sources for electricity generation, such as New Jersey.
- No tailpipe emissions for BEVs and PHEVs powered entirely on electricity.

FUEL ECONOMY

- Reduced fuel costs compared to conventionally fueled vehicles because of the high efficiency of electric motors.
- Shorter driving range compared to conventional fueled vehicles for some BEVs.
- Potentially long charging times for PEVs; more fueling flexibility for PHEVs.



Photo by Dennis Schroeder, NREL 26671

COST

- Lower fuel, maintenance, and operation costs.
- Although costs are dropping, high-capacity batteries are expensive, which in turn makes vehicles more expensive.

REGULATORY/OTHER BARRIERS

- Potentially long permitting and inspection processes for new charging stations.
- Lack of available public charging stations.
- Training needed for first responders.

APPLICATIONS

- Passenger vehicles for consumers and fleets.
- A wide variety of light-duty PEVs are available. A limited but growing variety of medium-, and heavy-duty vehicles are available.



PEVs use **electricity as either their sole fuel source** or, in the case of PHEVs, a **primary fuel source** in addition to the ICE. Onboard

rechargeable batteries store energy to power electric motors. Electricity can be produced from a variety of energy sources, including oil, coal, nuclear energy, hydropower, natural gas, wind energy, solar energy, and stored hydrogen. PEVs are capable of drawing electricity from off-board electrical power sources (generally the electricity grid) and storing it in batteries. New Jersey's electric generation sources are primarily natural gas (more than 50 percent) and nuclear (nearly 40 percent), making the state's power sector one of the cleanest in the country. The use of PEVs in New Jersey is particularly beneficial in terms of emission reductions. For state and national electricity source information, see the AFDC [Electricity Sources and Emissions](#) page.

PLUG-IN ELECTRIC VEHICLES (PEVs)

PEVs include PHEVs and BEVs. PHEVs are powered by both an ICE and a battery, and can be plugged-in to be charged. Their all-electric range is typically shorter than a BEV, but their total range can go up to 400 miles if the vehicle runs using the ICE. BEV ranges vary across vehicle models, with some offering a range as little as 95 miles, and others offering ranges up to 230 miles. All-electric driving ranges are increasing with advanced battery technologies becoming available.

The most common application for PEVs is passenger vehicles for consumer use, although PEVs are also used in some fleet applications, including car share programs and medium- and heavy-duty vehicles (e.g., transit buses). The number of PEVs on the roads continues to grow with a variety of new models entering the market each year, combined with the availability of state and federal incentives. For information on the current number of PEVs registered in New Jersey by county, see the NJDEP [Clean Vehicles](#) website.

Because PHEVs have ICEs, maintenance needs are similar to that of conventional vehicles. BEVs, on the other hand, require much less maintenance than conventional vehicles. Currently, there are only a handful of independent auto shops that service AFVs in New Jersey. As PEVs become increasingly more popular, PEV dealers, as well as third party repair shops, will likely begin offering

mechanics and specialized equipment that are able to repair and do maintenance.

PEV CHARGING INFRASTRUCTURE

To widely use PEVs, consumers and fleets need a **developed infrastructure of charging stations**. This infrastructure may include a combination of charging at home, charging at the workplace, and public charging. Currently in New Jersey, PEV infrastructure is clustered in the northern part of the state, though there are public and private stations throughout. PEV charging infrastructure is typically differentiated by the maximum amount of power that can be delivered to a vehicle's battery. This determines the time that it takes to fully charge. Three categories of charging stations currently dominate the market:

- ➔ **Level 1** chargers consist of a standard 110 volt (V) or 120V alternating current (AC) outlet that provides two to five miles of range per hour of charging, depending on the vehicle and other factors. Level 1 is most commonly found in garages for home charging but can be suitable for some fleet and workplace charging applications. Level 1 typically requires no additional cost or installation, provided that a power outlet on a dedicated branch circuit is available near their parking location.
- ➔ **Level 2** is a 240V or 208V AC outlet, and provides 10-20 miles of range per hour of charging. Level 2 is a popular option for public charging and can also be used at the home and workplace.
- ➔ **Direct Current (DC) fast chargers** provide 60-80 miles of range per 20 minutes of charging through different types of connectors – J1772 combo, CHAdeMO, and Tesla. The connectors for DC fast charging units are not standardized across vehicle manufacturers in the same way that Level 2 charging hardware is (via the J1772 standard). In other words, not all PEVs can use DC fast chargers, and even those that are equipped for fast charging may not have on-vehicle hardware compatible with the charging unit. Higher-powered DC fast charging technology, providing up to 20 miles of range per minute of charging, is also in development.

Natural Gas

DESCRIPTION

- The two main forms of natural gas used in transportation are compressed natural gas (CNG) and liquefied natural gas (LNG).
- Infrastructure requirements for CNG and LNG stations vary considerably.
- CNG stations require more equipment and configuration, while LNG stations require less equipment, but more safety precautions during fueling.
- There are two types of CNG stations: fast-fill and time-fill.
- The type of station needed is dependent on the application. Typically, retail stations use fast-fill and fleets that have central refueling and the ability to fill over a longer period of time use time-fill.

EMISSIONS

- Vehicles emit lower life cycle GHG emissions; natural gas made from renewable sources, such as landfill gas or food waste, significantly reduces GHG emissions.

FUEL ECONOMY

- LNG is suitable for traveling longer distances than CNG since LNG occupies only a fraction of the volume of CNG, it is more economical to transport and store.
- Bi-fuel systems, enabling vehicles to run on either natural gas or gasoline, offer fueling flexibility.
- Fuel tanks are heavier than gasoline tanks, and high-pressure storage tanks take up vehicle space.



Photo by Eric Pollard, NREL 39374

COST

- Has historically been less expensive, with less price volatility, than petroleum fuels on an energy equivalent basis.
- Vehicles are more expensive than conventional gasoline or diesel vehicles, but the cost can be offset by lifetime fuel cost savings.

REGULATORY/OTHER BARRIERS

- Infrastructure developers need to be aware of the regulatory and permitting process, including technology, design, and financing challenges.
- Limited number of publicly available fueling stations.
- Training needed for first responders.

APPLICATIONS

- Well-suited to power heavy-duty trucks and buses, and other high-mileage, centrally fueled fleets.
- While some light-duty vehicle options are available, CNG and LNG are more frequently used in medium-and heavy-duty applications.



Natural gas is a domestically produced gaseous fuel, and is **readily available through the utility infrastructure**. Whether produced via conventional or renewable methods (resulting in renewable natural gas), natural gas must be compressed or liquefied for use in vehicles. CNG is produced by compressing natural gas and storing it onboard a vehicle within fuel tanks at a pressure up to 3,600 pounds per square inch. The primary use of CNG in the region is by fleet vehicles in the medium- and heavy-duty sector. LNG is natural gas in its liquid form, produced by super-cooling the gas to turn it into a liquid. Because of LNG's relatively high production cost as well as the need to store it in expensive cryogenic tanks, the fuel's widespread use in commercial applications has been limited. Because of its greater energy density, LNG is suitable for heavy-duty trucks that require longer ranges.

Natural gas is an odorless, gaseous mixture of hydrocarbons—predominantly made up of methane (CH₄). With an extensive underground pipeline distribution system, it accounts for about 30 percent of the energy used in the United States. Although natural gas is a proven, reliable alternative fuel that has long been used to power vehicles, less than one percent is used as a transportation fuel.

NATURAL GAS VEHICLES (NGVs)

There are **three types of NGVs: dedicated, bi-fuel, and dual-fuel**. Dedicated NGVs run only on natural gas. Bi-fuel NGVs have two separate fueling systems allowing them to run on either natural gas or gasoline. An example of a light-duty bi-fuel CNG option is the Chevrolet Impala, and there are a wide variety of options available in medium- and heavy-duty applications. Finally, dual-fuel NGVs (typically only seen in heavy-duty applications) run on natural gas, but use diesel for ignition assistance. The driving range of NGVs is typically less than a comparable conventional vehicle due to the lower energy density of natural gas.

The most common applications for NGVs are in medium- and heavy-duty applications, such as public transit, school bus, and refuse fleets. For information on the current number of NGVs registered in New Jersey by county, see the NJDEP [Clean Vehicles](#) website.⁷

There are some different maintenance requirements for NGVs compared to conventional diesel vehicles.

Specifically, NGV fuel tanks should be inspected at regular intervals, according to federal requirements. In addition, it is important to know the end-of-life date of the tank so that it can be properly decommissioned at that time. On the other hand, since CNG burns much cleaner than diesel, CNG vehicles do not need to have diesel particulate filters or use diesel exhaust fluids, saving both maintenance costs and operational time.

NATURAL GAS FUELING INFRASTRUCTURE

Although New Jersey has an extensive natural gas distribution system in place, vehicle fueling infrastructure is limited. Therefore, fleets that are not near an existing station may need to install their own natural gas fueling infrastructure, or work with their local utility or with a private infrastructure provider.

There are nearly 30 CNG stations in New Jersey, the majority of which are private. There are no LNG stations available in the state. CNG stations are more prevalent in the southern part of New Jersey.



Photo by Warren Gretz, NREL 02488

⁷ The NJDEP's natural gas vehicle counts includes both NGV and propane vehicle registrations.

LPG Propane

DESCRIPTION

- Propane, or liquefied petroleum gas (LPG) is a clean-burning fossil fuel that can be used to power ICEs.
- The infrastructure needed for propane is very similar to gasoline and diesel refueling equipment.
- Propane is transported to the site via a delivery truck and put into onsite storage, traditionally above ground.

EMISSIONS

- Lower life cycle GHG and pollutant emissions than conventional fuels.

FUEL ECONOMY

- Slightly lower fuel economy, but similar driving range to conventional fueled vehicles.
- Bi-fuel systems offers fueling flexibility.

COST

- Usually less expensive than gasoline (varies seasonally).
- Vehicles are more expensive than conventional gasoline vehicles, but the cost can be offset by lifetime fuel cost savings.

REGULATORY/OTHER BARRIERS

- Lack of publicly available stations with equipment designed for fueling vehicles.
- Training needed for first responders.

APPLICATIONS

- While some passenger vehicle options are available, propane is more frequently used in fleet light-duty pickup and medium-duty applications.



Photo by Dennis Schroeder, NREL 31348

Propane has been used for decades to power light-, medium- and heavy-duty propane vehicles. A variety of propane vehicle models are available through original equipment manufacturers (OEMs) and select dealerships. Fleets and consumers also have the option of **economically, safely, and reliably converting in-use gasoline vehicles to propane operation** using qualified system retrofitters.

Propane is shipped from its point of production to bulk distribution terminals via pipeline, railroad, barge, truck, or tanker ship. Propane marketers fill trucks at the terminals and distribute propane to end users, including retail fuel sites. Several local, regional, and national propane marketers serve the NJTPA region.

PROPANE VEHICLES

There are two types of propane vehicles: dedicated and bi-fuel. Dedicated and bi-fuel propane vehicles have a similar driving range to that of conventional vehicles. Most light-duty propane vehicles are only available through conversions; however, there are a variety of medium- and heavy-duty options available. For information on the current number of propane vehicles registered in New Jersey by county, see the NJDEP [Clean Vehicles](#) website.⁸

Propane vehicles have the potential for lower maintenance costs due to the fuel's low carbon and low oil contamination characteristics, which can result in longer engine life. In addition, propane performs particularly well in cold weather.

⁸ The NJDEP's natural gas vehicle counts includes both NGV and propane vehicle registrations.



PROPANE FUELING INFRASTRUCTURE

Fuel providers and fleets can place propane dispensers alongside gasoline, diesel, or other alternative fueling infrastructure, or as a standalone system. The infrastructure needed for propane is very similar to gasoline and diesel refueling equipment. Many suppliers offer an inexpensive lease of the tank, pump, and dispensing equipment in return for a fuel supply contract. In these cases, the station owner or fleet is only responsible for the cost of equipment that cannot be removed from the site when the fuel contract expires, such as the electricity line or the concrete pad for the storage tank. This can make the upfront cost of propane infrastructure less expensive than that of other fuels.

There are approximately 20 propane stations in New Jersey, the majority of which are retail outlets.

Biodiesel

DESCRIPTION

- Biodiesel is a diesel replacement fuel produced from vegetable oils, animal fats or recycled restaurant oils. It is often available as a blend with petroleum diesel, most commonly B20 (20% biodiesel), B5 (5% biodiesel), and B2 (2% biodiesel).

EMISSIONS

- Less pollutants and life cycle GHG emissions than conventional fuels.

FUEL ECONOMY

- Slightly lower fuel economy compared to conventional fuel.

COST

- Can be more expensive than petroleum-based diesel.
- Diesel vehicles can run on biodiesel blends with little to no added cost.
- Biodiesel can be distributed at existing diesel stations, with minimal modifications.

REGULATORY/OTHER BARRIERS

- Lack of publicly available fueling stations providing blends greater than B5.

APPLICATIONS

- Can be used in most diesel engines without compromising the warranty, making this fuel accessible for all applications.



Photo by Charles Bensinger NREL 13531

Biodiesel is a **renewable, biodegradable fuel manufactured domestically from vegetable oils, animal fats, or recycled restaurant grease**. It is a cleaner-burning replacement for petroleum diesel fuel. Almost all diesel engines are capable of running on biodiesel blended with regular diesel fuel, without any engine modification. The most common biodiesel blend is B20, which is a blend of up to 20 percent biodiesel mixed with petroleum diesel. B5 (5 percent biodiesel, 95 percent diesel) is also commonly used in fleets. Diesel engines depend on the lubricity of the fuel to keep moving parts from wearing prematurely. One advantage of biodiesel is that it can improve fuel lubricity at blend levels as low as one percent.

Biodiesel should not be confused with renewable diesel, which is becoming increasingly popular. Renewable diesel is made from the same feedstocks as biodiesel, but is chemically similar to petroleum diesel.



BIODIESEL VEHICLES

Almost all conventional diesel vehicles are capable of running on biodiesel, making it suitable for all vehicle and fleet applications. However, before using biodiesel in a vehicle, it is important to check the OEM engine warranty to ensure that higher-level blends are approved for use in the engine. In addition, because biodiesel can have a cleansing effect on the vehicle's fuel system, fuel filters may need to be changed more frequently after initial use of biodiesel. Biodiesel vehicles have a similar yet slightly longer range than conventional vehicles. For information on the number of diesel vehicles on the road that have the potential to use biodiesel, see the National Renewable Energy Laboratory's (NREL) [TransAtlas](#) tool, which illustrates approximate vehicle density.

BIODIESEL FUELING INFRASTRUCTURE

Installing equipment that is compatible with biodiesel blends up to B20 is just like installing conventional diesel equipment. In general, the standard storage and handling procedures used for petroleum diesel can be used for biodiesel. The fuel should be stored in a clean, dry, dark environment. Biodiesel causes far less damage than petroleum diesel if spilled or released to the environment. It is safer than petroleum diesel because it is less combustible. Biodiesel is safe to handle, store, and transport.

Diesel fuel being sold throughout New Jersey is already blended with biodiesel up to five percent biodiesel (B5), however there are few publicly available stations in the region that offer higher blends.

Ethanol

DESCRIPTION

- Ethanol is an alcohol fuel made from plant material. E85 – an ethanol blend containing 51%-83% ethanol depending on season and geography with the remainder being gasoline – can only be used in flexible fuel vehicles (FFVs).

EMISSIONS

- Lower life cycle GHG emissions and some pollutant emissions; cellulosic ethanol, produced from non-food based feedstocks such as wood chips or crop residues, significantly reduces GHG emissions.

FUEL ECONOMY

- Lower fuel economy compared to conventional fuel; consumers have to refuel more frequently.

COST

- Can be more expensive than gasoline.
- FFVs typically cost the same as conventional gasoline vehicles.
- Ethanol can be distributed at existing gas stations, with minimal modifications.

REGULATORY/OTHER BARRIERS

- Lack of publicly available E85 fueling stations.

APPLICATIONS

- Passenger vehicles for consumers and fleets.
- E85 can only be used in FFVs, which are typically only available in light- and medium-duty applications.

Ethanol is a renewable fuel made from various plant materials (i.e., biomass). Just as biodiesel is a replacement for petroleum diesel, **ethanol can be a replacement for gasoline**. The use of ethanol is widespread, and more than 97 percent of gasoline in the United States contains some level of ethanol. The most common blend of ethanol is E10



Photo by Kwik Trip Inc., NREL 33251

(10 percent ethanol, 90 percent gasoline). Ethanol is also available as E85 – a high-level ethanol blend containing between 51 and 83 percent ethanol depending on season and geography.⁹ Due to distribution challenges, there are few publicly available stations in New Jersey that offer E85.

ETHANOL VEHICLES

While any gasoline vehicle can be fueled with low-level ethanol blends, FFVs are vehicles designed to operate on blends up to E85. FFVs have similar driving ranges and maintenance aspects to gasoline vehicles, making them a convenient AFV option. FFVs are typically used in any light- and medium-duty applications. Current estimates suggest that well over 100,000 FFVs are registered in New Jersey, with a significant portion of those vehicles registered in government fleets. For information on the number of FFVs on the road, see NREL's [TransAtlas](#) tool, which illustrates approximate vehicle density.

ETHANOL FUELING INFRASTRUCTURE

Low-level blends of E10 or less require no special fueling equipment, and they can be used in any conventional gasoline vehicle. Existing gasoline stations throughout New Jersey seamlessly dispense E10. It is also possible to accommodate blends above E10 in existing fueling equipment, however, some equipment will need to be upgraded to comply with federal code. There are very few fueling stations in New Jersey offering E85.

⁹ The federal Energy Policy Act's definition of alternative fuel only includes blends of 85% or more of alcohol with gasoline. This is currently interpreted to include the adjusted "E85" blends used in practice.

H₂ Hydrogen

DESCRIPTION

- Hydrogen can be used in fuel cells to power electric motors or burned in ICEs.
- The increased number of retail hydrogen fueling locations in select markets is supporting the initial rollout of fuel cell electric vehicles (FCEVs).
- The focus has been to add hydrogen fuel at existing gasoline stations.

EMISSIONS

- Produces no tailpipe emissions and fewer life cycle GHG emissions than conventional fuels.

FUEL ECONOMY

- Fuel economy, range and fueling time are similar to conventional fueled vehicles.

COST

- Production and fueling infrastructure costs are high.
- More expensive than conventional vehicles.

REGULATORY/OTHER BARRIERS

- A network of hydrogen fueling station is just beginning to be built in the Northeast.
- Training needed for first responders.

APPLICATIONS

- Beginning to enter the market as a fuel for passenger vehicles, however FCEV availability is very limited. Medium- and heavy-duty options are not yet commercially available.



Photo by Dennis Schroeder NREL 39802

Hydrogen can be used in a fuel cell to produce electricity, making it an **emissions-free alternative fuel produced from diverse energy sources**. The interest in hydrogen as an alternative transportation fuel stems from its ability to power FCEVs with no emissions, its potential for domestic production, its fast filling time, and the fuel cell's high efficiency.

HYDROGEN FUEL CELL VEHICLES

Vehicle manufacturers are just beginning to offer FCEVs to consumers in the northeastern United States. FCEVs use energy stored as hydrogen converted to electricity by the fuel cell. FCEVs can be used in consumer applications, as well as in heavy-duty applications such as trucking. At this time, there are no FCEVs registered in New Jersey, although several vehicle manufacturers, including Toyota, Honda, and Hyundai, have plans to introduce them into the local market over the next few years.

HYDROGEN FUELING INFRASTRUCTURE

The availability of stations providing reasonably priced hydrogen in places where vehicles will be deployed remains a key challenge to the adoption of this technology. Most retail hydrogen facilities in California, as well as those being developed in the Northeast, consist of an added hydrogen dispenser at an existing gasoline station. As part of a planned network of hydrogen fueling stations across the Northeast, two hydrogen fueling stations are under development in New Jersey (as of late 2017), one in Lodi and one in Whippany.

What Does it Take to Become AFV Ready?



Photo by Matthew Staver, NREL 39254

What Does it Take to Become AFV Ready?

The first step for a municipality to become AFV ready is to engage decision makers and stakeholders to identify common goals and the actions necessary to achieve them. Evaluation and analysis of the various alternative fuels and AFV technologies is also critical at every stage of the planning process. By evaluating the community's unique needs and opportunities, a municipality can create a custom-tailored approach.

Establish a Stakeholder Committee or Working Group



Stakeholder engagement is an important part of the planning process and **critical to successful AFV deployment**. Additionally, keeping stakeholders involved throughout the process will increase the likelihood that the community accepts and implements recommendations to promote AFVs.

Forming a stakeholder steering committee, advisory committee, or working group is one way to ensure that diverse perspectives are included early and often in the readiness planning process. **A stakeholder is anyone who is interested in or impacted by AFV deployment and infrastructure.** Since each community has a unique set of stakeholders, it will be important for the municipality to discuss which stakeholders to include and what perspective those individuals and organizations bring to the planning process.

The list below shows examples of stakeholders that might be included in such a committee.

- Local government officials, including elected officials
- Local fleet managers, including the municipal fleet managers
- Community organizations
- Higher education institutions, such as colleges and universities

Key Recommendation

Identify a set of diverse stakeholders and form a committee. Meet with the stakeholders as early as possible, and continue working with them regularly throughout the planning process.



- Local businesses, including business improvement districts (BIDs)
- Utilities and fuel providers
- Other transportation organizations, including non-profits, TMAs, and MPOs
- Citizens, including representatives from multi-family housing boards

The stakeholder committee should meet regularly to review alternative fuel readiness goals, discuss potential challenges, propose solutions, and agree on next steps. A municipality may decide, for example, to have committee members review next steps and upcoming readiness activities throughout the process of creating and implementing the readiness plan so that they can provide input. However, since AFVs may be a new topic to some, at the outset of the committee's existence, consider having one educational meeting to ensure everyone understands the current technologies and fuels. TMAs and MPOs can help educate stakeholders with speakers and presentations. Spending this time early can help focus later meetings on gathering input and moving things forward, rather than explaining the basics.

Tips for Engaging the Stakeholder Group



The frequency of meetings depends on a community's own timeline and needs. Some successful projects have scheduled regular (e.g., quarterly) stakeholder meetings, but a community may choose to hold meetings more frequently, especially in the beginning of the readiness planning process, or according to project milestones.



It can be beneficial to have one municipal point of contact to coordinate the committee's activities. This reduces potential confusion and streamlines the logistics of scheduling meetings, which can be especially challenging with large stakeholder groups

Set Goals and Integrate into Municipal Master Plans

AFV READINESS PLANNING PROCESS



Goal setting provides **direction, inspiration, and purpose** for the team. When a team shares a clear set of mutually agreed upon goals, individuals can collaborate and compromise as they work towards a common objective. When obstacles arise, having a well-defined goal in mind allows for effective problem solving. Setting measurable goals also enhances accountability, as goals provide milestones to gauge the team's progress. In general, it's best to select three to five goals to guide readiness planning efforts.

Goals can range in scope and complexity. The focus areas may include climate change, access and awareness, increasing resilience, decreasing air and water pollution, municipal logistics, community engagement, and fleet use. The focus of each goal may overlap with other initiatives or organizations in the municipality.

Coordinating AFV readiness with other municipal activities may allow access to a **broader array of funding opportunities**, and will help strengthen the case for allocating funding towards AFV readiness. For example, a municipality may be working to reduce GHG emissions by 25 percent from current levels in the next 10 years. Demonstrating the emissions reduction benefit of AFV readiness to municipal leaders may help foster stronger support for implementation, and even generate additional funding options. Similarly, goals identified during the readiness planning process should inform future updates to Master Plans and other municipal planning documents. By aligning AFV readiness goals with the municipal emissions reduction goal or other goals, both efforts benefit from mutual support and focused coordination.

Communities do not exist in isolation – it is critical to align readiness goals and efforts with other municipal objectives, and potentially with the objectives of neighboring municipalities. Keeping apprised of regional transportation planning initiatives or neighboring community efforts can also accelerate readiness planning efforts. Joining forces with other entities makes it easier

Key Recommendation

Set goals and integrate AFV planning into other municipal planning documents, including Master Plans.



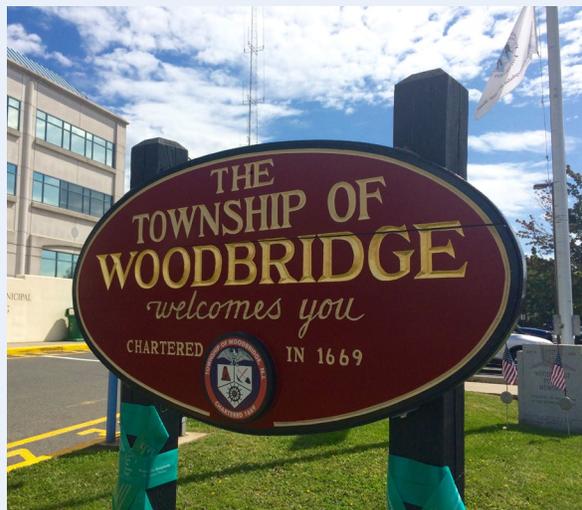
to share resources and achieve goals more efficiently. For example, an existing municipal goal may be to improve public health by reducing air pollution due to ongoing high levels of pollutants commonly associated with vehicle emissions. Demonstrating how AFV readiness actions would contribute to local and regional pollution reduction goals can help the plan gain traction with regional decision makers. A community may be able to

CASE STUDY: Woodbridge Township, New Jersey

Sustainable Community Plan and Climate Action Plan, Township of Woodbridge, New Jersey (2010)

This plan addresses a diverse and comprehensive range of energy conservation and climate change topics. It includes targeted recommendations to:

- Retrofit existing vehicles or purchase new vehicles for the municipal vehicle fleet so that 25% will utilize alternative fuels or be flex fuel capable by 2015.
- “Identify and support pilot alternative fuel, car-sharing, and electric vehicle projects for businesses and residents, to encourage actions that can reduce the global warming impact of transportation.”



leverage untapped resources and funding opportunities, and may even be able to team up with other municipalities planning for AFV readiness to share ideas and best practices.

To start, review plans of entities in the region (see box above for an example plan from Woodbridge Township), as well as goals of other groups within the municipality. List the areas where priorities overlap, and consider reaching out for an initial meeting to discuss collaboration.

Revisit Goals and Track Success Over Time



Planning should be a **dynamic process**, so if evaluation shows that something is not working, the team can change its approach and get back on track. The stakeholder group should routinely review goals, track progress towards meeting them, and update the goals and plans, as needed. Goals may also need to be reevaluated after the new information comes to light, such as from the market assessment process.

Understand Existing Conditions and Opportunities

AFV READINESS PLANNING PROCESS



Successful readiness planning involves characterizing the current AFV demand, identifying existing infrastructure, projecting future AFV demand, and evaluating the current regulatory environment. It is also critical for the municipality to have a **strong grasp of both the barriers to and opportunities** for increased AFV infrastructure deployment and alternative fuel use, as these form the basis of readiness plan implementation recommendations.

GATHER DATA

Vehicle and Infrastructure Statistics

Early in the readiness planning process, a municipality should document the number of AFVs registered in the municipality and the number of AFV fueling stations installed. As the planning and implementation

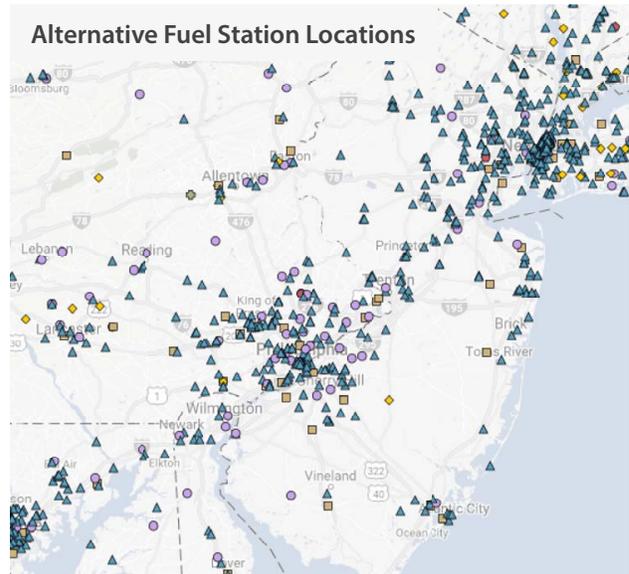
processes move forward, the municipality and stakeholders can measure progress against this baseline. These data points are also important to the analysis and forecasting explained later.

The NJDEP maintains AFV registration data for New Jersey, coordinating with the New Jersey Motor Vehicle Commission (NJMVC) to provide updated statistics twice a year (January and July). A municipality may request a spreadsheet containing data by sending an email to drivegreen@dep.nj.gov, using the subject line "Vehicle Registration Data Request." Other sources, such as IHS Markit (R.L. Polk & Co.), provide data for a fee.

For infrastructure data, refer to the AFDC [Alternative Fueling Station Locator](#). Note that this database does not include residential fueling and charging stations, including those at MUDs unless they are available to the public. Planned stations are included, to the extent those plans are known.

Regulatory

A primary goal of the readiness planning process is to identify regulatory barriers that may be preventing or slowing the use of AFVs and infrastructure. Some



Source: AFDC Alternative Fueling Station Locator (www.afdc.energy.gov/locator/stations/)

jurisdictions may have set regulations long ago that are now outdated or inaccurate but could still be enforced. These and other barriers can be uncovered through a review of regulations and other policies currently in place or under development.

The municipality should undertake a review of the following regulatory information to identify policies that relate, or could be interpreted to relate to AFVs, fueling infrastructure, and alternative fuels:

- ➔ Local community plans
- ➔ Zoning and parking codes
- ➔ Permitting and inspection processes and requirements
- ➔ Building codes

As part of the regulatory review process, the municipality and its stakeholders should gain an understanding of the roles and responsibilities at the local level, including departments and councils that would play a role in implementing recommended actions. It is also helpful to take a look at existing incentives and funding sources that exist at the federal, state, and local levels and would apply to AFVs and fueling infrastructure. The AFDC [Laws and Incentives](#) website is a comprehensive resource for information about relevant funding sources and incentive programs.

CONDUCT ASSESSMENTS, ANALYSES, AND FORECASTS

In order to plan for infrastructure and other needs, the municipality ideally should understand who is purchasing (and will purchase) AFVs, the current market status, the projected growth, and demand for infrastructure, as well as conduct analyses to help determine the best locations for AFV infrastructure. However, municipalities should not be deterred from initiating AFV infrastructure plans because of lack of data or analysis expertise.

A variety of approaches are available to assess the current AFV population and forecast demand. Market assessments will be much different for vehicle and fuel types geared towards the consumer market (PEVs), versus most applicable to fleets (all AFV types). The information that follows is broken down into those two categories.

One of the central challenges with AFV deployment is the accessibility of adequate fueling infrastructure to support the vehicles. A municipality may find an infrastructure demand analysis beneficial to determine where to focus new infrastructure. The goal of a demand analysis is to help guide and coordinate future infrastructure development efforts based on anticipated or projected demand. The municipality's role in analyzing infrastructure demand is most relevant for PEVs and charging infrastructure, as it serves residents, visitors, and others in the community. While the same approach could be applied to all alternative fuel types, most other fuels are best suited for fleet use and a fleet will determine if and where they install infrastructure.

Consumer Market: PEVs

Market assessments help a municipality understand the existing demand for PEVs and inform future demand for charging infrastructure. PEV demand and charging needs are closely related. Data on the type of PEVs that are on the road, as well as where they are registered, can help characterize the demand for charging infrastructure at different levels (including Level 2 and DC fast charging) and different applications (such as public charging). For instance, a market that is dominated by BEVs is likely to need more DC fast charging than a market that is dominated by PHEVs because BEV charging demands will likely be higher as a result of the larger batteries.

Vehicle Demand

The NJDEP [Clean Vehicles](#) website includes a map illustrating the distribution of PEVs throughout the state. The NJDEP will provide PEV and other vehicle data upon

One of the central challenges with AFV deployment is the accessibility of adequate fueling infrastructure to support the vehicles.



Photo by Thomas Kelsey, NREL 37699

request. This data can be helpful for benchmarking the percentage of PEVs compared to all light-duty vehicles, developing a profile of PEV types in the area (BEVs and PHEVs) to better understand trends and charging infrastructure needs, and tracking progress towards PEV adoption goals. A municipality can work with the MPO to analyze available data, produce maps, and conduct additional analyses.

Market outlooks, such as those produced by the U.S. Energy Information Administration and many firms, provide insight into potential future consumer use of PEVs within a specified region and planning timeframe. These forecasts are meant to be used as a general guide in the planning process to help shape and define regional PEV usage goals. There are a variety of ways to develop market outlooks. [Appendix B](#) provides a summary of the steps,

data sets, and assumptions that were used to develop PEV forecasts for the three pilot municipalities as part of the NJTPA study. They can be applied and adapted by other municipalities in New Jersey, particularly with assistance from the MPO.

Infrastructure Demand

A charging infrastructure analysis helps to broadly identify the areas within a municipality that are most likely to see a demand for PEV charging infrastructure. It is an analytical exercise that looks at key factors that closely correlate with PEV ownership – income, hybrid electric vehicle (HEV) ownership, home ownership, and dwelling type – and regional travel patterns. It complements vehicle forecasting and introduces an important geographic component that can guide municipal policy and investments to meet the increased demand for charging infrastructure. The results can be used to highlight areas where charger deployment can be the most cost effective,

as chargers located in an area where PEV drivers are most likely to travel will be utilized more.

A detailed summary of the data needs, methodology, and assumptions of the infrastructure demand analyses conducted for the pilot municipalities under the NJTPA study is included in [Appendix C](#). Other municipalities can work with the MPO to conduct the analyses and illustrate the results.

It is important to note that an infrastructure demand analysis is not intended to exclude certain areas from potential charging installations. Municipalities should consider the results as a useful guide to coordinating and prioritizing investments in charging infrastructure at a high level.

Charging infrastructure considerations for PEVs used in fleets are typically very specific to the organization and how the vehicles will be used.



Photo by Matthew Staver, NREL 39213

For the consumer market, there are **four primary types** of charging demand to consider:



Residential

Residential areas will likely experience high demand for charging as the number of PEVs in the area continues to increase. Since residential charging takes place at home, these are locations in which likely PEV owners live. Currently, the average PEV driver charges at home about 70-90 percent of the time. Most residential charging today occurs at Level 1, as it typically does not require any additional investment on the part of the PEV owner. Level 2 charging is more common at residences for BEVs compared to PHEVs, especially those vehicles with larger batteries and therefore longer all-electric ranges. The results of a residential charging demand analysis are most useful to local utilities to understand clustering and potential grid impacts of residential charging.



Multi-Unit Dwellings (MUDs)

Highlights areas in the region that will likely experience high demand for residential charging and have high incidence of multi-family units. Like residential charging, MUD charging is expected to be a combination of Level 1 and Level 2 charging. The market for MUD charging is in very early stages, and the most appropriate level of charging for this application is likely to evolve as the market advances. The MUD charging demand analysis can help municipalities identify MUD buildings and property owners for targeted outreach and education about installing charging infrastructure. It can also be useful for utilities to understand potential grid impacts.



Workplace

Highlights areas that will likely experience high demand for workplace charging, particularly areas where likely PEV owners work and vehicles are parked for several hours during the day. Level 1 and Level 2 charging are suitable for workplace charging; ultimately, the appropriate level of charging is something that should be determined based on facilities management, funding, and demand considerations. The workplace charging demand analysis can help municipalities identify workplaces located in the high charging demand areas, which are priority targets for employer education, outreach, and planning. The results can also help employers understand what level or amount of charging infrastructure may be needed to meet the future likely workplace charging demand.



Public

Highlights areas that will likely experience high demand for public charging (i.e., other non-home or non-work charging), including areas where likely PEV owners shop, dine, and travel for recreational activities. Level 1, Level 2, and DC fast charging are all options for public charging, with dwell times (i.e., how long are drivers likely to be parked) and local site conditions (e.g., accessibility to sufficient electrical power) the most important factors determining which strategy is appropriate. The public charging demand analysis is most relevant to municipalities for determining the need for direct investment in charging infrastructure. Municipalities can use the analysis to help prioritize potential charging station locations. The public charging analysis can also assist with longer-term PEV planning and policies. For example, if demand for public charging is higher in potential redevelopment zones, the municipality may want to include requirements for charging infrastructure or pre-wiring within those zones. Finally, it can be used to identify businesses that would likely benefit most from taking on the role of site host and providing public charging infrastructure.

Once it is known where PEV demand is likely to be located within a municipality and how PEV owners are likely to charge (e.g., at home, at work, at shopping locations), the next step is to identify areas that can physically support charging infrastructure. Municipalities may wish to conduct a land use and zoning analysis to identify properties where PEV charging infrastructure is likely to be needed.

Fleet Market (All AFVs)

Government and commercial operations have different approaches to incorporating AFVs into their fleets, and the approach to market assessment should reflect those differences. The key steps for municipalities to understand the fleet market include:

1. Identify fleets in the region

AFV registration data is available via the NJDEP, following the steps noted above. Data will differentiate between fleet and commercial vehicles but will not call out the fleet or operator. It may be necessary to conduct outreach to fleets operating in and around the municipality to understand whether they are using alternative fuels or could be candidates for AFV use in the future. It is straightforward to identify government or municipal fleets; simply reach out to various government entities operating

within the municipality and speak with the fleet or department manager to develop a list of fleets. Identifying commercial fleets can be more challenging. Municipalities may consider reaching out to local business groups such as the chamber of commerce to determine if they have access to some key fleets in the region.

2. Interview fleet managers

Short, semi-structured interviews with fleet managers can be useful to identify the key considerations being incorporated into AFV deployment, as well as barriers encountered. Topics of discussion may include vehicle maintenance, access to fueling infrastructure, driver operations, and fleet procurement plans and policies.

3. Support fleet analyses

A fleet interested in increasing their use of AFVs may want to pursue a comprehensive analysis or outlook using more granular detail on factors including fleet composition (e.g., vehicle make, model, and year), vehicle use (e.g., miles traveled, trip lengths, trip types, trip frequency), and fuel consumption. These types of variables can be incorporated into a total cost of ownership calculator or life cycle cost tool. The municipality can assist fleets by providing links to useful tools, and by facilitating connections with other fleets and relevant organizations.



Photo by Robert Prohaska, NREL 36841

Identify Gaps and Understand Barriers

AFV READINESS PLANNING PROCESS



A community may encounter gaps and deficiencies in available resources and information. Taking a **proactive approach** to addressing these challenges and gaps will facilitate AFV readiness. A “gap” is any lack of resources or information that hinders progress towards achieving a goal or completing a task efficiently. For example, the municipality may want to know to what extent existing PEV chargers are already being used, but may not be able to access that information. This gap can be addressed by conducting outreach to site hosts to ask for any usage data or estimates they are able to share. If achieving certain goals relies on specific information or contacts, the municipality and stakeholders should work to gather as much relevant information and insight as possible.

It may be valuable to start by meeting with the municipal team to determine what information exists and what is lacking. By going through each goal one by one, the team can uncover gaps and strategize about ways to address them. Certain gaps may be straightforward to remedy, while others can only be addressed by other parties, such as state-level government.

Key Recommendation

Work with stakeholders to identify gaps and barriers.

One strategy that can shed light on barriers from the public’s perspective is to conduct a survey of the broader community. The survey could be as simple as a booth at a community event asking for input, or it could be an online survey of residents and businesses. For example, planners in Vermont administered a survey of stakeholders and consumers, which pinpointed PEV-related barriers perceived by the community.¹⁰ These included vehicle

¹⁰ Vermont Energy Investment Corporation, A Survey of Electric Vehicle Awareness & Preferences in Vermont, <https://www.veic.org/documents/default-source/resources/reports/veic-a-survey-of-electric-vehicle-awareness-and-preferences-in-vermont.pdf?sfvrsn=2>, September 2014.

range and cost, as well as concerns about vehicle reliability in harsh terrain and winter weather conditions. Using the results of a survey like this one, planners can better target their actions and message as they proceed with the readiness planning and implementation process.

Reaching out to and working with stakeholders is one way to address gaps in resources or information, as outlined in the Establish a Stakeholder Committee or Working Group section. It may be necessary to reach beyond the stakeholder committee to reach others with relevant experience and perspective. For example, speaking with local car dealerships can provide information about the local interest in PEVs.

The NJTPA study pilot municipalities identified a number of key barriers to AFV infrastructure expansion (see box below), which are important to understand as part of the readiness planning process.

The following sections do not cover all possible barriers, but provide a more in-depth look at some of the challenges municipalities should be aware of.

Key Recommendation

Gain a basic understanding of key challenges related to AFV readiness

Key Barriers to PEV Adoption

- ➔ Current vehicle cost
- ➔ Charging station build-out and range anxiety
- ➔ Consumer awareness
- ➔ Enabling charging at MUDs
- ➔ Establishing workplace charging programs
- ➔ Business case for charging station site hosts

Key Barriers to AFV Adoption

- ➔ Higher fuel costs (for some)
- ➔ Up-front vehicle cost, lack of incentives
- ➔ Economic viability of stations



Photo by Dennis Schroeder, NREL 26685

ENABLE CHARGING AT MULTI-UNIT DWELLINGS (MUDs)

MUDs, including townhomes, are a commonly identified gap in the PEV charging market. This area continues to be one of the most challenging because of the varying dynamics between and among vehicle owner, property owner, homeowners association (HOA) in many cases, parking accessibility, electricity demand and load considerations at the facility, and long-term management of the charging equipment. PEV charging station installations in MUDs will vary depending on the building architecture, physical design, parking structures, and parking policies. There are several approaches based on case studies, however, each application is case-specific and therefore, each method should be carefully evaluated before implementation.

In **garden-style apartments and low-rise condominiums**, the biggest problem is the location of the electrical room, which may be far from the charging locations. Major excavations result in increased installation cost. One option is to install the chargers near the electrical room and designating them as a community resource for residents to share rather than installing individual charger across the property. Some issues with this option are establishing guidelines for using the chargers such as how long a resident can charge and the potential to interfere with the community's established assigned parking spaces.

For **mid- and high-rise apartments and condominiums** with parking garages, a common issue is the electrical capacity in the parking structures. Because parking lots were only designed to accommodate low electrical capacity to support lighting, elevators, and other miscellaneous loads, a costly electrical upgrade may be required depending on the current capacity, desired number of chargers, and the type of chargers. Low-cost surface-mounted conduits for circuit wirings may be an option since visual aesthetics are not a major concern in parking structures. This usually involves coordination with a local utility and electrical contractors. A Level 1 charger installation is an option to avoid electrical service upgrade, though it would taking more time to fully charge a vehicle.

In some cases, a **third-party vendor** that provides charging equipment, installations, operations, and maintenance has proven to be cost-effective and successful. Contracts can also involve a subscription-based program in which residents are directly billed for their usage with no interactions required by the property owner or the building management, eliminating any potential administrative burden.

Though these are important issues for property managers, it is not necessarily a barrier that local governments can address through zoning and parking ordinances. The most important role a municipality can play related to MUDs is to provide outreach and education to HOAs, developers, and building owners. For example, the municipality may

share sample HOA resolutions to encourage an MUD to consider factors such as liability and cost. The municipality may also explore options for charging in public parking areas near the development. This could include making certain municipally-controlled parking lots available during off-peak hours to permitted PEV drivers living in MUDs.

Conversations with MUD management companies suggest there is limited demand for PEV charging at older, established buildings. Over the near term, future demand for charging infrastructure at MUDs will be driven by new developments and significantly renovated buildings that may draw higher income tenants, as PEV charging may be an attractive amenity to future tenants. The construction phase is also the point in time when charging infrastructure installation costs are less. Recommendations for targeting education and outreach specific to MUDs are included later in the guidebook.

ESTABLISH A WORKPLACE CHARGING PROGRAM

While there is not a one-size-fits-all solution for workplace charging, there are several factors any employer should consider related to providing PEV charging at the workplace.

These include the following:

Assess demand

Employers considering whether workplace charging is right for their organization will want to start by assessing employee demand with an employee survey. The Businesses and Employers section below includes information on the types of workplaces that may benefit most from an employee-focused PEV charging program. Once this assessment is complete, employers may set goals for meeting workplace charging demand, either by planning to meet the entire need (i.e., all drivers that have expressed or will express interest in PEV charging) or by dedicating a percentage of parking spaces to PEV charging. For example, Google has a goal to dedicate 5 percent of all parking spaces to workplace charging.

Procure and install

Employers should determine what types of charging stations to purchase. There are a few decisions to make, including charging level (i.e., Level 1, Level 2), and whether or not the stations are networked. Employers should also be sure to get quotes from a number of charging station providers. Businesses will work with their electrical contractor to determine charging station placement; station installation can be an expensive process, but employers can minimize costs by siting stations in locations that require minimal trenching, boring, and electrical panel upgrades.

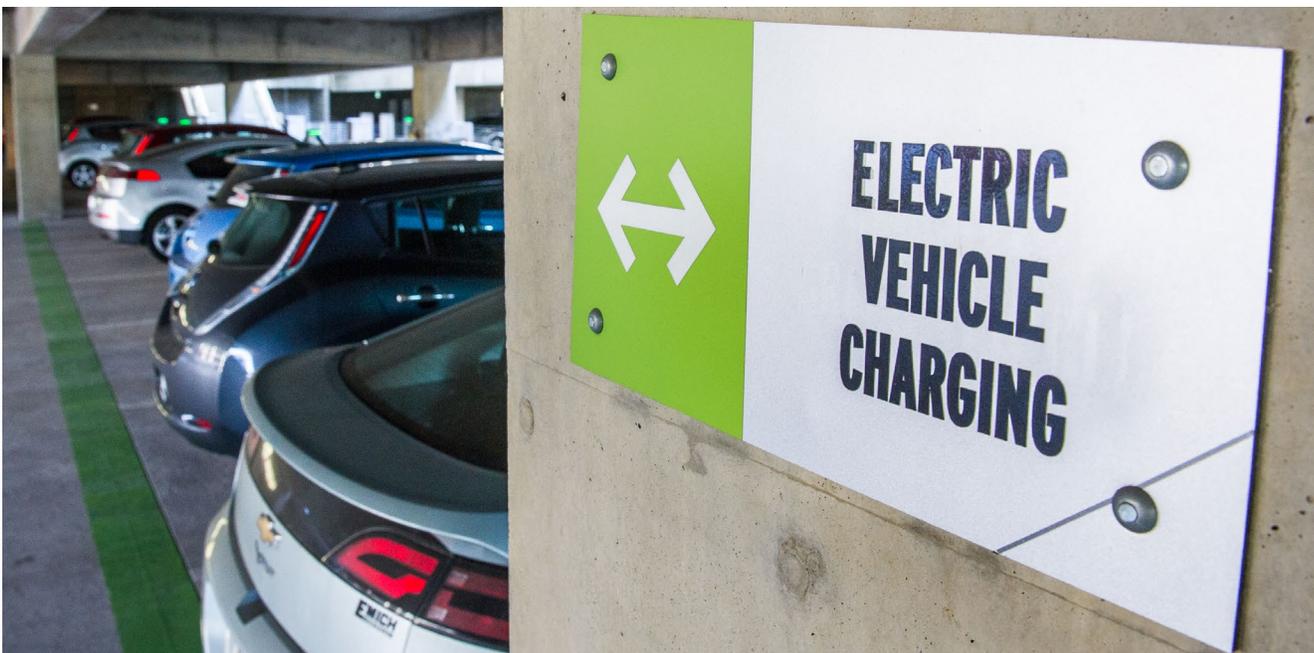


Photo by Dennis Schroeder, NREL 26765



Photo by Dennis Schroeder, NREL 32860

Manage

A well-managed, well-planned workplace charging program can ensure station access to all employees, promote strong communication between employers and station users, and encourage responsible station use. Employers will need to consider issues such as registration and liability, station sharing, and pricing. For consistency, workplaces may consider aligning with municipal zoning requirements related to the amount of time a vehicle can park in a certain space (see the Zoning Ordinance section below). In addition, it is important to differentiate between spaces set aside for employees versus patrons at a commercial destination.

Resources specific to these considerations and other aspects of workplace charging are available on the [AFDC Workplace Charging for PEVs](#) website.

DETERMINE THE BUSINESS CASE AND OWNERSHIP MODEL FOR A FUELING STATION

The economics of AFV fueling infrastructure depend on a variety of factors and vary between fuel types. In most cases, the economic viability of fueling stations includes factors such as land and station equipment costs, operational and maintenance costs, fuel prices, station throughput and design, and other related revenue streams (e.g., advertising).

There are numerous ownership models for AFV fueling infrastructure, which differ based on fuel type.

Infrastructure may be owned by a fuel retailer (e.g., a conventional fuel retail chain), public or private fleet, fuel provider (e.g., utility), or infrastructure provider. The owner of the equipment may or may not be the operator. For example, PEV charging infrastructure ownership can be retained by the station provider or transferred to the site host or another third party. The traditional sale method would make the host, whether residential or commercial, the owner and operator of the charging equipment and responsible for the operation and maintenance of the equipment. Under some contracts, the charging station provider may retain ownership of the charging equipment and provide compensation to the host for the use of the site. The charging station provider then may be responsible for the maintenance and operation of the equipment.

Some charging infrastructure business models provide charging at no cost to the driver. Access fees may be collected through subscriptions or pay per use programs. These fees generate revenue and will likely be collected at most publicly available charging sites. The revenue may be shared between the charging station provider and the charging site host, based upon the negotiated terms. This method encourages the host to maximize the utilization of the equipment. Other contracts may provide a fixed rate to the host, and are typically designed to compensate for the host's costs associated with hosting the charging infrastructure, including rent for the parking space. The balance of any revenue then would be retained by the charging station provider.

Natural gas station ownership, on the other hand, can fall into three different categories: fleet (or other end-user), local distribution company (e.g., utility), or third-party ownership. According to NGV America, the national industry association dedicated to growing the NGV market, the key variables to consider include the station owner, the speed of delivery (e.g., fast-fill, time-fill), the party responsible for station maintenance, the station accessibility (i.e., public or private), the funding mechanism for infrastructure development, and the means by which payment will be collected (e.g., pay-at-the-pump, negotiated fuel contracts). Ownership models may be based on a hybrid model. For example, the utility may own the compressor, storage, and dispensing equipment, and a third party owns the land, payment card reader, and retail transaction equipment. In addition, one entity may own the station, while another operates it.

PEV Charging Service Providers

PEV charging service providers can offer a variety of services, including procurement, installation, management, ownership, and network services. Some common providers include (in alphabetical order):

- CarCharging/BLINK
- ChargePoint
- eVgo
- Greenlots
- SemaConnect
- Tesla



Photo by Matthew Staver, NREL 39207

Assess PEV Charging Fees

Owners of PEV charging spaces may contract with PEV charging service providers or third-party operators who install, operate, and set the fees on charging equipment (see box). However, when owners do have the ability to set fees—either explicitly or implicitly through their choice of operator—they face conflicting goals. Owners often need to recoup the costs of installing, maintaining, operating chargers. They may also wish to price charging in order to encourage turnover so chargers are available to those who need them most, increasing the price after a certain time period to encourage drivers to unplug and move on once the vehicles are fully charged. Both of these considerations may push operators toward charging higher fees. On the other hand, pricing charging so that driving a PEV is cheaper on a per-mile basis than a gasoline-powered vehicle creates an incentive for people to purchase PEVs or charge PHEVs so that they use more electricity and less gasoline.

When access fees are assessed, they may be set on a fixed fee, a fixed rate or a pay per energy consumed basis.

A **fixed fee** would mean that each charging session has a set cost. It would not matter how long the connection is made or how much energy is charged into the battery, since the set fee is charged. The fixed fee may be applicable for an employer in a workplace setting or when charging is provided as part of a parking lot fee. In these

situations, the car is typically parked for a significant period of time.

A **fixed rate fee** may be charged if high utilization and turnover of vehicles is desired. Fees may be charged per hour or other intervals for Level 2 charging and a per minute basis for DC fast charging. It would be desirable for the PEV driver to be aware of the time the vehicle is charging to maximize the charge with the convenience of gaining range. In certain situations, the fee could change to discourage unnecessarily long dwell times in that space. For example, one rate could apply at a Level 2 charger for the first few hours, then a higher rate after that time period. Alternatively, a higher rate could be charged during busier daytime hours and a lower rate during off-peak hours.

A **pay per energy consumed** basis would require measuring the energy delivered and charging a rate based upon the amount of electricity consumed.

Membership or subscription programs may offer the same type of services. A fixed rate may be charged to the driver on a monthly basis for an unlimited number of connects or time connected at publicly available charging infrastructure. Discounts on the fixed rate may be provided by the membership program. In most cases, a pay per use is generally available although restrictions may apply based upon the membership program.

Develop Recommended Actions



Once a stakeholder committee is established, and goals and key barriers have been identified, the team can begin developing recommended actions for increasing municipal readiness. The following sections are divided into areas of focus that can serve as a guide for AFV readiness planning. Within each area of focus are one or more associated recommendations of best practices. Some recommended actions are more appropriate for or applicable to specific AFVs and fueling infrastructure, so icons are used throughout this section to easily align recommendations and topics with fuel types.



While addressing each action identified in this section is preferable, municipalities can prioritize using the methods outlined in this guidebook in order to identify and address the most pressing issues, as well as those that can be undertaken quickly, first.

When developing recommendations for a readiness plan, the municipality should

address each of the following questions:

- ➔ What needs to be done in terms of community awareness and outreach?
- ➔ How will different elements of the project be funded? What are the various funding opportunities available and how can they be leveraged?
- ➔ What is the overarching timeframe intended for this process?
- ➔ What can be started now? What steps are dependent on previous steps?
- ➔ Who should be responsible for each step?
- ➔ How will progress be measured?
- ➔ How will the team be held accountable for their responsibilities?

Municipalities should consider an overall implementation time horizon of about 10 years. Each recommended action can be categorized as ongoing, to be implemented in the near-term (e.g., 1-2 years), medium-term (e.g., 3-5 years), or long-term (e.g., 6-10 years). These timeframes may be determined based on a realistic assessment of how long

it will take to complete an action, or set based on the target completion date to along with a community goal. A municipality may also choose to group actions in terms of priority (high and low).

Regardless of what approach is taken, the municipality should work closely with the stakeholder committee to develop an action plan. Keep in mind that goal setting and action planning can be an iterative process. Perhaps the group discovers that some of the “high priority” actions do not align well with goals, or maybe there is a goal for which the team did not identify any concrete actions. Allow for flexibility by creating a new goal to capture desired actions, or reprioritizing a recommended action as needed.

Working with the pilot municipalities, the NJTPA found it useful to align recommended actions with the infrastructure type, particularly for PEVs. Groupings were differentiated by answering the question, who will use this infrastructure? As a result, recommendations may be distinguished by their connection to residential, MUD, workplace, public, and fleet fueling. The recommendations can also be aligned with planning areas — general plans and policies, building codes, zoning and parking codes, permitting and inspection, and fleet planning.

The most effective plans will detail specific actions and assign responsible parties to each action. That lead organization may be an entire municipal department, an organization (e.g., the TMA), or a specific stakeholder. Assigning responsibility helps keep team members accountable for making progress towards completing the action.

The following table summarizes some of the key recommendations for each focus area. Additional detail on each of areas, as well as the key recommendations, can be found in the subsequent sections.

FOCUS AREA	KEY RECOMMENDATIONS
Policy Measures: Zoning and Parking	Establish clear definitions for AFV fueling and PEV charging infrastructure.
	Amend zoning codes to include PEV charging as a permitted accessory use and to include requirements or incentives for pre-wiring (for PEV charging) or installation of fueling infrastructure.
	Amend parking codes to include restrictions, enforcement policies, and fees for municipally-controlled PEV charging stations.
Policy Measures: Permitting and Inspection	Streamline AFV infrastructure permitting and inspection procedures.
	Produce guidance documents clearly outlining AFV infrastructure permitting requirements and steps.
Policy Measures: Municipal Fleet	Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities to incorporate AFVs.
Key Stakeholder Engagement	Engage in cross-jurisdictional opportunities for sharing lessons learned.
	Partner with utilities to share information, enhance market participation, and gauge impacts.
Targeted Education and Outreach	Reach out, engage, and educate relevant stakeholders.
	Identify AFV grants and other funding opportunities for fueling infrastructure development.

ZONING AND PARKING

Local governments have an important role to play in the development of public and private AFV fueling infrastructure due to their regulatory authority over zoning and parking. Through zoning codes, design standards, and parking requirements, the municipality has the opportunity to ensure both that there is sufficient infrastructure to meet projected AFV demand and that AFV fueling stations and parking spaces are effectively designed and regulated. The municipality can also use its regulatory and approval authority to ensure new development projects have ample PEV charging opportunities. There is no one right way forward, but taking action now sets a precedent that municipalities can expand upon as AFV infrastructure demand increases or development patterns shift.

Sustainable Jersey Resources

Consistency and **standardization** across municipalities for zoning codes and parking regulations will reduce confusion for municipal staff and consumers. New Jersey municipalities engaged with the Sustainable Jersey program are already exposed to many of these best practices. For instance, to earn points for the Make Your Town Electric Vehicle Friendly action, municipalities must update zoning and parking policies to encourage PEV deployment. Municipalities can choose from a list of other activities, including pre-wiring ordinances.

Zoning and Parking	Permitting and Inspection	Municipal Fleet	Key Stakeholder Engagement	Targeted Education and Outreach
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Key Recommendation

Definitions and Infrastructure Design Criteria

Establish clear definitions for AFV fueling and PEV charging infrastructure.

Definitions

The first step in drafting ordinances and updating the zoning code is to establish standard definitions for alternative fuels, AFVs, and related infrastructure. Without a clear definition, developers, PEV owners, and others might hesitate to install charging infrastructure. While there are no definitions for AFVs in the New Jersey Municipal Land Use Law, municipalities can look to other states and local governments for examples. Illinois provides the following definitions within the State Vehicle Code:¹¹

- ➔ “Electric vehicle” means a battery-powered electric vehicle operated solely by electricity or a plug-in hybrid electric vehicle that operates on electricity and gasoline and has a battery that can be recharged from an external source.
- ➔ “Electric vehicle charging station” means any facility or equipment that is used to charge a battery or other energy storage device of an electric vehicle.

The City of Seattle provides the following definitions, which are relevant to PEV parking spaces and enforcement policies:¹²

- ➔ “Electric vehicle charging station” means a parking space that is served by battery charging station equipment that has as its primary purpose the transfer of electric energy (by conductive or inductive means) to a battery or other energy storage device in an electric vehicle, and that is 1) publicly owned and publicly available (e.g., Park &

Ride parking, public library parking lot, on-street parking), or 2) privately owned and publicly available (e.g., shopping center parking, non-reserved parking in multi-family parking lots).

- ➔ “Electric vehicle parking space” means any marked parking space that identifies the use to be exclusively for the parking of an electric vehicle.
- ➔ “Non-electric vehicle” means any motor vehicle that does not meet the definition of “electric vehicle.”

For the purpose of parking spaces and enforcement, Montclair Township defines a PEV as “any car, truck, or other vehicle that does not produce tailpipe or evaporative emissions or is a plug-in hybrid electric vehicle (PHEV).”¹³

Design Criteria

Infrastructure design criteria will help to ensure fueling stations are easy to find, easy for drivers to use, and meets the needs of the user, particularly in the case of public stations. Design guidelines vary based on the type of location (e.g., parking lot, conventional fueling station) but all generally consider accessibility (i.e., the amount of space needed to access the equipment), safety, equipment protection, and signage.

The municipality should understand how infrastructure design guidelines differ based on the wide variety of fuel types and fueling scenarios. Existing resources, including those noted in [Appendix A](#), can be referenced as part of general guidelines and requirements.

Siting Considerations

Municipalities should be aware of other infrastructure siting considerations, as they are in a position to help communicate best practices related to selecting sites and installing stations. These include:

Dispensing capacity requirements, including the number of chargers or pumps

In the case of PEV charging, installers should understand the demand (via a siting analysis, discussed above) to determine whether Level 1, Level 2, or DC fast chargers will be most appropriate. For gaseous fuels, compression

¹¹ Illinois Compiled Statutes, (625 ILCS 5/), Illinois Vehicle Code, <http://www.ilga.gov/legislation/ilcs/ilcs4.asp?ActID=1815&ChapterID=49&SeqStart=129100000&SeqEnd=129600000>. Accessed October 20, 2017.

¹² City of Seattle Municipal Code, Section 11.72.125, https://library.municode.com/wa/seattle/codes/municipal_code?nodeId=TIT11VETR_SUBTITLE_ITRICO_PT7STSTPALO_CH11.72STSTPARE_11.72.125ELVEPACHSTELVE. Accessed August 30, 2017.

¹³ Montclair Township Code of Ordinances, Chapter 230: Parking Lots, <https://ecode360.com/MO0769>.

capacity requirements will depend on the number and frequency of vehicles fueling. It is important to understand operating characteristics so that the station can deploy the appropriate fill or dispensing equipment. For CNG stations, the three generic types of equipment include fast fill (similar to a conventional gasoline fueling station), time fill (a slower option for so-called return to base operations that can be fueled slowly over a period of time e.g., overnight), or a combination fast fill and time fill station.

Fleet needs or customer profile

As a developer seeks to deploy an AFV station, it will be important to understand the needs of various fleets and other operators that will be using the station. The station owner should understand if the station will be accessible only to fleets, have public access, and if there are any so-called anchor tenants that require minimum access to fueling at particular times. Furthermore, the size of the vehicles that comprise the fleet will help size the facility appropriately.

Future infrastructure demand

Taking a “dig once” approach can help minimize the cost of future installation or expansion. For PEV charging, this includes upgrading the electrical service for the estimated future charging load and running conduit to the anticipated future charging locations.

Proximity to the fuel source

NGV fueling stations should have good proximity to both a natural gas pipeline and electrical service. The former is to meter the gas, dry it, compress it, and then dispense it into vehicles; the latter is to power the station and critical functions such as compression. For PEV charging stations, the DOE Clean Cities program provides the following recommendations:¹⁴

- ➔ Place the charging equipment close to the electrical service to minimize the need for trenching/boring and the costs of potential electrical upgrades.
- ➔ Instead of locating the charging station at a highly visible parking spot a great distance from the electrical panel, use signage to direct PEV drivers to the charger.
- ➔ If trenching is needed, minimize the trenching distance.
- ➔ Choose a location that already has space on the electrical panel with a dedicated circuit.

¹⁴ U.S. DOE, Clean Cities. 2015. Costs Associated with Non-Residential Electric Vehicle Supply Equipment. http://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf

Utility Input

Involving utilities in the infrastructure site selection process can help **alleviate any unknowns or concerns** surrounding gas pressure, distance from gas distribution infrastructure, and sufficient supply of both natural gas and electricity to power the equipment. Utilities can provide **up-to-date information** about existing natural gas infrastructure in the region as well as the feasibility of a given location.

Source: NGVAmerica, CNG Station Construction and Economics, <http://www.ngvamerica.org/stations/cng-station-construction-and-economics/>.



Photo by Warren Gretz, NREL 05857

Zoning and Parking	Permitting and Inspection	Municipal Fleet	Key Stakeholder Engagement	Targeted Education and Outreach
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Key Recommendation

Zoning Ordinances

Amend zoning codes to include PEV charging as a permitted accessory use and to include requirements or incentives for pre-wiring (for PEV charging) or installation of fueling infrastructure.

Zoning ordinances can facilitate (or hinder, if not developed thoughtfully) AFV fueling infrastructure deployment.

PEV Zoning Considerations

The municipality specifies how much parking should be provided at different locations or land uses through zoning ordinances, development guidelines and standards, or accompanying parking codes. It is recommended that the municipality update these documents to include charging requirements or incentives.

Zoning ordinances and development regulations are similar to building codes in that they can be used to specify how much charging or pre-wiring should be provided, and where. However, there are two key differences that enable zoning codes to provide more flexibility:

- ➔ Zoning ordinances can be used to **increase charging opportunities in high priority locations**. Building codes usually categorize land uses broadly (e.g., residential and non-residential), while zoning ordinances can be more nuanced, distinguishing between residential districts of different densities, non-residential districts with differing types and mixes of uses, or high-activity areas such as downtowns and transit stations. This means that zoning ordinances usually offer more flexibility to focus new PEV infrastructure in the places where it

matters the most, such as downtowns and activity centers with high turnover or employment centers. In general, zoning ordinances should allow for Level 1 or Level 2 charging infrastructure in any district. DC fast charging may be restricted to commercial and industrial areas. As an example, the City of Methuen, Massachusetts incorporated language into their [zoning code](#) permitting Level 1 and Level 2 in single- and multi-family zones and all other zones. DC fast charging is restricted to parking lots at commercial or municipal destinations or vehicle service stations.¹⁵

- ➔ Zoning ordinances offer **flexible ways to require new charging infrastructure**. A zoning ordinance that requires pre-wiring could have the same effect as updating the building code. However, the municipality could also use zoning ordinances to encourage PEV charging deployment in different ways. For example, it could require actual charger installations at new developments in specific areas through zoning ordinances or development standards, or offer developers incentives such as density bonuses in exchange for providing increased charging opportunities.

The Importance of PEV Charging Stations as a Permitted, Accessory Use

Zoning codes that do not reference PEVs or charging stations can unintentionally **create barriers** to the deployment of charging stations and may leave the municipality susceptible to **legal challenges**. Amending municipal zoning code to include PEV charging stations as a permitted accessory use in all or specified zoning districts is an important first step in PEV readiness.

¹⁵ City of Methuen, Massachusetts Comprehensive Zoning Ordinance, Section V-T Electric Vehicle Charging Station and Electric Vehicle Battery Exchange Station, <http://www.cityofmethuen.net/sites/methuenma/files/uploads/zoningord10217.pdf>. Revised through September 5, 2017.

EXAMPLES: Zoning Ordinances in Support of AFVs

New York City's New Construction Pre-Wire Requirement

New York City requires that newly constructed and upgraded parking garages and open lots include the necessary hardware for charging infrastructure in at least 20% of the parking spaces.

Source: General Administrative Provisions for Construction Codes, Section 28-101.4.3; Building Code, Sections 406.2.11 and 406.7.11 (<https://www1.nyc.gov/site/buildings/codes/2014-construction-codes.page>).



Montclair Zoning – Requiring Charging Infrastructure through Redevelopment Plan

Following is an excerpt from one of three redevelopment plans for Montclair Township that include requirements for accommodating PEVs:

Seymour Street Redevelopment Plan (2016): PEV charging stations are a stated permitted use. All parking facilities within the Redevelopment Area must include a minimum of two PEV charging stations as well as the infrastructure necessary to support future demand (e.g., conduit). The car-charging facilities are the responsibility of the redeveloper.

Municipalities should consider amending the municipal zoning codes to require or incentivize pre-wiring or charging station installations at new residential and non-residential developments (see box above). Pre-wiring is when builders run electrical conduit, intended to power charging equipment, to locations where vehicles will be parked. While pre-wiring alone does not create new charging opportunities, addressing this need during the construction phase dramatically reduces the cost of installing chargers in the future. Redevelopment plans provide an opportunity for municipalities to require pre-wiring or actual station installation.

Montclair Township has requested such modifications to several redevelopment plans, including the one summarized in the box above.

Codes can also include or refer to guidance on siting and installing PEV charging stations (see above). Ideally, requirements should specify the number of chargers or pre-wired spaces to be provided at new developments of different sizes and land-use types.

If the municipality has minimum parking requirements, consider whether PEV parking should count toward overall parking requirements. Allowing PEV parking to count toward parking requirements is recommended since it would incentivize developers to provide PEV parking without increasing the total number of spaces required. The municipality could consider allowing each designated PEV space to count as three spaces toward meeting off-street parking requirements. This incentive is included in Georgia's proposed model municipal ordinance.¹⁶

¹⁶ Plug-in Georgia, Proposed Laws and Initiatives, A model proposed municipal ordinance to update the zoning code. <http://www.plugingeorgia.com/index.php/advocate>. Accessed October 20, 2017.

Other Fuel Type Zoning Considerations

Though most other new AFV fueling infrastructure will be located in areas zoned for commercial or industrial use (these areas should already allow for installation), it is important to ensure compliance with existing statewide codes and regulations and to engage local officials in the preliminary stages of any AFV fueling infrastructure development project. According to a Hydrogen Energy Center report, a challenge faced by infrastructure developers is that building code requirements are sometimes invoked for fueling systems that do not have a building component.¹⁷ Municipalities in the NJTPA region may benefit from a collaborative effort to develop model permit terms and standards so that the process for developing, permitting, and managing non-building fueling infrastructure is more predictable across the region.

Fleets and others need to take local zoning requirements into account when developing AFV stations, not only in terms of land use considerations, but also for safety regulations relating to the storage and dispensing of fuel, including maintenance facility upgrades. Storing and dispensing fuel requires adherence to fire codes and other environmental considerations.

Additional considerations are appropriate for residential NGV fueling. Guidance from the California Statewide Alternative Fuel and Fleets Project provides an example of how cities can include residential requirements in preparation for potential at-home NGV fueling infrastructure.¹⁸ The residential requirement would be most applicable if the consumer NGV market takes hold, which thus far has not been the case. Further, it is unlikely to develop given that no major automobile manufacturer currently offers a light-duty passenger vehicle using natural gas.



Photo by Dennis Schroeder, NREL 20040

¹⁷ Hydrogen Energy Center, Regulatory Barriers to Development of Vehicle Alternative Fuel Infrastructure in New England, <http://www.gpcog.org/wp-content/uploads/2015/03/Final-HEC-report.pdf>. January 2015.

¹⁸ TIAX, Natural Gas Vehicle Market Analysis, <https://www.aga.org/tiax-natural-gas-vehicle-market-analysis>. Accessed September 7, 2016.

Zoning and Parking	Permitting and Inspection	Municipal Fleet	Key Stakeholder Engagement	Targeted Education and Outreach
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Key Recommendation

Parking Ordinances and Codes

Amend parking codes to include restrictions, enforcement policies, and fees for municipally-controlled PEV charging stations.



After establishing zoning policies to encourage or require the deployment of PEV charging infrastructure, the next step is to update parking ordinances and codes to account for PEV parking spots. The goal when making these changes should be to ensure that PEVs have unobstructed access to charging equipment. If desired, also ensure that the community can recoup the costs of municipality-owned and operated publicly-available charging infrastructure by establishing charging fees.

When designating PEV parking ordinances and codes, consider applicable definitions (discussed earlier in this section), time limits, restrictions, enforcement policies, and fees.

Time limits and restrictions

While internal combustion engine vehicles are usually the most common cause of obstructing access to charging spaces, there can also be issues with PEVs being left in charging parking spaces long after the charging session has completed. It is important that drivers unplug and move their car as soon as possible to make way for other plug-in drivers to charge up when needed. One way of doing this is specifying a time limit for charging in parking codes or ordinances. A general best practice is to restrict the use of PEV charging stations to vehicles that are plugged-in and actively charging to ensure the equipment is available for drivers who need it. For example, the City

of Dublin, California limits parking in charging stations to four hours and specifies that vehicle parked in PEV stations must be connected to the charging equipment.¹⁹

Enforcement policies

It is important to define how restrictions and time limits will be enforced. Without an enforcement policy, there is no incentive to follow the restrictions. Within parking codes and ordinances, the municipality can specify towing of vehicles in violation of the restriction or impose a fine.

- ➔ The City of Raleigh, North Carolina Code of General Ordinances requires that vehicles parked in designated PEV spaces must be connected to the charging station or be subject to a \$50 fine.²⁰
- ➔ The Illinois State Vehicle Code includes the following language for enforcement by towing: “Any person or local authority owning or operating any public or private off-street parking facility may, after notifying the police or sheriff’s department, remove or cause to be removed to the nearest garage or other place of safety any non-electric vehicle parked within an electric vehicle charging station space designated for use by electric vehicles.”²¹

Fees

Imposing fees for PEV charging can help the municipality recover costs associated with providing charging services to the public. See the Assess PEV Charging Fees section above for more detail on possible fee options. As an example, the City of Palo Alto, California charges \$0.23 per kilowatt-hour to recover the cost of PEV charging stations at city facilities. This is in addition to a per-hour connection charge. The city has also established a discretionary fee of up to \$5.00 per hour after the vehicle has finished charging, which is referred to as an “Electric Vehicle Charger Connection Overstay” fee.²²

¹⁹ City of Dublin, CA, Electrical Vehicle Charging Stations, <http://dublinca.gov/1482/Electric-Vehicle-Charging-Stations>. Accessed August 30, 2017.

²⁰ City of Raleigh, NC, Raleigh City Ordinance 11-2174(c) Electric Vehicle Parking FAQs, <http://www.raleighnc.gov/content/PWksParkingMgmt/Documents/EVParkingFAQ's.pdf>. Accessed April 10, 2017.

²¹ Illinois Compiled Statutes, (625 ILCS 5/) Illinois Vehicle Code, <http://www.ilga.gov/legislation/ilcs/ilcs4.asp?ActID=1815&ChapterID=49&SeqStart=129100000&SeqEnd=129600000>. Accessed August 30, 2017.

²² City of Palo Alto, CA, Amendments to CMR 8020, FY 2018 Proposed Municipal Fee Schedule for Electric Vehicle Charges, <http://www.cityofpaloalto.org/civicax/filebank/documents/57898>. May 18, 2017.

Zoning and Parking	Permitting and Inspection	Municipal Fleet	Key Stakeholder Engagement	Targeted Education and Outreach
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Other Recommendations

Signage








Signage is important as it helps drivers identify and navigate to fueling stations and, in the case of PEV charging, clearly state time limits and restrictions that improve access to charging and facilitate enforcement. Signage can also increase the visibility of a station, drawing attention to the fuel it provides, and help alleviate any range anxiety or concerns about the lack of available infrastructure.

PEV Charging Stations

Parking ordinances can be used to standardize PEV charging station signage. The FHWA defines the minimum standards for signage, which it publishes in the Manual on Uniform Traffic Control Devices (MUTCD), updated every five to six years. The FHWA intends to include standard regulatory signage for charging stations in the next Notice of Proposed Amendment to MUTCD, but the agency has released interim designs and optional plaques detailed



in the Regulatory Signs for Electric Vehicle Charging and Parking Facilities guidelines.²³ These signage designs should be included in the municipality's parking codes, general codes, or any PEV charging station related ordinances.

- ➔ Wayfinding signs are used to indicate the location of chargers and can be combined with directional arrows to guide drivers to chargers.
- ➔ Parking signs can also be used to designate restrictions or time limits on PEV charging spaces.

Other Fueling Stations

Through alternative fuel corridor designation efforts, the FHWA has also identified standard signage for CNG, LNG, propane, and hydrogen fueling stations. Specific designs and specifications can be found on the [MUTCD](https://mutcd.fhwa.dot.gov/resources/policy/rsevcpfmemo/) website.

²³ FHWA, Regulatory Signs for Electric Vehicle Charging and Parking Facilities, <https://mutcd.fhwa.dot.gov/resources/policy/rsevcpfmemo/>. Accessed August 30, 2017.

Zoning and Parking	Permitting and Inspection	Municipal Fleet	Key Stakeholder Engagement	Targeted Education and Outreach
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Other Recommendations

Building Codes



Building codes contain safety standards and specifications that guide new construction and renovations. The New Jersey Department of Community Affairs (NJDC), specifically the Division of Codes and Standards, enforces statewide building codes – referred to as the Uniform Construction Code (UCC).

Municipalities in New Jersey are limited to the statewide UCC, and are therefore not in a position to amend building codes as they are related to PEVs or other issues. Therefore, it is recommended that the municipality focus on updating local zoning requirements rather than attempting to change the building code. However, some municipalities have taken steps to advocate for UCC updates that incorporate PEVs where appropriate and feasible.

There are two major opportunities to create building codes that support PEV deployment:

- ➔ Specify standards for PEV charging infrastructure in the building code to ensure that any charging station installations are safe and accessible.
- ➔ Require pre-wiring for charging stations to lower the cost of future installations.

Key Recommendations

Streamline procedures

Streamline AFV infrastructure permitting and inspection procedures.

Produce guidance documents

Produce guidance documents clearly outlining AFV infrastructure permitting requirements and steps.



EXAMPLE: Permitting Guidance

The City of Milpitas, California has issued guidance that summarizes the requirements for a PEV charger permit and includes diagrams illustrating typical configurations of chargers in different garage types in order to assist applicants of single-family residences with determining the proposed location of the charging system. Permit fees for residential and commercial electric vehicle charging systems are available on the website, along with electronic plan submittal and information on the building inspection procedure.

Source: City of Milpitas, CA, Electric Vehicle Charging Station Permitting <http://www.ci.milpitas.ca.gov/milpitas/departments/building-and-safety-department/electrical-vehicle-charging-station/>.



Photo by City of Milpitas, CA

PERMITTING AND INSPECTION

An important piece of AFV readiness is efficient and easy-to-navigate permitting and inspection processes. The installation of AFV fueling and charging equipment typically requires obtaining municipal permits and passing inspections, the process for which currently varies by municipality. There are opportunities to streamline permitting and inspection procedures and to harmonize processes between jurisdictions. Making the permitting process easy and affordable can help speed the roll out of AFV infrastructure and make installations more straightforward. From the municipality's perspective, minimizing permit requirements can enable staff to process permits more efficiently.

All AFV Infrastructure

The permitting requirements and process can seem overwhelming to a resident, employer, developer, or other party interested in installing AFV fueling or charging infrastructure. Municipalities can help to make it more approachable and feasible by providing clear, concise information about the steps involved. Because state law dictates permitting and inspection requirements, site plan approval is one of the only aspects over which municipalities have control. Municipalities should explicitly state whether site plan approval is required for various charging station installations and explore options to exempt MUD and commercial charging stations from site plan approval process. Municipalities could also consider developing permitting checklists that help applicants through the permitting processes specific to MUD and non-residential installations.

Where possible, a municipality should work with neighboring communities to make processes and requirements consistent. This coordination will make it easier for contractors (e.g., electrical) who work throughout the region.

Residential PEV Charging Stations

NJDCA issued guidance for municipalities on PEV charging station permitting at residential locations (see box). Municipalities can also implement the following actions specific to PEV charging stations installed at single-family residences:

- ➔ Make permits available online or over-the-counter.
- ➔ Issue required permits in under 48 hours.



Photo by Matthew Staver, NREL 39210

- Set fees between \$100 and \$250 for residential charging station permits.
- Limit the number of required inspections to one.
- Minimize requirements for supporting materials to information about the PEV charging system (i.e., level of charger, compliance with national standards, proposed location) and electrical service (i.e., existing electrical panel service information, load calculations, whether panel upgrades or a new meter installation are required).



State Guidance on PEV Charger Permitting

The NJDCA published “Electric Vehicle Charging Stations – What you need to know,” to provide guidance to municipalities on types of permitting required for the installation PEV charging stations at residential locations. A previous NJDCA article, “Electric Vehicle Charging Stations – Installation and Permit Requirements” (in NJDCA’s Construction Code Communicator, Vol. 23, Number 1, Spring 2011) provides more detailed information.

In 2011, the NJDCA reviewed all applicable state codes and regulations and determined that installation of residential PEV charging equipment is considered “minor work.” This means that the homeowner or contractor need only provide verbal notification to the local code enforcement agency prior to starting the installation and submit the permit application within five days of notification. This interpretation of state code streamlines the process homeowners do not have to wait up to three weeks for permit approval.

Key Recommendation

Lead by example

Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities to incorporate AFVs.



EXAMPLE: Secaucus, New Jersey

The Secaucus municipal fleet includes several PEVs, including this one charging at town hall.



MUNICIPAL FLEET

If one does not exist already, a municipality should develop a fleet management plan to provide a framework for considering how AFVs might be incorporated as older vehicles are being retired. The first step is taking inventory of existing vehicles to understand how vehicles are distributed across and controlled by the various departments and offices. The fleet management plan should also include meaningful metrics for measuring progress over time. [Sustainable Jersey's](#) Green Fleets actions provide useful guidance. If a municipality reaches the point of vehicle procurement, it should be aware of the types of AFVs that are on the current version of the New Jersey Department of the Treasury's supply contract, and of the aggregated purchase options for both vehicles and infrastructure, including the Mid-Atlantic Region initiative under [Fleets for the Future](#) as well as [EV Smart Fleets](#).

Municipal fleet managers may have previous experience with AFVs, positive or negative, that could influence their understanding of the technology, performance, and other considerations. Education targeting these individuals is addressed later in this section, and will be a critical step to help address any misconceptions and highlight potential benefits.

Vehicle acquisition at the municipal level is often reactive and needs to happen quickly. Having an inventory and plan in place will aid the decision-making process.

Zoning and Parking	Permitting and Inspection	Municipal Fleet	Key Stakeholder Engagement	Targeted Education and Outreach
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Key Recommendation

Collaborate with other municipalities

Engage in cross-jurisdictional opportunities for sharing lessons learned.








KEY STAKEHOLDER ENGAGEMENT

In addition to the formal committee established at the start of the readiness planning process, there are other stakeholder that can provide valuable insight and serve as important partners to the municipality. These include other local governments and utilities.

The NJTPA region encompasses many local governments, each with its own challenges and experiences with AFV use. An individual community stands to benefit from the sharing of best practices and lessons learned by stakeholders across its neighboring jurisdictions. Successful collaboration and information-sharing will require a municipality to invest the time and resources necessary to actively engage with its neighbors. But creating and sustaining a network of stakeholders who work on AFV-related issues will help strengthen AFV readiness in both the municipality and throughout the region, reaching a greater audience.

Sustainable Jersey provides one such forum, leveraging regional hubs to connect communities. This group of green team and environmental commission members, as well as leaders in government, business, and community, can learn from a municipality and potentially support efforts going forward.



There are two broader initiatives to be aware related to AFVs and AFV readiness, namely:

- ➔ At the state level, [ChargEVC](#) is a coalition of car manufacturers, technology companies, utilities, consumer advocates and non-governmental organizations to promote PEV use in New Jersey. The organization released [A Roadmap for Vehicle Electrification in New Jersey](#).
- ➔ The NJCCC, which supports all forms of petroleum reduction in the transportation sector, chairs a New Jersey Natural Gas Vehicle Workgroup as a committee within the NJCCC. Participating members include representatives from gas distribution utilities, vehicle and engine manufacturers; fuel and infrastructure providers; transit, refuse haulers and other fleet users of natural gas; and others interested in increasing and strengthening the deployment of low-emission NGVs throughout New Jersey.

Both initiatives provide municipalities with means to stay updated on developments and opportunities related to complementary activities at the state and regional level, such as alternative fuel corridor planning and utility rate filings.

Zoning and Parking	Permitting and Inspection	Municipal Fleet	Key Stakeholder Engagement	Targeted Education and Outreach
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Key Recommendation

Engage with Utilities

Partner with utilities to share information, enhance market participation, and gauge impacts.



A partnership between the municipality and the local electric and gas utilities can be mutually beneficial in advancing AFV use. As mentioned earlier in the guidebook, there is a lot that municipalities can learn from utility experience. However, the municipality can also help utilities develop consumer outreach content and messaging by sharing information about AFV use and helping to distribute utility-developed materials throughout the community. For example, residents would benefit from information about time-of-use (TOU) electricity tariff structures, if offered. TOU rates charge higher electricity rates during times of peak demand and lower rates during off-peak hours. TOU rates can be advantageous for PEV owners, as drivers are encouraged to charge their vehicles overnight during the cheaper off-peak hours. TOU rates also help utilities manage demand by minimizing the adverse impacts of having all PEV drivers plug-in their vehicles when they get home from work during on-peak hours.

Electric Utilities

North Jersey is home to three major electric utilities: Jersey Central Power & Light (a FirstEnergy Company), Rockland Electric Company, and Public Service Electric & Gas (PSE&G). The NJBPU website includes a [map](#) of service territories. Electric utilities in New Jersey have already been involved in creative ways to stimulate and support the AFV market. While some of these efforts are directed internally toward the utilities' own vehicle fleets or employees, many of these efforts are also directed to providing a resource to the communities that they serve. For example, PSE&G provides an incentive for workplace charging infrastructure and has funded more than 130 charging stations at 20 sites within the service territory.²⁴

²⁴ Kenny Esser, PSE&G, email communication, September 6, 2017.

Although sales of PEVs are forecasted to grow, regional impacts on the electrical grid (in terms of greater demand for electricity as more vehicles are charging) will likely be negligible for many years. However, unmanaged charging station installations and increased regional PEV ownership in specific areas could negatively affect local electrical distribution systems.

One of the primary causes of concern for PEVs is clustering of the load associated with vehicle charging. Utilities generally have a transformer replacement program to regularly target transformers that have reached the end of their useful life or have been identified as grossly overloaded. However, the adoption of PEVs may occur faster in some areas, thereby causing gaps in the information that utilities would generally use to inform their replacement programs. In order for utilities to minimize the potential grid impacts of charging PEVs, they need to know where the vehicles are being used and how they are being charged (e.g., Level 1 versus Level 2). This information allows the utility to evaluate if the local distribution system is adequate to serve PEV charging needs. One simple, but not always utilized, solution to this potential challenge is for utilities to establish a clear notification protocol so they are aware of new chargers being added to the grid. This notification could be integrated with the municipal permitting process for charging station installations. Municipalities can provide valuable perspective and advanced notice regarding anticipated PEV clustering, new construction, and DC fast charging corridors along the way.

Gas Utilities

North Jersey has three natural gas utilities: New Jersey Natural Gas, PSE&G, and Elizabethtown Gas. The NJBPU website includes a [map](#) of natural gas service territories. These companies have been engaged in AFV efforts, and have been active in various degrees in developing the CNG market. While some of their efforts are directed internally toward the utilities' own vehicle fleets, many provide support to the communities that they serve. For example, New Jersey Natural Gas, South Jersey Gas, and Elizabethtown Gas have invested in publicly available CNG fueling infrastructure over the last five years.²⁵ All of these utilities play a critical role in providing information and resources to any entity interested in using natural gas as a vehicle fuel.

²⁵ NJBPU and NJDEP, New Jersey Energy Master Plan Update, http://nj.gov/emp/docs/pdf/New_Jersey_Energy_Master_Plan_Update.pdf. December 2015.

UTILITY READINESS CASE STUDY: Los Angeles Department of Water and Power (LADWP)

While the utility regulatory scheme in California differs from that of New Jersey, it is interesting to note that the Los Angeles' municipal utility, LADWP is leading Los Angeles' PEV efforts and is a great example of the prominent role electric utilities can play in PEV readiness.

- LADWP upgraded over 250 publicly accessible charging stations, provided rebates for nearly 1,000 residential and commercial charging stations, and fully funded an additional 2,000 charging stations.
- LADWP has been promoting off-peak residential charging by offering discounted electric rates and working with charging infrastructure providers to evaluate the interaction of charging infrastructure with utility meters to enable effective time-of-use pricing.
- LADWP incorporated both light- and heavy-duty PEVs into its fleet.
- LADWP initiated the Southern California Regional PEV Plan (SoCal EV) to foster collaboration among southern California utilities, governments, automakers, businesses, and other stakeholders in support of PEV and charging infrastructure deployment.

TARGETED EDUCATION AND OUTREACH

Zoning and Parking	Permitting and Inspection	Municipal Fleet	Key Stakeholder Engagement	Targeted Education and Outreach
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Key Recommendations

Reach out, engage, and educate relevant stakeholders

Identify funding opportunities

Identify AFV grants and other funding opportunities for fueling infrastructure development.

Engaging community stakeholders is vital to the success of any initiative, especially AFV use. Community members need to understand the rationale behind the readiness planning effort, recognize the opportunities and benefits of increased AFV use in their community, and participate in making the vision a reality. A successful outreach campaign will require tailoring messages to different audiences using an array of media types. Although executing this recommendation will require some upfront financial resources and staff time to prepare materials and conduct outreach, over the long run it could be relatively low cost and could be highly impactful if done



Volkswagen Clean Air Act Settlement

The VW Settlement established two programs that may result in AFV deployment and infrastructure support in the NJTPA region.

1. ZEV Investment Plan: VW, through a newly formed entity called Electrify America, will install, operate, and maintain ZEV infrastructure nationwide, initially focusing on 11 major metropolitan areas. Electrify America has committed to the following activities in the NYC metro area, which includes northern New Jersey:

- Level 2 charging installation at MUDs, workplaces, and public sites;
- DC fast charging facility installation on highway and other transportation corridors; and
- Education and outreach that builds or increases public awareness of ZEVs.

2. Environmental Mitigation Trust: The State of New Jersey is eligible to receive and use approximately \$72 million in funding through this trust. While the specific program in New Jersey has yet to be established or implemented, these funds could be used to replace polluting diesel equipment with cleaner vehicles, including local freight trucks, transit buses, school buses, shuttle buses, and refuse trucks. A certain portion of these funds could also be used to install PEV charging stations.

For more information, see www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement.

thoughtfully. For example, housing all of these resources in one place online will enable stakeholders to seek out the information versus only learning through active outreach.

It is critical to tap all actors early for input into the readiness planning effort, and circle back with any outcomes and to address any education and training needs. In fact, continuous engagement following the initial readiness planning effort is integral to keeping the key players accountable.

The following sections provide recommendations for outreach, education, and engagement targeting specific stakeholder groups.

As a municipality proceeds with implementation, it is important to track funding opportunities that may assist the community, stakeholders, and other partners with progress toward infrastructure development goals and targets. The [AFDC Laws and Incentives](#) website is a comprehensive resource for information about relevant funding sources and incentive programs administered at the federal, state, and local levels, as well as by utilities. Outside of the AFDC, municipalities can reach out to the local Clean Cities coalition, and staff at key state or regional agencies (e.g., NJTPA, NJDEP, NJBPU) to learn more about incentives. In addition to monitoring the AFDC database, other funding opportunities may emerge over time. These include state-level programs funded through the Volkswagen (VW) Clean Air Act Settlement (see box at left). The NJDEP established a [website](#) to provide more information specific to New Jersey.

Residents



While PEVs are gaining more attention, most residents will have questions about how they work, how much electricity they draw while charging, and how much it costs to fuel them. Even more questions will arise related to other alternative fuels, as public knowledge may be even more limited. A municipality can provide basic information such as simple fact sheets, utilizing resources available from the [AFDC](#), the [NJCCC](#), or [Sustainable Jersey](#).

Housing resources in one place online will enable residents to seek out the information versus only being the recipients of active outreach. If a municipality has access to existing distribution channels, such as environmental listservs or forums like [Greenable Woodbridge](#), it can leverage those to reach the community. Community

events, particularly those focused on sustainability, are another way to reach residents willing to learn about adopting alternative technologies in order to reduce their personal footprint. Engaging residents at these events may require municipalities to develop a poster or table-top display. These materials can also be used in more general settings, such as shopping malls, or regular gatherings, such as farmer's markets, which provide low-cost access to residents. Municipalities can also draw upon the assistance from the TMAs.

Additionally, consider efforts to target younger generations, such as student drivers, in order to change their mindset regarding miles driven per day and the reliability of AFVs for their daily transportation needs. This education may ease concerns about charging station availability, for example, and whether PEVs can fit into their lifestyle.

Multi-Unit Dwelling Property Managers



The NJTPA region includes many residents that own or rent property in MUD developments, where they might have a dedicated parking space but do not technically own the property on which they park. This presents unique challenges for PEV owners seeking to access a PEV charging station at their home, as discussed earlier in the guidebook. Residents of MUDs are often overlooked for targeted awareness and education activities related to PEVs because it is not often within a resident's power to install charging infrastructure. In areas where a significant portion of the population resides in MUDs, the municipality can have a very tangible impact on PEV deployment by creating materials to inform property managers and HOAs or boards about the overall benefit of providing the spaces, as well as key considerations.

A municipality can work with MUD stakeholders to develop policies that allow residents to install PEV charging infrastructure or provide shared charging for residents.

The MUD demand analysis can help a municipality prioritize specific developments and areas for outreach and engagement. Additional and future demand for MUD charging will be driven by new developments and significantly renovated buildings that may draw higher income tenants, as PEV charging may be an attractive amenity to current and future tenants.

See the resources in [Appendix E](#), which are specific to MUDs in New Jersey.

Businesses and Employers



Because most municipalities have limited opportunities and resources to install publicly-accessible PEV charging infrastructure on public land, it is important for local landowners to understand how they can contribute to the charging network. A municipality can work with the TMA to reach out through existing networks to education and partner with businesses and employers that can provide public or workplace charging. In commercial areas, in particular, it will be important to have both options, so that employees are not occupying space designated for the public or vice versa.

Public Charging

A municipality and its local businesses should actively seek support in developing a robust charging station network that will ensure visitors can easily reach the town and residents without home charging can access nearby charging options for their PEVs. This will both ease range anxiety and maximize the number of miles driven in electric mode.

Providing data on public charging demand can help start the conversation with businesses and other organizations in a position to host public charging infrastructure. The municipality can share with them the results of its PEV charging siting analysis discussed earlier in the guidebook. The same siting analysis results can help the municipality determine which areas to target. The municipality should



Photo by Mike Simpson, NREL 18873

reach out to these retailers and other businesses to explain that PEV charging stations can be amenities that help draw customers, and ultimately, pose opportunities to grow the local economy through increased visitor traffic and community spending. The business case or return on investment for public charging is not always obvious, so a municipality may need to help a potential site host understand the challenges and benefits (see the Identify Gaps and Understand Barriers section above). For example, a station host should not focus exclusively on the revenue they collect from the stations via fees, they must also consider the added value of having the station on the property.

If the municipality has the means to installing charging infrastructure for use by residents and visitors, it could consider locations such as community centers and municipal parking lots. The municipality should consult demand analysis results to identify areas of high public charging demand and also consider how to make PEV charging accessible to MUD residents during off-peak times.

Workplace Charging

Providing data on workplace charging demand can help motivate workplaces to gauge employee demand and eventually install infrastructure. Similar to the approach for public charging, the municipality can share with employers the results of its PEV charging sitting analysis discussed earlier in the guidebook. It is recommended that the municipality focus outreach on employers located in employment centers since demand will likely be highest in those areas. While any employer with adequate demand is a good candidate for a workplace charging program, businesses with a sustainability or technology focus, universities, healthcare facilities, and utilities have had

Public-Private Partnerships

Municipalities should team up with business improvement districts (BIDs) to increase awareness about PEV charging stations among local businesses and coordinate efforts to build out infrastructure. The BID is typically in a position to convene business representatives, serve as a liaison between those interests and the municipality, and distribute factual information about the benefits and business case.

EXAMPLE: Workplace Charging



Photo by Bayshore Recycling

Valerie Montecalvo, President and CEO of the Bayshore Family of Companies, charges a PEV using workplace charging. Bayshore Recycling is one example of a company championing workplace charging in the NJTPA region. Bayshore Recycling received a \$5,000 grant from the NJDEP to install a Level 2 workplace charger at its facility in Keasbey, part of Woodbridge Township.

particular success. Large corporations and municipal, state, and federal government offices are also candidates for workplace charging. Organizations that own their property may have an easier time installing workplace charging, though leasing companies are often willing to work with tenants to meet employee charging needs.

In addition to highlighting the demand for charging infrastructure, the municipality can raise employer awareness about resources on workplace charging. For example, the AFDC's [Workplace Charging for PEVs](#) website has information for employers on evaluating and planning for workplace charging, installing workplace charging, managing workplace charging, and engaging employees. Also see the workplace charging program development discussion earlier in the guidebook. Employers will need to gauge demand (current and future) and consider the logistics of providing charging equipment, including the etiquette for moving vehicles once the charging

session is complete. They will also need to understand the approval process for new development versus existing development installations, and what activities would require a permit or approval from the local planning board versus being done independently. The TMA can serve an important role in this education process, reaching out to its network of employers to provide factual and relevant information.

An employer that has an environmentally-focused mission or strong sustainability initiatives may be priority targets for outreach by the municipality. These organizations are typically more proactive in terms of actions that can help reduce the company's carbon footprint. It is also important to engage high-level decision makers so they can understand the benefits of workplace charging and support decisions to move forward. (See example of Bayshore Recycling in box on previous page.)

A municipality can play an important role in accelerating regional AFV adoption by helping local businesses identify and pursue grant funding, both for AFVs and for workplace and fleet fueling/charging infrastructure. Once a municipality conducts a siting analysis specific to workplace charging demand, it can show it has taken a thoughtful and data-driven approach to identify particular facilities that are well suited for charging stations. In addition to equipment and installation, funding could also be used for workshops, trainings, outreach campaigns, and events that support workplace charging and fleet use of AFVs. These may be specific to one community, or coordinated with other municipalities in the region to conserve costs and increase the reach and impact.

Developers and Builders



It is critical to educate developers and builders on how they can include PEV charging infrastructure when planning and constructing new developments. More specifically, single-family garages and MUD parking lots should be wired for Level 2 charging and commercial buildings should ideally be wired for DC fast charging, where appropriate. Pre-wiring can help developers avoid unnecessary costs later on. Anecdotal industry experience indicates the cost to pre-wire a space for Level 2 charging during construction is several hundred dollars compared to thousands of dollars if the required upgrade is done once construction is completed.

An employer that has an environmentally-focused mission or strong sustainability initiatives may be priority targets for outreach by the municipality. These organizations are typically more proactive in terms of actions that can help reduce the company's carbon footprint.

A significant portion of residents in the NJTPA region reside in MUDs, and providing these residents with convenient access to PEV charging is a key challenge discussed earlier in the guidebook. MUD developers are therefore particularly high priority targets for education and outreach. Commercial developments can provide workplace and public charging opportunities, making them priority targets as well. Developers and builders need to understand the approval process for new development versus existing development installations, and what activities would require a permit/approval from the local planning board versus being done independently. The municipality can facilitate this discussion by providing guidance materials that address questions specific to PEV charging infrastructure development.

Strategic outreach can take additional time, but it can also be highly impactful. The MUD and public charging demand maps (mentioned earlier in the guidebook) will help a municipality prioritize target developments and areas. See the resources in [Appendix E](#), which are specific to MUDs in New Jersey.

Fleet Managers and Vehicle Maintenance Technicians



Public and private fleets can provide opportunities for AFV introduction. However, fleets often require assistance navigating and weighing the various considerations associated with AFV ownership as compared to conventional vehicle ownership. For this reason, information sharing can encourage investment in AFVs among corporate and government fleets alike.

A municipality can provide educational resources to fleet managers to educate them regarding the total cost of AFV vehicle ownership, operating considerations, and station installation costs and guidelines. The [AFDC](#) is a comprehensive starting point for this information,

Engaging Private Fleets



Collaboration with local fleets is integral to readiness planning. Because the individual consumer has extremely limited access to natural gas, hydrogen and other fueled passenger vehicle models, fleets are at the forefront of development and are providing real-world examples of how alternative fuels can be used effectively on a long-term, large-scale basis. As part of readiness planning efforts, the project team should collect input from local fleets, specifically high-mileage medium- and heavy-duty fleets.

covering all fuel and vehicle types, and includes information on technician training and other topics.

In the case of electrification, since most PEVs available today are passenger cars, near-term focus should include reaching out to fleets that use light-duty vehicles, such as car service fleets or those that provide campus security. As more medium- and heavy-duty PEV technology develops, the municipality can provide additional resources that draw upon best practices and lessons learned from local and regional case studies of fleets deploying such vehicle models. The opposite is true with NGVs; most natural gas technology is currently for use in medium- and heavy-duty vehicles. The municipality should therefore focus NGV outreach on medium- and heavy-duty fleets in the near-term, which may include shuttle buses and vans and trash collection and recycling fleets.

Fleets often require assistance navigating and weighing the various considerations associated with AFV ownership as compared to conventional vehicle ownership. Beyond providing educational materials to fleet managers, the municipality may consider organizing or funding technical assistance and training workshops for local fleet managers. For example, the National Alternative Fuels Training Consortium (NAFTC) offers a wide range of courses and workshops geared towards fleet managers, automotive technicians, and others. Their trainings are offered in both traditional classroom settings and in online formats, and

they provide an understanding of the vehicle type, safety issues, operating costs, and vehicle efficiency. The NAFTC is willing to work with municipalities to tailor their courses or workshops for a particular setting. Additional information about the NAFTC course offerings, including a course schedule, can be found on the [NAFTC](#) website.

Local governments and fleet managers can also take part in trainings offered by Clean Cities coalitions. For example, the NJCCC has hosted numerous workshops and delivered presentations on a variety of issues related to the range of AFVs and infrastructure.

A fleet considering AFVs will need to understand whether new fueling infrastructure is needed or if there are existing stations available for use. The municipality can help the fleet identify public stations in the area and speak with local fleets amenable to an infrastructure partnership. There are various ownership models associated with fueling infrastructure, as discussed earlier in this guidebook.

Emergency Responders



AFV readiness cannot be accomplished without support from local institutions most immediately affected by a shift to AFVs. Providing training to key personnel – including emergency responders – will arm these individuals and teams with the tools necessary to carry out their responsibilities in an AFV-ready community.

Training first responders will ensure that safety procedures are in place in the case of any AFV or charging/fueling station-related emergency. There are several detailed resources and trainings already available to emergency responders. The most comprehensive training that is widely accessible to emergency responders is the National Fire Protection Association (NFPA) [Alternative Fuel Vehicles Safety Training Program](#), which includes online training and an emergency field guide.

The municipality should consider reaching out to local police, state troopers, sheriff's deputies, fire departments, EMTs/paramedics, tow operators, and others to make them aware of these resources. Additionally, the NJCCC may be able to help organize a training event for emergency responders, as they have in several other locations.

Inspectors and Other Local Officials



Providing inspectors and other local officials with basic information about AFV fueling and PEV charging stations and installations will help ensure these staff can provide property owners and site hosts with additional information about safety practices and other requirements. Similarly, inspectors would benefit from access to factual information and relevant details specific to each municipality (e.g., public fueling and charging locations) since they interface with residents, businesses, and others. A municipality may consider organizing an educational session focused on codes, safety, standards, site assessments, electric load calculations, permitting processes, and utility notification.

Municipalities can partner with organizations to provide training, if necessary. The [Electric Vehicle Infrastructure Training Program](#) (EVITP) offers courses that train and certify electricians to install PEV charging stations, including a curriculum especially tailored for local government staff and stakeholders. Alternatively, there may be local staff from neighboring jurisdictions with experience from working on various types of projects who can provide a peer training workshop. Additionally, the DOE Clean Cities program produced a series of [YouTube](#) training videos on residential PEV charging station installation. Key information for training includes codes, safety, standards, site assessments, electric load calculations, permitting processes, and utility notification.

Training inspectors and other local officials is an area where regional planning authorities might step in to fund a workshop for permitting staff from each municipality in the region. Municipalities should also collaborate with neighboring communities to create an ongoing region-wide schedule of training and outreach events so that stakeholders can stay informed on opportunities across the region.

Dealerships



Dealership engagement and training results in a more educated vehicle salesforce, more likely to accurately and effectively promote the vehicles and the associated benefits. If AFV buyers have a positive experience, it will assist in the continued spread of AFV use. While only FFVs and PEVs are currently sold at traditional dealerships, fleets purchasing NGVs and propane vehicles will likely interact with OEM sales staff at some point.

In collaboration with dealerships, the municipality could consider developing a system to monitor AFV readiness by tracking purchases. The uptake of AFVs should be continually monitored – through leveraging relationships with local dealerships to determine which of the medium- and long-term readiness actions to prioritize and the appropriate level of additional funding needed to achieve AFV goals.



Photo by Dennis Schroeder, NREL 28369

Track, Revisit, and Update



Emerging technologies, government policies, and changing consumer preferences may impact AFV demand and related infrastructure needs, such as continued increase in car sharing and ride hailing services, the introduction of connected and autonomous vehicles onto public roadways, and advancements in AFV technology that can make vehicles cheaper and more attractive to consumers. To that end, municipalities should periodically review the market demand for AFVs and related infrastructure needs, updating the infrastructure siting analysis as appropriate.

Now What?

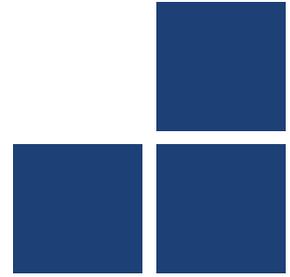
This guidebook contains a wealth of information regarding AFV readiness planning, including the steps a municipality can take to turn this guidance into an action-oriented readiness plan. There are numerous technical assistance resources in a position to provide municipalities with support and direction, including:

- The NJTPA and other MPOs
- [Sustainable Jersey](#)
- [The NJCCC](#)

In addition to the examples and case studies highlighted throughout the guidebook, municipalities should refer to the appendices for additional information. More specifically:

- [Appendix A](#) includes key resources organized to correspond with the focus areas presented in the guidebook.

- [Appendix D](#) was adapted from the DOE's Clean Cities program and provides links to relevant PEV readiness resources.
- [Appendix E](#) provides a snapshot of resources for MUD managers, HOAs, boards, and residents interested in PEV charging.



Appendices



Photos by (clockwise, from top left): Dennis Schroeder, NREL 31343; John De La Rosa, NREL 27783; Austin Marie Sipiora, NREL 43162; Matthew Staver, NREL 39250

Appendix A: Key Resources

General/Overarching:

- DOE's [AFDC](#)
- NJDEP's [Clean Vehicles](#)
- ChargEVC's [Roadmap for Vehicle Electrification in New Jersey](#)
- DVRPC's [Energy and Climate Change Initiatives](#)
- [Transportation & Climate Initiative \(TCI\)](#)
- New York State Energy Research and Development Authority's (NYSERDA) [Electric Vehicles](#)

Infrastructure Design, Siting, and Selection:

- DOE's [PEV Handbook for Public Charging Station Hosts](#)
- DOE's [Handbook for Handling, Storing, and Dispensing E85 and Other Ethanol-Gasoline Blends](#)
- DOE's [Biodiesel Handling and Use Guide](#)
- NYSERDA's [Siting and Design Guidelines for Electric Vehicle Supply Equipment](#)
- Chittenden County (VT) Regional Planning Commission's [EV Charging Installation Guide](#)
- California Energy Commission-funded [Electric Vehicle Charger Selection Guide](#)
- NGVAmerica's [CNG Station Design](#)
- Propane Education & Research Council's [Refueling](#) page
- AFDC Infrastructure Development pages (e.g., [Hydrogen Infrastructure](#))

Municipal Fleet Actions:

- [Fleets for the Future](#)
- [EV Smart Fleets](#)

Education, Outreach, and Training:

- [Tahoe-Truckee Tools for Users](#) (PEVs)
- DOE [eGallon](#) (PEVs)
- NFPA [AFV Safety Training](#)

Appendix B: Recommended Plug-in Electric Vehicle Forecast Methodology

Typically, this type of analysis has a 10-20 year outlook into the future. A municipality should choose a timeframe that aligns with its regional transportation plans for consistency and potential integration.

- ➔ **Step 1: Collect existing vehicle sales and vehicle stock data.** The NJDEP can provide PEV registration data upon request. New vehicles sales data can typically be retrieved from the [National Automobile Dealers Association \(NADA\)](#), available at the national and state levels. Vehicle registration totals are also available online via the ZEV [Sales Dashboard](#), maintained for the Auto Alliance; the website provides a breakdown of ZEVs by vehicle architecture, including BEVs, PHEVs, and FCEVs. Note that data sources differ and may present a range of estimates.
- ➔ **Step 2: Develop analysis scenarios.** There are a variety of factors that influence the adoption of PEVs. With market outlooks, a best practice is to develop multiple scenarios that provide a range of expected PEV deployment depending on different variables and parameters such as economic growth, fuel pricing, vehicle pricing, and consumer behavior. These scenarios should take into consideration relevant policies and programs that influence the PEV market. The table below shows the three different scenarios developed for the NJTPA pilot municipality readiness plans.

Scenario	Description
Low	<p>Reflects adoption trends comparable to the Reference Case in the U.S. Energy Information Administration’s (EIA) Annual Energy Outlook (AEO) 2016, adjusted slightly for increased potential indicated in the Mid-Atlantic region.²⁶ (See step 3 below for more details on this data set.)</p> <p><small>26 Using the AEO as a base for forecast provides the benefit of transparency and consistency with national-level assessments. Further, the amount of data that is required to conduct a locally specific forecasting exercise is generally prohibitive. Lastly, the data are something that can be updated annually and modified by stakeholders easily, rather than relying on some proprietary methodology.</small></p>
High	<p>Assumes that PEV adoption rates will be consistent with the Zero Emission Vehicle (ZEV) mandate in place for New Jersey,²⁷ with a fair-share assumption (i.e., that ZEV deployment will occur in the state on a population-weighted basis in the long-term).</p> <p><small>27 ZEV programs aim to increase sales of ZEVs, which include PEVs and FCEVs, by requiring that some portion of vehicle manufacturer sales in the state be ZEVs. More information on New Jersey’s ZEV mandate is available online at http://www.nj.gov/dep/cleanvehicles/LEV.pdf.</small></p>
GHG Stretch	<p>The PEV strategy of the NJTPA Regional GHG Mitigation Plan calls for a 60 percent market share of PEVs by 2040 to meet state goals. The GHG stretch scenario assumes that PEV adoption rates will be slightly lower than the plan, with a 50 percent market share by 2040.</p>

- ➔ **Step 3: Apply assumptions and data for the low scenario.** The low scenario uses data trends from the AEO 2016. The AEO provides modeled projections of domestic energy markets through 2050, and includes cases with different assumptions of macroeconomic growth, world oil prices, technological progress, and energy policies. Within these data sets, which can be downloaded from the [EIA](#) website, are information on light-duty vehicle stock by technology type. Of relevance to this analysis is the PHEV10, PHEV40, BEV100, and BEV200 (the four types of PEVs included) for the Mid-Atlantic region and the national totals in the Reference Case. From this data, a municipality can apply regional percentages of the existing vehicle stock (NADA and vehicle registration data) to determine a specific municipality’s share of the total forecasted PEV stock.

- ➔ **Step 4: Apply assumptions and data for the high scenario.** The high scenario assumes that each municipality in New Jersey will achieve its own fair share of the state's ZEV mandate. The state has set out ZEV compliance paths in the [New Jersey Low Emissions Vehicle Program](#) requirements, which can be applied to the jurisdiction's share of the AEO new vehicle sales projections.
- ➔ **Step 5: Apply assumptions and data for the GHG stretch scenario.** For the GHG stretch scenario, the municipality can choose PEV adoption rates based on its regional or local plans and goals. To be consistent with the NJTPA Regional GHG Mitigation Plan, this would entail applying a 60 percent market share of PEVs to the projected existing vehicle stock by year 2040.

Appendix C: Recommended Charging Infrastructure Demand Analysis Methodology

DATA NEEDS

To conduct a charging infrastructure demand analysis, a municipality will need access to the following data:

- ➔ Demographic information from the American Community Survey (ACS) for the region on the census block group (CBG) level. This includes median household income, home ownership rates, and dwelling types (e.g., single family, multi-family).
 - Data source: U.S. Census Bureau's [ACS website](#).
- ➔ HEV ownership counts and total vehicle counts for each CBG within the region.
 - Data source: The NJDEP maintains AFV and HEV registration data, coordinating with the NJMVC to provide updated statistics twice a year (January and July). A spreadsheet containing this data is available upon request by sending an email to drivegreen@dep.nj.gov, using the subject line "Vehicle Registration Data Request."
- ➔ Regional travel model data. Data needs to indicate the number of trips between various traffic analysis zones (TAZs) in the region for different purposes, such as commuting (home-based work trips) and shopping, running errands, and dining (home-based other trips). The municipality will also need the maximum distance between each TAZ. Regional travel modelers can also provide a translation of TAZs to CGBs so the ACS demographic data can be applied at the TAZ level.
 - Data source: The applicable MPO.

METHODOLOGY

The following methodology was used to develop the charging infrastructure demand analysis for the NJTPA study, which focused on three pilot municipalities.

The first step is to identify where PEVs owners are most likely to live, which requires identifying the likely PEV adopters. The infrastructure demand analyses are largely based upon the foundational data points of the NJTPA region's current and likely PEV ownership.²⁸ Socio-economic data were extracted from the ACS (five year estimates). These data are available at the CBG level and include income, tenure or property ownership, and dwelling type. The analysis also relies on vehicle registration, particularly of HEVs. The key parameters used to develop the charging infrastructure siting analysis were:

- ➔ **Income.** Market research on early adopters of PEVs suggests that households with higher incomes are more likely to purchase a PEV. Because these vehicles tend to have higher upfront costs, income can be a limiting factor and individuals with a low income might not be able to afford a PEV. Furthermore, higher income households generally buy a disproportionate share of new vehicles across all market segments and vehicle types.
- ➔ **HEV ownership.** There can be long-term fuel savings associated with HEV (and PEV) ownership, which is one of the main reasons some might invest in such a vehicle. However, research shows that households who value the non-economic (e.g., environmental) benefits of HEVs are more likely to purchase PEVs, particularly in the early adoption phases. Many HEV owners have shown a willingness to pay to reduce gasoline use that goes beyond the economic benefits of using an HEV. A Ford Motors representative noted that typical Focus Electric buyers have purchased HEVs in the past.²⁹ Research from the University of California, Davis (UC-Davis) supports this assumption: 68.3 percent of

²⁸ There are multiple overlapping geographies considered in the charging infrastructure siting analysis. For instance, vehicle ownership data are provided at the ZIP code level; socio-economic indicators are provided at the CBG level; and trip data are generated for TAZs. These overlapping geographies can lead to uncertainty in the analysis; however, the analysis typically relies on values as percentages rather than absolute numbers. This approach generally minimizes uncertainty. Furthermore, this makes the analysis less sensitive to changes on a time scale less than a year. For instance, if a municipality obtains PEV ownership at six-month intervals, and seeks to update the analysis, it is unlikely it will observe substantive changes in the results.

²⁹ Mike Tinsky, Associate Director, Sustainability and Vehicle Environmental Matters, Vehicle Electrification and Infrastructure, Ford Motor Company. Phone interview, April 9, 2012.

PEV owners surveyed either own or have owned an HEV and locations of HEV owners correlate with locations of PEV owners.³⁰

- ➔ **Home ownership.** Households who own their property are more likely to purchase a PEV than those who rent, according to market research by Nissan and Chevrolet and surveys by UC-Davis and California's Clean Vehicle Rebate Project recipients. Home ownership reduces both financial and non-financial barriers to charging infrastructure deployment.
- ➔ **Dwelling type.** Dwelling type (i.e., single-family detached, single-family attached, or MUD) can help indicate PEV ownership. Consumers with a single-family detached home generally have fewer barriers to PEV adoption as they usually have access to a garage or driveway. Consumers living in MUDs are more likely to encounter barriers to installing chargers (e.g., limited space for infrastructure installation, home owners' association restrictions, installation costs for trenching, additional metering requirements, power availability).³¹

The charging infrastructure siting analysis leverages Origin-Destination trip tables from NJTPA, which indicate the number of trips from an origin TAZ to a destination TAZ.³² Trip types include home-based work (HBW), home-based other (HBO), and non-home non-work (NHNW) trips.

The readiness plans include the mapped results of each infrastructure demand analysis – residential, MUD, workplace, and public/opportunity charging. Each demand type is presented separately (e.g., the rankings are not combined). The maps include five levels of shading, based on the percentile of each TAZ's score relative to the entire NJTPA region, and ranked as shown in the table below.

Level of Demand Scores and Percentiles

Scoring	Percentile	Demand
1	0 – 40%	Low
2	40 – 60%	Low/Medium
3	60 – 80%	Medium
4	80 – 95%	Medium/High
5	95 – 100%	High

The resulting maps help to visualize the demand by assigning a different color to each score or category. Areas shown as warmer colors represent higher demand for charging while the cooler colored areas rank lower for charging demand. Each separate area is a TAZ. The rankings and corresponding colors are based on the TAZ's demand score relative to the entire NJTPA region. For example, a TAZ ranked high on the workplace charging demand map means that area scored in the top 5 percent for workplace charging demand across the NJTPA region. Similarly, a TAZ with a public charging ranking of low scored among the bottom 40 percent for public charging in the region.

Residential Charging

The residential charging demand analysis (associated with both HBW and HBO trips) relies exclusively upon socio-economic data for each TAZ. This data determined a General Residential Charging (ResGeneral) Score, which is directly correlated with residential charging infrastructure demand. As such, no trip data was incorporated into this assessment.

30 Gil Tal, Michael Nicholas, Justin Woodjack, Daniel Scrivano, Tom Turrentine, Plug-in Hybrid and Electric Vehicle Research Center of the Institute of Transportation Studies, University of California, Davis. Plug-In Vehicles in the San-Diego Region: A Spatial Analysis of the Demand for Plug-In Vehicles. Presented by Gil Tal, May 9, 2012, at EVS 26, Los Angeles, CA.

31 Graham, R.L., J. Lieb, J. Sarnecki, R. Almazan, B. Neaman. Wise Investment in Electric Vehicle Charging Infrastructure through Regional Planning. EVS26 International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium, 2012.

32 The socio-economic data are scored at the CBG-level and the trip data are available at the TAZ level. NJTPA staff provided a look-up table linking each CBG with a TAZ.

The socio-economic indicators explained above were scored with different weighting factors, which were linked to survey and market research of PEV owners and based heavily on California's extensive PEV ownership data. These factors contributed to a ResGeneral Score:

$$\text{ResGeneral Score} = \sum \alpha \text{Income}, \beta \text{HEV_Ownership}, \gamma \text{Tenure}, \delta \text{ DwellingType},$$

where

$$\alpha + \beta + \gamma + \delta = 1.$$

Each weighting factor was based on the level of correlation associated with PEV ownership to date, and each factor is skewed towards the first two parameters: income and HEV ownership. The latter two factors – tenure and dwelling type – were used to differentiate amongst areas with higher potential.

The most critical parameter in this infrastructure siting analysis is income, which accounts for 60 percent of the scoring. To integrate this factor, CBGs were scored against one another by comparing the share of different income groups. This provides more granularity to the analysis than simply comparing median incomes.

The second most prominent parameter in the analysis is HEV ownership, which accounts for 30 percent of the scoring. This analysis compared the percent of HEVs owned in each CBG against the percent ownership of HEVs in that CBG's municipality and against the entire state of New Jersey. CBGs scored higher in the analysis if they had HEV ownership higher than the state median.

The tenure parameter represents the rate of home ownership relative to the median rate of home ownership for the state of New Jersey. Based on survey data and PEV market research, home ownership as a percent of the number of residential units available in a given area are short- to mid-term indicators for PEV ownership but are less effective indicators over the long-term. For this reason, the tenure parameter accounts for 5 percent of the total score. Additionally, these parameters were used exclusively to differentiate amongst areas with better than median income and HEV ownership profiles. In other words, if an area did not have a higher than median income but did have a higher than median rate of home ownership, the home ownership factor would not impact the ResGeneral Score. However, for areas with a similar median income and/or HEV ownership profile, a higher rate of home ownership would yield a higher ResGeneral Score.

For the final parameter, dwelling type, areas were scored based on the rate of single-family units relative to the median rate of single-family units. This parameter also accounts for 5 percent of the total score and a higher rate of single-family units yields a higher ResGeneral Score.

Multi-Unit Dwelling Charging

This analysis includes a new metric to estimate the likely demand for charging at MUDs. This metric was developed by using the same approach as outlined previously for the residential charging estimates, however, the value of the weighting factor for dwelling type, δ ,³³ and the structure of the scoring were modified to favor areas with above median income, above median hybrid ownership, and a high share of MUDs (instead of a higher rate of single family units).

Workplace Charging

To forecast the likely demand for workplace charging infrastructure, the results of the residential siting analysis were combined with regional travel demand data to determine the TAZs within the municipality that have the highest number of trips originating from TAZs with the highest likelihood of PEV ownership. The analysis relied upon an output matrix from the NJTPA's travel model, referred to as origin-destination trip tables for home-based work trips. The trip originating from TAZ_O was multiplied by the score determined in the residential siting analysis, ResGeneral Score_O. The likelihood of workplace charging is simply correlated with the number of trips concluding at the workplace destination TAZ_D. The letters O and D represent origin and destination.

³³ The weighting factor for dwelling type was increased to 25% from 5%, and the weighting factors for income and hybrid ownership were decreased to 50% and 20%, respectively. These changes are more subjective than the analysis behind the residential siting analysis, and it is important to update these values as the demand for charging at MUDs is better understood.

Public Charging

In the long run, public charging (also referred to as opportunity charging) will consist of predominantly Level 2 and DC fast charging,³⁴ with Level 2 being the charging type most feasible for municipalities to install and support. For this reason, the forecast for public charging focuses on Level 2 charging, using a methodology similar to the workplace charging analysis. However, instead of multiplying the ResGeneral Score by HBW trips, it is multiplied by HBO trips, which served as a proxy for public charging.

³⁴ The Association of Electrical and Medical Imaging Equipment Manufacturers (NEMA). "EVSE: Powering the Electric Vehicle." <https://www.nema.org/Products/Documents/nema+evse+presentation+for+communities.pdf>. Accessed February 1, 2017.

Appendix D: Plug-in Electric Vehicle Community Readiness Resources

This information was adapted from a collection of resources compiled by the DOE's Clean Cities program, focusing on tools, documents, websites, and other information available via DOE's Office of Energy Efficiency and Renewable Energy.

[DOE EV Everywhere Electric Vehicles: Stakeholder Solution Center](#)

STATES AND MUNICIPALITIES

States and municipalities are key players in increasing PEV readiness. The best way for states and municipalities to improve their PEV readiness is to partner with their [local Clean Cities coalition](#), which can connect them to specific regional resources and other relevant stakeholders.

- [Plug-in Electric Vehicle Readiness Scorecard](#): Hosted on the AFDC, the Scorecard allows communities to assess their readiness, receive feedback about ways to improve, read about best practices, and record progress.
- [Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects](#): This guide, which is on the DOE Clean Cities website, summarizes the best practices in streamlining permitting processes, revising codes, training emergency personnel, developing incentives, and educating the public based on the experiences of 16 PEV readiness projects across the country.
- [Reports from the Clean Cities' EV Community Readiness Projects](#): These are individual reports and community readiness plans from each of the projects, hosted on the Clean Cities website. (See list of projects in chart, below).
- [Zoning, Codes and Parking Ordinances](#): This page on the AFDC links to relevant NIST codes for electric vehicle charging.
- [Handbook for Public Charging Station Hosts](#): This handbook on the AFDC provides an overview for what cities hosting public charging stations need to know before installation.
- [Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools](#): Published by the Transportation and Climate Initiative, this guide provides information on the steps to create, administer, and amend planning processes, rules and regulations, including in zoning, parking, and permitting.
- [EV-Ready Codes for the Built Environment](#): This guide, published by the Transportation and Climate Initiative, provides an overview of building and electrical codes as relating to PEVs, as well as providing recommendations specific to jurisdictions in the Northeast and Mid-Atlantic.
- Training on PEVs for First Responders through the [National Alternative Fuels Training Consortium](#) and the [National Fire Protection Association](#) provides essential education to firefighters, police officers, EMTs and others that may need to respond to accidents involving PEVs.
- [Drive Electric Vermont Case Study](#): This case study examines the opportunities and barriers to enabling small and midsize communities to partake in the PEV market and benefit from the economic and environmental advantages of the vehicles.

EMPLOYERS

Providing charging at the workplace can encourage employees to purchase PEVs, be an attractive employee benefit, and maximize all-electric miles driven by PEV owners. The EV Everywhere [Workplace Charging Challenge](#) was a DOE program to encourage and recognize employers providing workplace charging.

- [Resources to Install and Manage Workplace Charging](#)
- [Handbook for Workplace Charging Hosts](#)

FLEETS

Like consumers, fleets can benefit from the low operating costs and other benefits associated with PEVs. [Local Clean Cities coalitions](#) can help fleets decide which technologies and models will be most appropriate to meet their needs.

- [Handbook for Fleet Managers](#): This handbook on the AFDC provides fleet-specific information on the basics of PEVs, including issues like maintenance and charging.
- [Plug-in Electric Light, Medium and Heavy-Duty Vehicle Search](#): This tool on AFDC provides information on PEVs that can be filtered by class/type and manufacturer.
- [AFLEET Tool](#): Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation Tool allows fleet managers to calculate the cost of ownership, petroleum use, GHG emissions, and air pollutant emissions of AFVs.

ELECTRICAL CONTRACTORS AND INSPECTORS

The installation of residential, workplace and public charging is essential to establishing a PEV market.

[Electric Vehicle Infrastructure Training Program](#): This program provides training and certification at community colleges and electrical training centers across the United States for people installing PEV charging equipment for residential and commercial markets.

[EVSE Residential Charging Installation Video](#): A series of segments on the Clean Cities TV YouTube channel walk electricians through the basics of installing PEV charging infrastructure in homes, including an overview of the equipment, the relevant National Electrical Codes, inspection, and best practices.

UTILITIES

Through a partnership with the Edison Electric Institute, DOE is developing a suite of tools for utilities to support the use of PEVs.

- [The Utility Guide to Plug-in Electric Vehicle Readiness](#): A guide from the Edison Electric Institute, this document covers structuring your company to support PEVs, adding PEVs to utility fleets, enhancing the customer experience, working with state and local governments, and managing the electrical grid with PEVs.
- [Utilities Power Change](#): This case study showcases how PSE&G and Southern Company's unit Georgia Power are launching workplace charging programs for their commercial customers.

ADDITIONAL RESOURCES

[At A Glance: Electric-Drive Vehicles](#)

[Charging Plug-In Electric Vehicles in Public](#)

[Charging Plug-In Electric Vehicles at Home](#)

[Resources for Electrical Contractors and Inspectors](#)

[Developing Infrastructure to Charge Plug-In Electric Vehicles](#)

[Plug-In Electric Vehicle Deployment Policy Tools: Zoning, Codes, and Parking Ordinances](#)

[Signage for Plug-In Electric Vehicle Charging Stations](#)

[Plug-In Electric Vehicle Handbook for Consumers](#)

[Workplace Charging: Charging Up University Campuses](#)

[Electric Vehicle Charging for Multi-Unit Dwellings \(webpage with links to resources and case studies\)](#)

[Massachusetts Plug-in Electric Vehicle and Charging Infrastructure Case Study](#)

[Rolling Down the Arizona EV Highway \(case study\)](#)



[San Diego Prepares for Electric Vehicles in Multi-Unit Dwelling Communities](#) (text version and video)

[Houston Energizes Deployment of Plug-In Electric Vehicles](#) (case study)

[Seattle Rideshare Fleet Adds EVs, Enjoys Success](#) (case study)

[Alternative Fuels Data Center Publications](#) (search by keyword for additional resources)

Appendix E: Multi-Unit Dwelling Plug-in Electric Vehicle Charging Resources

KEY WEBSITE

- [AFDC Electric Vehicle Charging for MUDs](#)
Includes links to guides, case studies, and other websites.

ADDITIONAL GUIDANCE DOCUMENTS

- [Install Electric Vehicle Charging Stations in MUDs](#)
- [How to Install Electric Vehicle Charging Stations at MUDs](#)
- [Increasing Electric Vehicle Charging Access in MUDs in Los Angeles](#)
- [Charging at Condos, Apartments and Community Living Areas](#)
- [How to Create an Effective Condo Association Electric Vehicle Policy](#)

ADDITIONAL CASE STUDIES

- [Overcoming Barriers to Electric Vehicle Charging in MUDs: A South Bay Case Study](#)
- [ChargePoint Customer Stories](#)

NEW JERSEY-SPECIFIC INFORMATION

- [NJ Cooperator Article: Electric Revolution On the Horizon?](#)
- MUDs Advertising PEV Charging as an Amenity
 - Dwell Luxury Apartments (<http://www.dwellcherryhill.com/amenities.php>)
 - Lincoln Apartments (<https://www.lincolnapts.com/properties/montclair-residences-at-bay-st-station-montclair-nj/amenities>)
 - Madox Apartments (<http://www.madoxapts.com/amenities/>)
- Other MUDs with Charging Stations
 - Based on data from networked charging station companies (as of September 2017)

Property	Address	City	Website
Queens Gate Apartments	675 Tea St	Bound Brook	https://www.queensgateapts.com/
South Independence	2 12th St	Hoboken	https://appliedapartments.com/buildings/south-independence-shipyard-apartments/
The Berkshire	1401 Hudson St	Hoboken	https://appliedapartments.com/buildings/the-berkshire-at-the-shipyard-hoboken-luxury-rentals/
Monaco	475 Washington Blvd	Jersey City	http://monacojc.com/
The Oakman	160 1st St	Jersey City	http://theoakmanjc.com/
Modera Lofts	350 Warren St	Jersey City	https://www.moderalofts.com/
Trump Plaza	88 Morgan St	Jersey City	
The Gateway	9 West South Orange Ave	South Orange	http://thegatewayso.com/
Greene 750	780 Bear Tavern Rd	Trenton	http://greene750.com/

PEV CHARGING SERVICE PROVIDERS

These companies specifically call out MUDs in their marketing materials/websites. Please note there may be other companies providing these services. Also note that inclusion on this list does not mean these businesses are recommended or certified in any way.

- Blink/CarCharging – <http://www.blinkcharging.com/multifamily>
- ChargePoint – <https://www.chargepoint.com/businesses/apartments-and-condos/> and <https://www.chargepoint.com/products/multi-family-home-service/>
- EverCharge – <https://evercharge.net/>
- Greenspot – <http://joingreenspot.com/ev-ownership-2/>
- SemaConnect – <https://www.semaconnect.com/personalcharging/>
- eVgo – <https://chargedevs.com/newswire/evgo-offers-convenient-ev-charging-solution-for-multifamily-properties/>
 - The Ready for Electric Vehicle (REV) program has ended, but information provided here for reference.

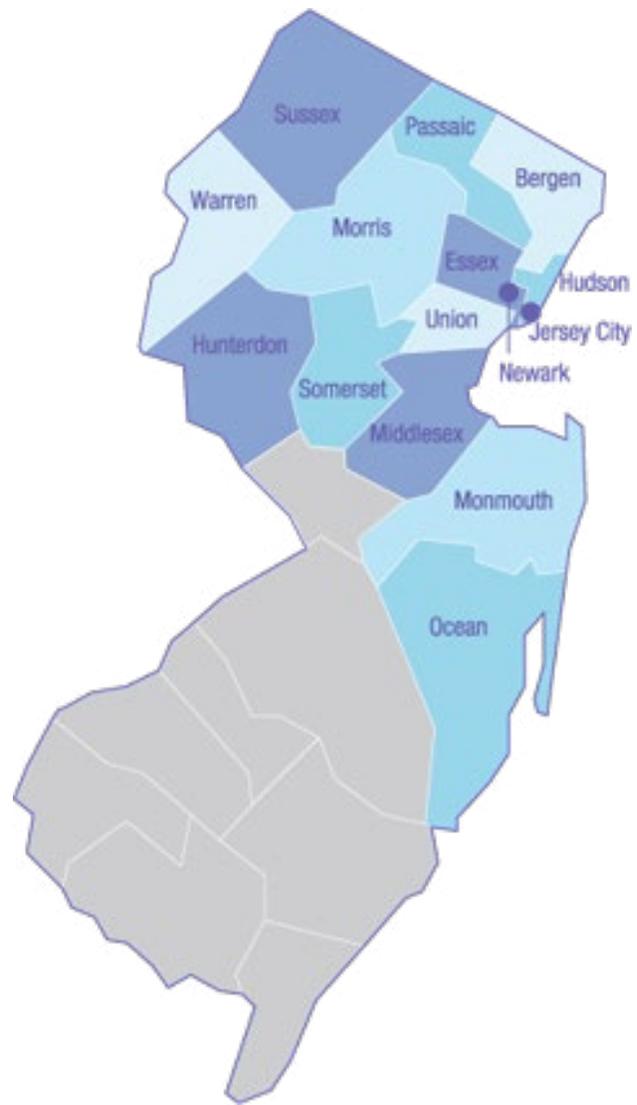
Appendix F: NJTPA Region

The NJTPA regional planning area consists of 13 counties within North New Jersey; Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, and Warren; and its two largest cities, Newark and Jersey City. The region spans 4,200 square miles, about half of the state's land area. It is the fourth largest MPO in the nation in terms of population, serving more than 6.7 million people and over 3.1 million jobs.³⁵

The region has a robust multi-modal transportation network, including 26,000 miles of roads, 255 local and express bus routes, and 13 commuter/light rail lines with 228 stations, and 18 ferry routes from 19 piers.³⁶ Situated between New York and Philadelphia, the area is a regional corridor for both intra- and inter-state transportation. According to the ACS, 34 percent of regional residents work outside their county of residence and 14 percent work outside of the state. The ACS found that the majority (70 percent) of commuters report driving alone, a rate that is significant but lower than most major metropolitan areas. In 2015, the region had 149.1 million miles of vehicle travel.³⁷

The NJTPA's regional transportation plan – Plan 2045: Connecting North Jersey – outlines the principles that guide project selection and provide policy and planning direction.³⁸ These include:

- ➔ **Help Northern New Jersey Grow Wisely** – Transportation investments should encourage economic growth while protecting the environment and minimizing sprawl in accordance with the state's Smart Growth plan, Energy Master Plan, and environmental plans.
- ➔ **Make Travel Safer** – Improving safety and security should be explicitly incorporated in the planning, design, and implementation of all investments.
- ➔ **Fix It First** – The existing transportation system requires large expenditures for maintenance, preservation, and repair, and its stewardship should be the region's highest priority.
- ➔ **Expand Public Transit** – Investment to improve the region's extensive transit network should be a high priority, including strategic expansions to serve new markets.
- ➔ **Improve Roads but Add Few** – Road investments should focus on making the existing system work better and



³⁵ NJTPA, Plan 2045: Connecting North Jersey, <https://apps.njtpa.org/plan2045>.

³⁶ New Jersey Transit, Facts at a Glance – Fiscal Year 2016, <http://www.njtransit.com/pdf/FactsAtAGlance.pdf>.

³⁷ New Jersey Department of Transportation, New Jersey's Roadway Mileage and Daily VMT by Functional Classification Distributed by County, http://www.state.nj.us/transportation/refdata/roadway/pdf/hpms2015/VMTFCC_15.pdf.

³⁸ NJTPA, Plan 2045: Connecting North Jersey, <https://apps.njtpa.org/plan2045>.

road expansion should be very limited without compromising the tremendous accessibility provided by the existing highway system.

- **Move Freight More Efficiently** – Investments should be made to improve the efficiency of goods movement because of its importance to the region’s economy and quality of life.
- **Manage Incidents and Apply Transportation Technology** – Investments should be made to improve information flow, operational coordination, and other technological advances that can make the transportation system work smarter and more efficiently.
- **Support Walking and Bicycling** – All transportation projects should promote walking and bicycling wherever possible.
- **Increase Regional Resiliency** – Investments should be made to mitigate risks associated with sea level rise, extreme weather, homeland security, and other potential threats. Investments should consider criticality of infrastructure, vulnerability, and level of risk.

While the expansion of transit and smart land-use planning work to reduce single occupant travel, the adoption of AFVs within the region will help reduce the environmental impact of the remaining vehicle trips, supporting the NJTPA’s goal of protecting the environment.

Appendix E: Outreach Materials

Updated AFV Brochure

Project One-Pager

Summary Presentation

Appendix E: Outreach Materials

Updated AFV Brochure

Project One-Pager

Summary Presentation

Alternative Fuel Vehicles & the NJTPA Region

About the NJTPA

The North Jersey Transportation Planning Authority (NJTPA) is the federally authorized Metropolitan Planning Organization for 6.76 million people in the 13-county northern New Jersey region. Each year, the NJTPA oversees ~~the investment of~~ more than \$2.1 billion in ~~federal funding for~~ transportation ~~improvement~~ projects and provides a forum for interagency cooperation and public input ~~into funding decisions~~. It also sponsors and conducts studies, assists county planning agencies and monitors compliance with national air quality goals.

The NJTPA Board of Trustees includes 15 local elected officials, including one representative from each of the 13 northern New Jersey counties—Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union and Warren—as well as from the cities of Newark and Jersey City. The Board also includes the Commissioner of the New Jersey Department of Transportation (NJDOT), the Executive Director of NJ TRANSIT, the Chairman of the Port Authority of New York & New Jersey, ~~the Director of the Governor's Authorities Unit~~ and a Citizens' Representative appointed by the Governor.

This document was prepared by the North Jersey Transportation Planning Authority, Inc. with funding from the Federal Transit Administration and the Federal Highway Administration. The NJTPA is solely responsible for its contents.

About this Brochure

This publication presents a summary of alternative fuel vehicles (AFVs) and discusses the work of the NJTPA to promote AFV readiness in the region. National attention to AFVs has grown dramatically in recent years, largely because of their potential health, environmental and economic benefits. AFVs can reduce air pollution, greenhouse gas (GHG) emissions and dependence on imported oil. Future generations depend on the decisions made today and AFVs promise to help build a more sustainable region and economy. ~~In addition, in terms of diversifying our vehicle fuel options, AFVs can add an important element of resiliency and emergency preparedness.~~

NJTPA and Alternative Fuel Vehicles

The NJTPA's Regional Transportation Plan calls for protecting the environment and reducing transportation emissions. Facilitating the marketplace for AFV adoption speaks directly to these goals.

In 2013, the NJTPA participated in the ~~Regional-Northeast~~ Electric Vehicle Network, an 11-state consortium spanning from Vermont to Washington, DC. The Network received a grant from the U.S. Department of Energy (U.S. DOE) to investigate the infrastructure needed to promote and support natural gas, biofuel and ~~plug-in~~ electric vehicles in the Northeast and Mid-Atlantic states. This effort analyzed the challenges to implementing ~~plug-in electric vehicles (electric vehicles-PEVs), and~~ provided model guidelines for zoning, siting, and other policies necessary for ~~electric vehicle charging~~ infrastructure in the 11-state region ~~and resulted in several publications to address these changes.-~~

To advance this work, the NJTPA hosted "Plug It In: Advancing Electric Vehicle Adoption in New Jersey," a public symposium held in December 2013. It featured a panel of ~~PEV~~ experts ~~on EVs~~. Much of their knowledge and experience is shared in this brochure.

The NJTPA is collaborating with Sustainable Jersey, a nonprofit that which administers a certification program for municipalities in New Jersey that want to "go green," on the development of two an "action

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items,” or recommended measures, to facilitate the adoption of electric vehicles PEVs. In October 2014, Sustainable Jersey added the Make Your Town Electric Vehicle Friendly and Public Vehicle Charging Infrastructure action items. Once the action item is approved, the organizations Sustainable Jersey and the NJTPA are now working together to can provide tools, training and other types of support to communities as they pursue this action. Completion of these activities will help a community towards earning a certification through Sustainable Jersey.

Working with the NJTPA and other New Jersey stakeholders, the Sustainable Business Initiative of the New Jersey Department of Environmental Protection NJDEP will incorporate the topic of AFVs in their mission to raise awareness, educate and motivate companies to pursue sustainability as a competitive business strategy and a shared community responsibility. Working with the NJTPA and other New Jersey stakeholders in partnership with the New Jersey Clean Air Council, the program hosted a stakeholder meeting in November 2014 will incorporate AFVs in their strategy, in efforts to focused on expanding workplace charging and supporting employer and employee incentives for the adoption of AFVs.

In 2015, the NJTPA, with the other stakeholders of Together North Jersey—a consortium of public, private and nonprofit groups—released The Plan 2015. Together North Jersey seeks to support and facilitate the adoption of municipal, county and state actions to advance AFVs across the region. Actions proposed in The Plan 2015 include incentive programs to encourage the deployment of AFVs, as well as PEV charging and alternative fueling stations.

The NJTPA has worked closely on many of these initiatives with the New Jersey Clean Cities Coalition, a U.S. DOE-designated coalition focused on promoting of public-private partnerships related to the development and use of alternative fuels, advanced technology vehicles, and the appropriate related infrastructure.

In 2016, the NJTPA is began now developing a study of local AFV readiness planning for our region and will work with three pilot municipalities – Montclair, Secaucus, and Woodbridge. Preparing such readiness plans by localities has picked up speed across the country. The NJTPA’s commitment to engaging with local municipalities is innovative, however, because most readiness planning has historically been done at the state or regional level. The study will:

- Examine regulations affecting the advancement of AFVs, explore ways to facilitate the use of these vehicles and their related infrastructure, and develop an AFV readiness plan for each of the pilot municipalities.
- Engage local decision makers, parking and housing authorities, utilities, residents and other stakeholders to identify ways to overcome challenges associated with AFV deployment.
- Develop a handbook of best practices to inform, educate and guide others in pursuing AFV readiness planning for their town or county.
-

These activities will help advance the objectives of the State of New Jersey’s Global Warming Response Act, which mandates statewide greenhouse gas emissions reductions through 2050.

What Are Alternative Fuel Vehicles?

Fuel	Description	Benefits	Challenges/Considerations
Electric	<p>All-electric vehicles (AEVs) such as <u>the</u> Nissan Leaf and Tesla models, operate completely on battery power charged from the electrical grid.</p> <p><u>Plug-in hybrid electric vehicles (PHEVs) such as the Chevy Volt, can be charged from the grid or run on the internal combustion engine (ICE).</u></p> <p>Hybrid electric vehicles (HEVs) such as the <u>original</u> Toyota Prius, have small <u>internal combustion engines</u> ICES and an electric motor <u>with a battery charged by the engine and regenerative braking.</u></p> <p><u>Plug-in hybrid electric vehicles (PHEVs) such as Chevy Volt can be charged from the grid.</u></p>	<p>Compared with conventional vehicles:</p> <ul style="list-style-type: none"> • Lower <u>life cycle (well-to-wheels)</u> GHG emissions, especially in regions that use low-polluting energy sources for electricity generation, <u>such as New Jersey</u>. • No tailpipe emissions (AEVs and PHEVs powered entirely on electricity). • <u>Lower fuel and maintenance costs</u> inexpensive to operate/maintain. • Better fuel economy. • Increased domestic energy security. • More fueling flexibility (<u>hybrid vehicles</u> PHEVs). 	<p>Challenges/Considerations</p> <ul style="list-style-type: none"> • Expensive batteries/vehicles. <p>Compared with conventional vehicles:</p> <ul style="list-style-type: none"> • Shorter driving range (<u>some EVs</u>). • Potentially long <u>long</u> recharging time (<u>EVs and PHEVs</u>). • <u>High-capacity</u> batteries take up <u>batteries take up</u> vehicle space. • Lack of available <u>public</u> charging stations (<u>EVs and PHEVs</u>). • <u>Training needed for first responders.</u>

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<http://www.afdc.energy.gov/vehicles/electric.html>

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Fuel	Description	Benefits	Challenges/Considerations
<p>Natural Gas</p>	<p>Well suited to power heavy-duty trucks and buses. Used for trucks, transit buses, taxi fleets, and school buses.</p> <p>The two main types of natural gas used in transportation are compressed natural gas (CNG) and liquefied natural gas (LNG).</p> <p>While some light-duty vehicle options are available, CNG and LNG are more frequently used in medium- and heavy-duty applications.</p> <p>Examples: CNG versions of the Honda Civic, Chevrolet Silverado 2500, Dodge Ram 2500 CNG and Ford F-250 pickups.</p>	<ul style="list-style-type: none"> • Vehicles emit <u>an 25-up to 11 percent cleaner lower life cycle GHG emissions</u>; <u>natural gas made from renewable sources, such as landfill gas and livestock operations, significantly reduces GHG emissions.</u> • <u>Can be less expensive than petroleum fuels on an energy equivalent basis.</u> • <u>Advantageous for high-mileage, centrally fueled fleets that operate within a limited area.</u> • <u>Costs about 20-60% less than petroleum fuels on an energy equivalent basis.</u> Available domestically and has widespread distribution infrastructure in place. • <u>Well-suited to power heavy-duty trucks and buses, and other high-mileage, centrally fueled fleets. Used for trucks, transit buses, school buses and taxi fleets.</u> • <u>LNG suitable for traveling long distances.</u> • <u>Since LNG occupies only a fraction of the volume of CNG, it is more economical to transport and store.</u> • <u>Bi-fuel systems offer fueling flexibility.</u> 	<ul style="list-style-type: none"> • <u>Incorporating high-pressure storage tanks into vehicle designs without taking up too much vehicle space is difficult.</u> • Fuel tanks are <u>also</u> heavier than gasoline tanks. • <u>Shorter driving range (CNG).</u> • <u>Lack of available refueling stations.</u> • <u>Limited vehicle availability.</u>
<p>Ethanol</p>	<p><u>Ethanol is an Renewable, domestically produced, alcohol fuel made from plant material. E85—an ethanol blend containing 51%-83% ethanol depending on season and geography—can be used in flexible fuel vehicles (FFVs).</u></p> <p><u>Nearly 97% of U.S. gasoline contains up to 10% ethanol (E10), which can be used in conventional gasoline vehicles and is generally used in our region.</u></p>	<ul style="list-style-type: none"> • <u>A specific blend, E85, produces lower life cycle GHG emissions and of some pollutant emissions; s than conventional vehicles—cellulosic ethanol, produced from non-food based feedstocks, significantly reduces GHG emissions.</u> • <u>FFVs typically cost the same as conventional gasoline vehicles.</u> • <u>Renewable, domestically produced fuel.</u> • <u>Can be distributed at existing gas stations, oftentimes with minimal modifications.</u> • <u>Lower GHG emissions and reductions of some toxins.</u> 	<ul style="list-style-type: none"> • <u>Can be more expensive than gasoline.</u> • <u>Limited availability.</u> • <u>Lower fuel economy.</u> • <u>E85 can only be used in flexible fuel vehicles FFVs.</u> • <u>Difficult to transport.</u> • <u>Lack of available fueling stations.</u>

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Fuel	Description	Benefits	Challenges/Considerations
Biodiesel	Biodiesel is a form of diesel replacement fuel manufactured/produced from vegetable oils, animal fats, or recycled restaurant oils. It is often available as a blend with petroleum diesel, <u>most commonly B20 (20% biodiesel), B5 (5% biodiesel), and B2 (2% biodiesel).</u>	<ul style="list-style-type: none"> Less pollutants and <u>life cycle</u> GHG emissions than petroleum-based diesel. Biodegradable, <u>non-toxic and safe to handle.</u> Can be used in most diesel engines <u>without compromising the warranty.</u> <u>Improves lubricity of fuel, reducing premature wear on vehicle parts.</u> 	<ul style="list-style-type: none"> Can be <u>currently</u> more expensive than petroleum-based diesel. Slightly lower <u>power and fuel economy.</u> <u>Lack of available fueling stations.</u>
Propane	Propane, or liquefied petroleum gas (LPG), is a clean-burning fossil fuel that can be used to power internal combustion engines/CEs. <u>While some passenger vehicle options are available, propane is more frequently used in fleet light-duty pickup and medium-duty applications.</u>	<ul style="list-style-type: none"> Potentially lower CO2, CO, and hydrocarbon GHG and pollutant <u>emissions.</u> Usually less expensive than gasoline. <u>Most LPG-propane used in the U.S. comes from domestic sources.</u> Can be used without degrading vehicle performance, <u>including similar driving range to gasoline vehicles.</u> <u>Bi-fuel systems offer fueling flexibility.</u> 	<ul style="list-style-type: none"> <u>Slightly</u> lower fuel economy. Lack of available <u>purpose-built stations with equipment designed for fueling vehicles. Less readily available than gasoline and diesel.</u> <u>Limited availability for vehicle availability currently on the market.</u>
Hydrogen	Hydrogen is <u>beginning to enter the market being explored</u> as a fuel for passenger vehicles. It can be used in fuel cells to power electric motors or burned in internal combustion engines/CEs.	<ul style="list-style-type: none"> Produces no <u>tailpipe pollutants emissions and fewer life cycle or greenhouse-gases-GHG emissions than when used in fuel-cell vehicles/conventional fuel.</u> <u>Fuel economy, range and fueling time are similar to conventional vehicles.</u> Can be produced domestically from several sources such as biomass or electrolysis of water. 	<ul style="list-style-type: none"> Releases <u>pollutants NOx</u> when burned in <u>internal combustion engines/CEs.</u> More expensive than conventional vehicles. <u>Stations currently only available at a few locations, mostly Lack of available fueling stations, particularly outside in California.</u> <u>Not yet available for sale to public/very limited vehicle availability.</u> <u>Tank requires more frequent refills compared to conventional vehicles.</u>

Alternative fuel vehicles (AFVs) use combinations of various types of non-petroleum fuels and advanced technologies to reduce the use of petroleum in on-road vehicles. The most common AFVs driven today are PEVs electric vehicles (EVs) and natural gas vehicles (NGVs).

Alternative Fuel Vehicles in the Region

There are ~~more than~~ nearly 25075 public stations offering alternative fuels in the NJTPA region. Electric and CNG fueling-charging stations are concentrated in the eastern part of the region, with the highest numbers in Bergen, Essex, Middlesex and Monmouth Counties, with some additional clusters of ~~electric fueling stations in Monmouth Hudson, Ocean Morris and Middlesex Union Counties~~ and others spread throughout the region. Public CNG stations can be found in Essex, Monmouth, Ocean and Union Counties. Over ~~100-800~~ PEVs are registered in Monmouth County and ~~nearly 100-over 2000~~ in Bergen County. In New Jersey, electric vehicles are the cleanest option since the state has a very clean mix of electric generating facilities. Nuclear energy generates almost 50% of our electricity, with zero carbon emissions at the plant site. Almost all of the remaining electricity is produced by clean burning natural gas, with an increasing portion derived from renewable sources. ~~In New Jersey, electric vehicles are the cleanest option as nuclear energy generates more than 50% of the State's electricity, with zero carbon emissions at the plant site.~~

The table below demonstrates how different types of AFVs are distributed in the region. Overall, nearly more than half of the region's AFVs are PHEVs.

Distribution of ~~Regional Alternative Fuel Vehicle Purchases-Registrations~~ in the Region (as of 2014~~6~~)

County	CNG and Propane*	Electric	PHEV	County Total
Bergen	<u>7</u>	<u>784</u>	<u>1237</u>	<u>2028</u>
Essex	<u>56</u>	<u>349</u>	<u>428</u>	<u>833</u>
Hudson	<u>4</u>	<u>113</u>	<u>218</u>	<u>335</u>
Hunterdon	<u>2</u>	<u>79</u>	<u>124</u>	<u>205</u>
Middlesex	<u>74</u>	<u>301</u>	<u>436</u>	<u>811</u>
Monmouth	<u>31</u>	<u>343</u>	<u>461</u>	<u>835</u>
Morris	<u>59</u>	<u>322</u>	<u>435</u>	<u>816</u>
Ocean	<u>10</u>	<u>79</u>	<u>287</u>	<u>376</u>
Passaic	<u>6</u>	<u>109</u>	<u>262</u>	<u>377</u>
Somerset	<u>3</u>	<u>294</u>	<u>271</u>	<u>568</u>
Sussex	<u>2</u>	<u>37</u>	<u>106</u>	<u>145</u>
Union	<u>22</u>	<u>235</u>	<u>238</u>	<u>495</u>
Warren	<u>0</u>	<u>14</u>	<u>40</u>	<u>54</u>
Region	<u>276</u>	<u>3059</u>	<u>4543</u>	<u>7878</u>

* Aftermarket conversions may not be represented in these counts.

Source: New Jersey Department of Environmental Protection (November 2016)

Commented [NS11]: Rather than maintain these numbers, refer to the NJDEP Clean Vehicles site for the county map.

Advancing Alternative Fuel Vehicles in New Jersey

In recent years, New Jersey has taken steps to encourage the increased use of AFVs, in particular PEVs and NGVs. This includes:

- Streamlining the permitting process for ~~most-residential~~ charging stations
- Providing a sales tax exemption and E-ZPass discount for battery-powered or fuel cell-powered zero emission vehicles.
- ~~Allowing government agencies at all levels to purchase EVs through the State Motor Vehicles Purchasing Contract.~~

- Including a goal in the State Energy [Master Plan](#) to increase the number of natural gas truck, bus and vehicle engines.
- Launching Drive Green New Jersey, an initiative to promote the use of PEVs in the state. The initiative includes It Pay\$ to Plug In grants of up to \$5,000 for the installation of workplace charging stations. This program complements a similar workplace charging incentive by PSE&G.
- Continuing to implement and adopt stricter California low emission vehicle standards, requiring the sale of low emission vehicles in the state.
- Engaging a variety of stakeholders to promote AFVs in conjunction with the U.S. DOE-designated [New Jersey Clean Cities Coalition](#).

Next Steps

The NJTPA ~~will be is~~ assisting in ~~preparing~~ action plans to facilitate municipal ~~AVFV~~ readiness ~~over the next few years~~. Typically, AFV readiness plans make recommendations to spur market penetration; assess town regulations that affect the advancement of AFV infrastructure; identify possible suitable locations for infrastructure; review parking ordinances; review permitting requirements and inspection processes within building departments; conduct outreach to stakeholders and potential consumers; develop guidance in addressing emergency response for AFVs; and provide recommendations for mechanical certification in the maintenance of AFVs.

~~NJTPA is collaborating with Sustainable Jersey, a nonprofit which administers a certification program for municipalities in New Jersey that want to “go green,” on the development of an “action item” of recommended measures to facilitate the adoption of electric vehicles. Once the action item is approved, the organizations can provide tools, training or other types of support to communities as they pursue this action. Completion of this activity will help a community towards earning a certification through Sustainable Jersey.~~

~~The Sustainable Business Initiative of NJDEP will incorporate the topic of AFVs in their mission to raise awareness, educate and motivate companies to pursue sustainability as a competitive business strategy and a shared community responsibility. Working with the NJTPA and other New Jersey stakeholders, the program will incorporate AFVs in their strategy, in efforts to expand workplace charging and support employer and employee incentives for the adoption of AFVs.~~

~~The NJTPA, with the other stakeholders of Together North Jersey—a consortium of public, private and non-profit groups developing a Regional Plan for Sustainable Development—seeks to support and facilitate the adoption of municipal, county and state actions to advance AFVs across the region. Actions range widely from establishing fleet procedures that enable the full range of AFVs to compete for government contracts, to developing permit and zoning procedures and/or ordinances and codes that ensure timely approval of fast charge installations for electric vehicles.~~

TITLE: Alternative Fuel Vehicle Infrastructure Planning Project

What are AFVs and what are municipalities doing to support their use?

The North Jersey Transportation Planning Authority (NJTPA), a transportation policy-making organization, is partnering with three municipalities – Montclair in Essex County, Secaucus in Hudson County, and Woodbridge in Middlesex County – to develop local “readiness” plans that encourage the use of alternative fuel vehicles (AFVs). AFVs use various types of fuels and technologies to reduce the use of petroleum in on-road transportation. The readiness plans will focus on plug-in electric vehicles (PEVs) and natural gas vehicles (NGVs). PEVs are becoming more popular passenger vehicle options while NGVs are well-suited for vehicle fleets, such as garbage and recycling collectors and delivery companies. The use of AFV technology allows residents and businesses to reduce fuel costs; save on maintenance costs; support local industries, and promote environmental sustainability.

Towns can help get more AFVs on the road and be prepared for their use by having a readiness plan in place. The plans will consider how current municipal policies and infrastructure can be improved to increase the use of AFVs, including a review of local zoning and land use ordinances, permitting requirements, and potential locations for charging and fueling stations.

The goal of this project is to make it easier for northern New Jersey residents and businesses to use AFVs. The NJTPA has been working with a variety of stakeholders to analyze the potential market as well as the benefits and challenges of using PEVs and NGVs throughout the NJTPA region. Based on the results of this analysis, strategies and recommendations will be developed for each pilot community to help them to become more PEV- and NGV-ready.

The NJTPA will also produce a guidebook so that other communities in the NJTPA region can plan for and support AFVs. While the guidebook will focus on electric and natural gas vehicles, it will also describe the benefits and challenges of other alternative fuels – including biodiesel, hydrogen, and propane – and the required infrastructure for their use.

Why is the NJTPA conducting the study?

National attention to AFVs has grown dramatically in recent years, largely because of their potential health, environmental and economic benefits. AFVs can reduce air pollution, greenhouse gas emissions, and dependence on oil.

In recent years, New Jersey has taken steps to encourage the increased use of AFVs. This includes streamlining permits for most charging stations, providing a sales tax exemption for certain vehicles, and including a goal in the New Jersey State Energy Plan to increase the number of natural gas truck, bus, and vehicle engines.

Through the AFV Infrastructure Planning Project, the NJTPA and its municipal partners will build upon and align with these efforts in order to simplify the local processes for the adoption of AFVs and increase their use, not only in the pilot communities, but throughout the NJTPA region.

To stay connected and get updates on the progress of this project, visit the NJTPA website and connect with us via social media.

Interagency Collaboration on Alternatively Fueled Vehicle Infrastructure

Project Summary Presentation

December 2017

Defining the Vision. Shaping the Future.



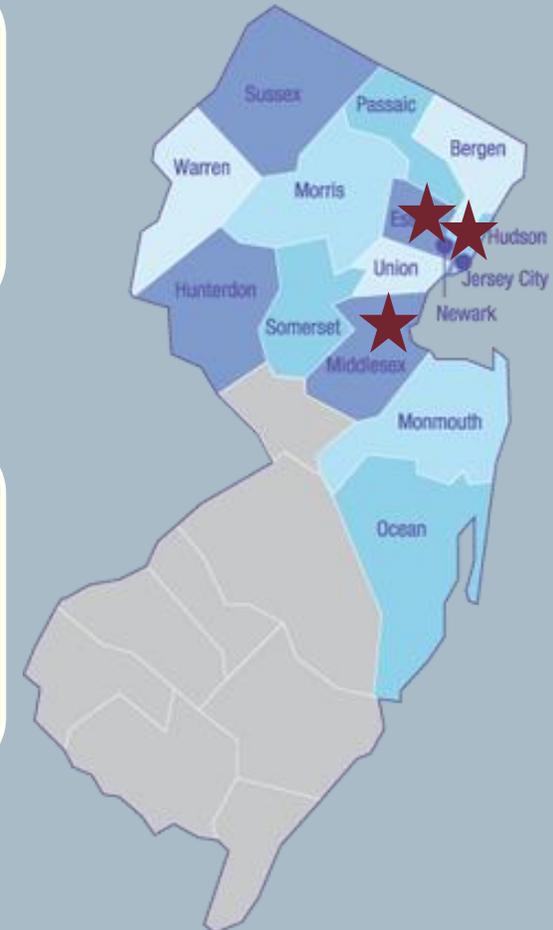
Interagency Collaboration on AFV Infrastructure Project Components

AFV Readiness Plans

- **Three pilot communities (Montclair, Woodbridge, and Secaucus)**
- **Goal: Increase use of plug-in electric vehicles (PEVs) and natural gas vehicles (NGVs)**
- **Assess demand and challenges**
- **Recommend regulatory updates and other actions (e.g., outreach)**

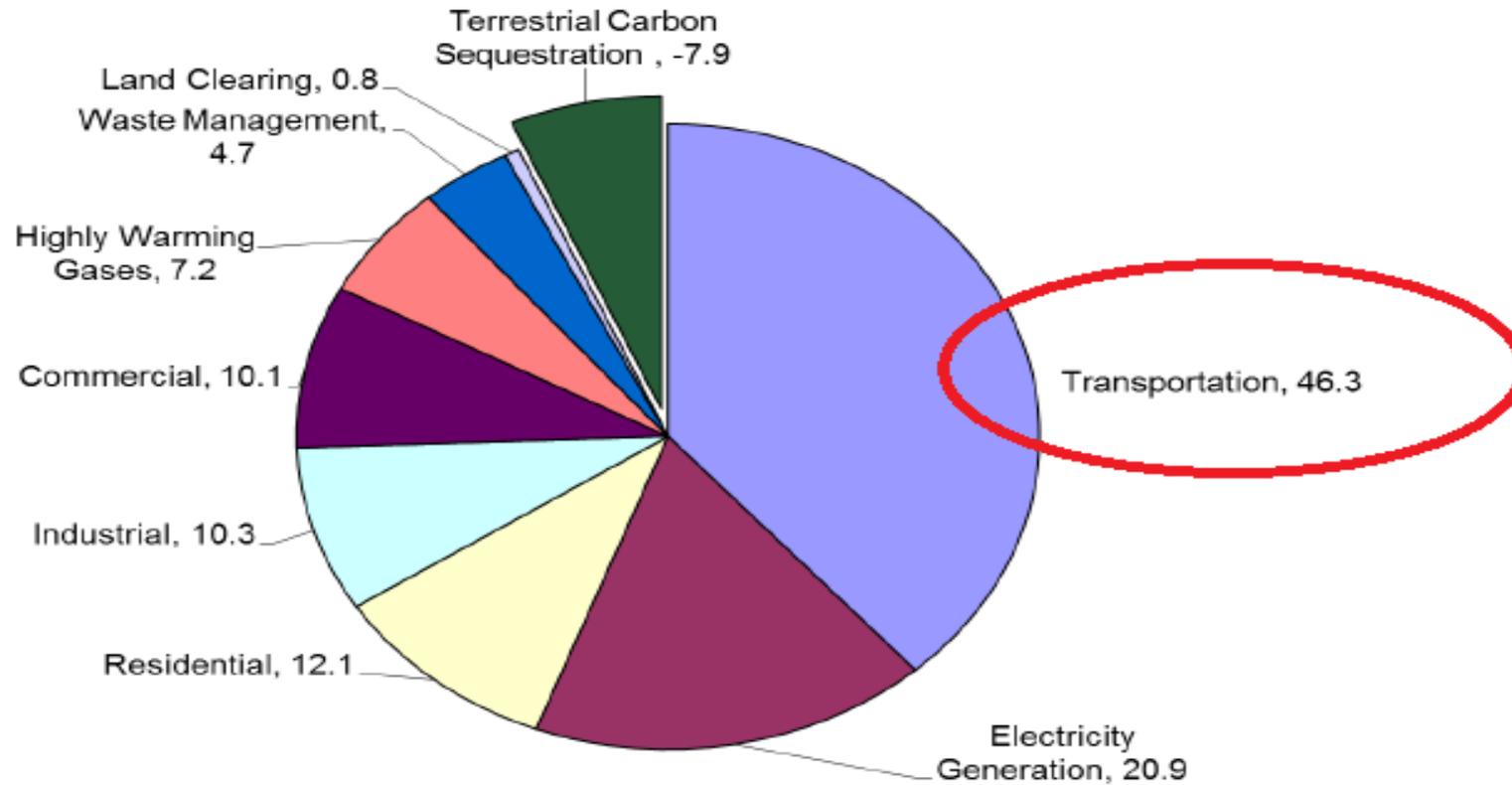
Guidebook

- **All municipalities in the region**
- **Goal: Provide guidance for communities looking to increase use of a variety of AFVs**
- **Describe benefits and drawbacks**
- **Offer recommendations and identify resources**



Why Alternative Fuels In New Jersey?

Estimated NJ Statewide Greenhouse Gas Emissions, 2012
Total emission 104.6 MMTCO₂e



Source: 2012 Update to New Jersey's Statewide Greenhouse Gas Emissions Inventory, Michael Aucott, Marjorie Kaplan, and Jeanne Herb; Rutgers University, New Brunswick, NJ, March 2015

Plug-In Electric Vehicles



Plug-in hybrid electric vehicles (PHEVs)

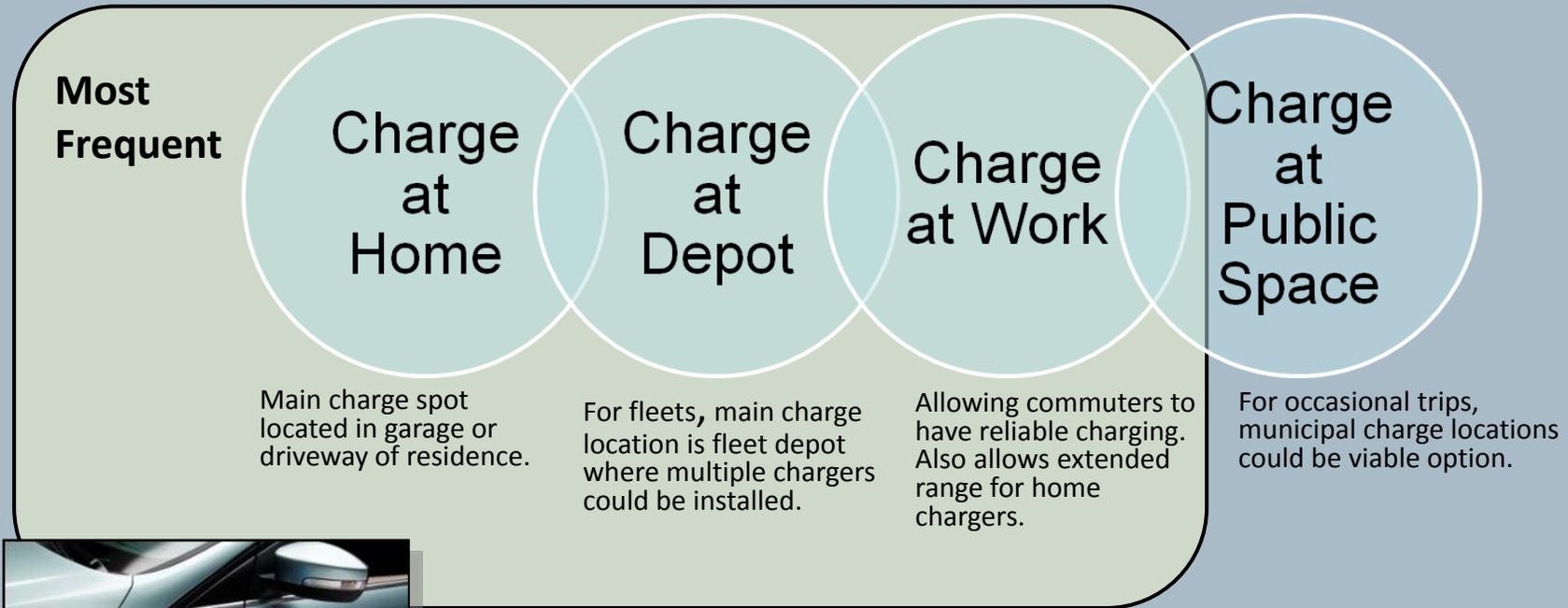
- Use a combination of gasoline/diesel engine and electric motor
- Power sources for battery recharging include electrical outlet, gasoline engine onboard vehicle, and regenerative braking
- Emission reduction varies depending on driving/charging habits and power source (grid mix)
- Example: Chevrolet Volt



Battery electric vehicles (BEVs)

- Use an electric motor
- Power source for battery charging is an electrical outlet; energy storage limited, but improving
- Zero tailpipe emissions
- Example: Nissan Leaf

Charging Infrastructure



Charging infrastructure is a key enabler to PEVs regardless of where consumers end up charging their vehicles

Natural Gas Basics

- **Fuel Types**

- Compressed (CNG)
- Liquefied (LNG)

- **Vehicle Applications**

- Medium-duty (e.g., shuttles)
- Heavy-duty (e.g., refuse, transit)

- **Benefits**

- Cleaner-burning fuel
- Less expensive, prices are less volatile than diesel
- Domestically produced
- Proven technology



CNG Fueling Infrastructure

- **Fill Types**
 - Time
 - Fast
 - Combo
- **Access**
 - Public
 - Private
 - Public/Private



Project Scope

Task 1 – Literature Review

**Task 2 – Local Readiness
Plans**

**Task 3 – AFV Readiness
Guidebook & Final Report**

Task 4 – Stakeholder Engagement

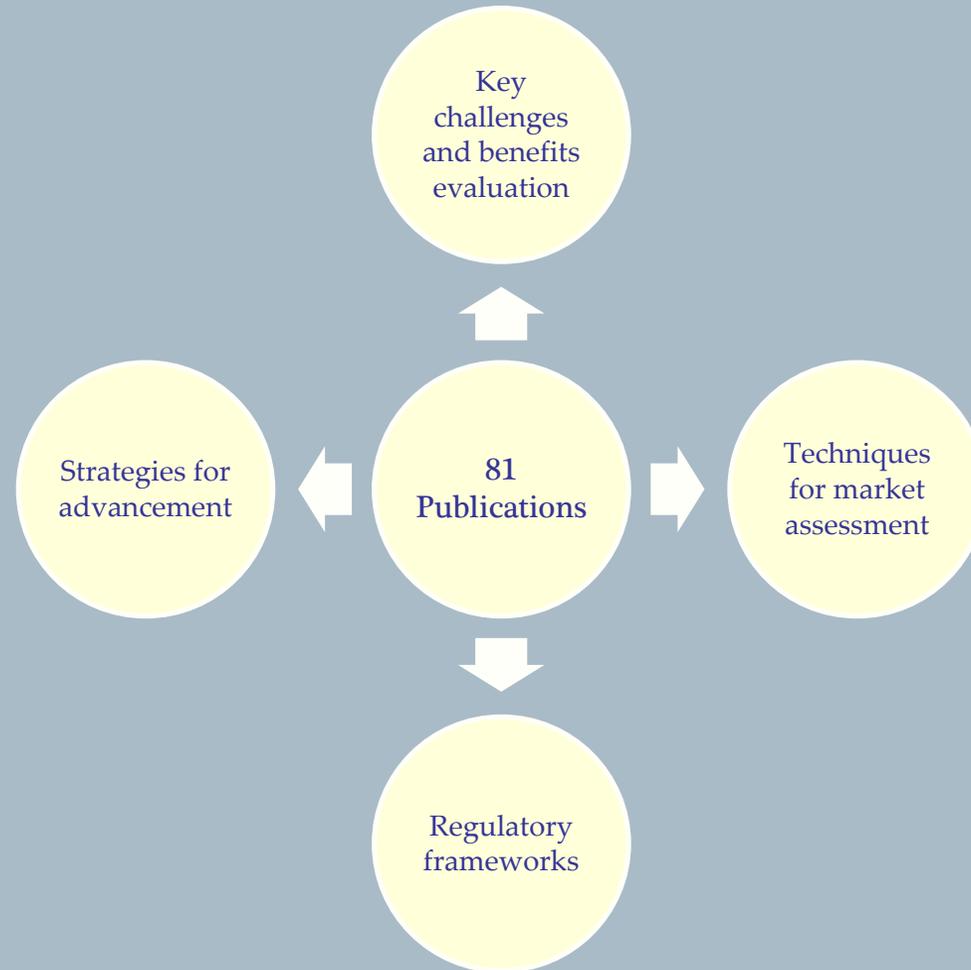
Stakeholder Advisory Committees (SAC)
Technical Advisory Committee (TAC)

Literature Review

Purpose and Goals

- Provide a baseline regarding technology, policy and regulatory frameworks, and community readiness strategies
- Highlight case studies, lessons learned, and best practices that could apply to municipalities in the region
- Identify and discuss key unaddressed issues

Literature Review



Literature Review

Key Findings

The following are important for readiness planning:

- **Regulatory elements**, including codes, standards, permitting, and parking
- **Utility and grid considerations**
- **Incentives**, financial and otherwise
- **Purposeful and inclusive infrastructure planning**
- **Clarity, collaboration, and consistency in communication**
- **Opportunities for training and education**, including municipal and fleet decision-makers and first responders

Literature Review

Key Findings

PEVs

- Key opportunities include meeting air quality and climate goals, diversifying energy mix, and stimulating economic growth
- Key challenges include vehicle cost, infrastructure and “range anxiety,” and impacts on electrical grid
- Market assessment techniques are well established
- Building and electrical codes, procurement practices, and training needs should be examined; templates and best practices exist

Literature Review

Key Findings

NGVs

- Key opportunities include **meeting environmental goals and fleet cost savings**
- Key challenges include **lack of fueling infrastructure and financing for the upfront vehicle and infrastructure cost**
- Significant **gaps in literature**, specifically in recent lessons learned
- Focus should be on **fleet applications and infrastructure**
- **Municipal codes and standards are important, but not as critical as with PEVs.**

Readiness Planning: The Basics



Municipal Readiness Plans

- Executive Summary
- Introduction
 - Municipal Goals
- PEVs, NGVs & Infrastructure
 - Current Market
 - Barriers to Increased Adoption
 - Market Outlook
 - Regulatory Framework
 - Incentives/Funding
- Recommendations & Steps to Implementation
- Appendices



Barriers to Increased AFV Adoption

- **Key Barriers for PEVs**

- Vehicle cost
- Charging station build-out
- Range anxiety
- Consumer awareness

- **Key Barriers for NGVs**

- Low gas quality for transportation applications
- Lack of incentives
- Fuel price differential

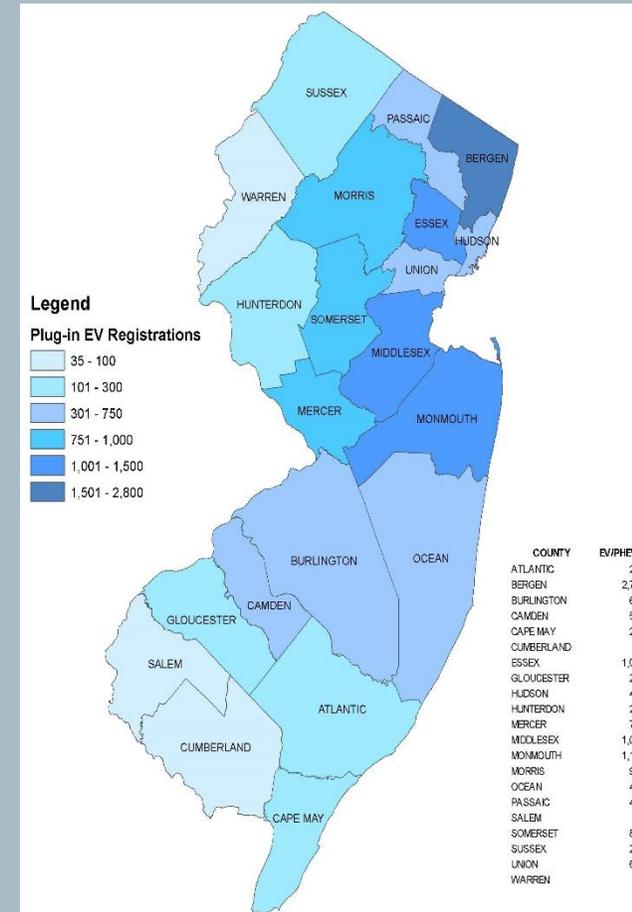
Data Collection and Analysis

Collection

- Vehicles
- Infrastructure
- Regulatory review

Analysis

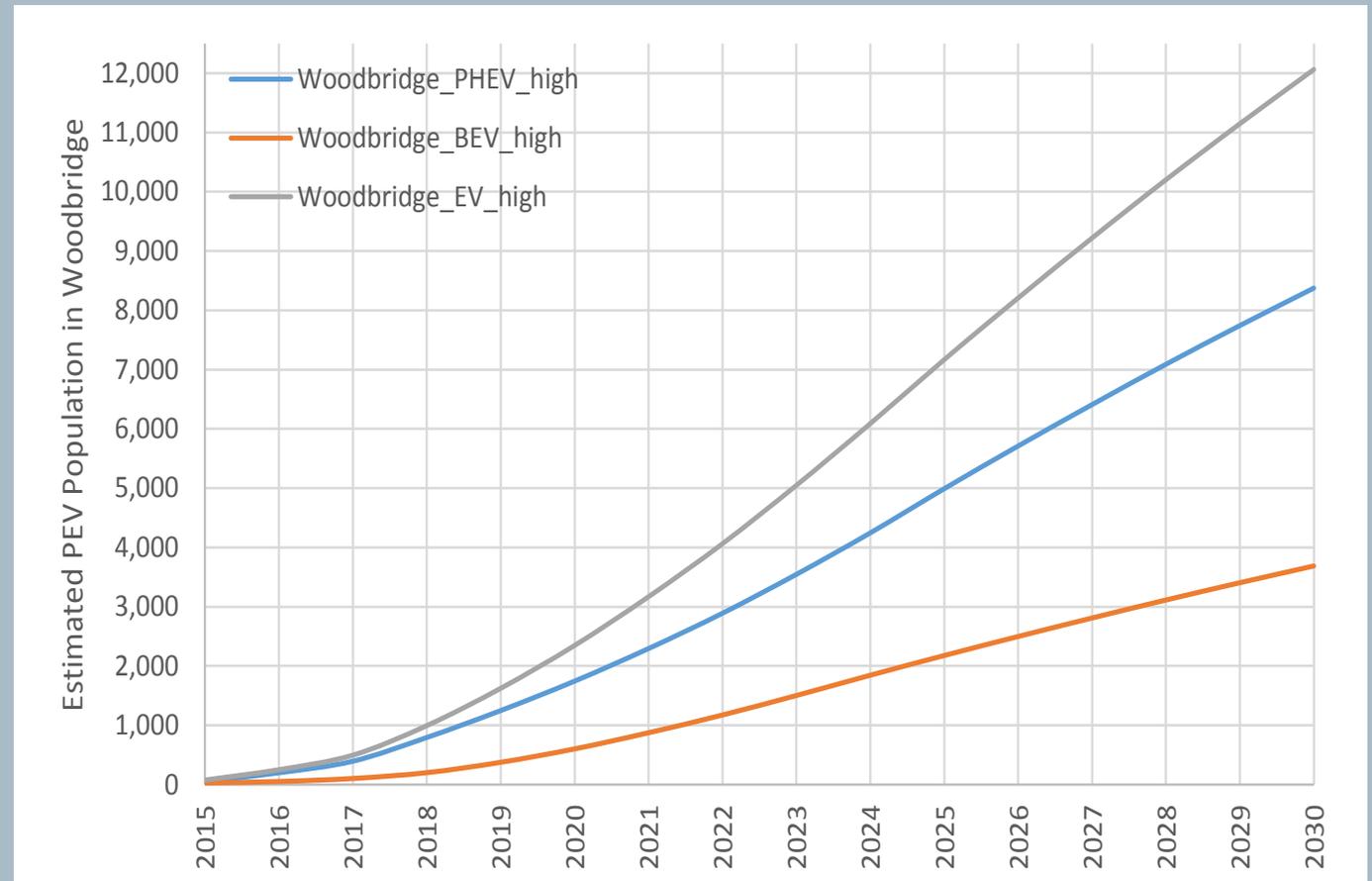
- Demand projections
- Infrastructure siting



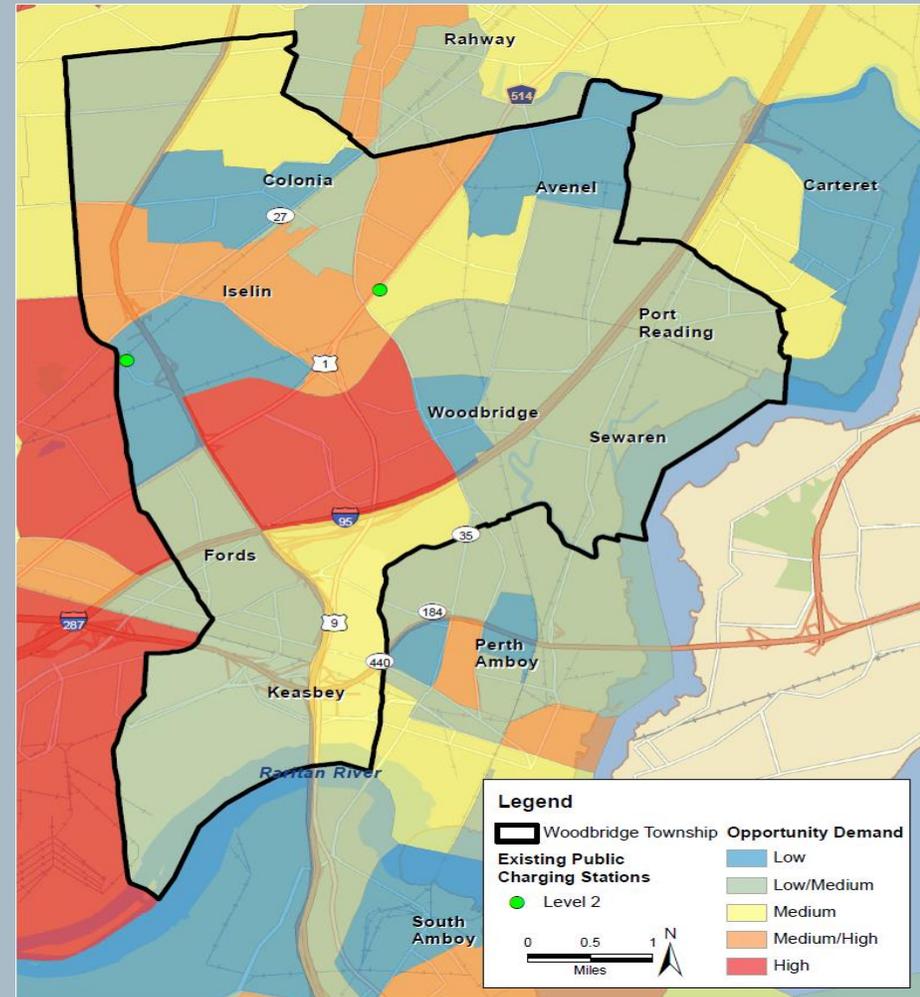
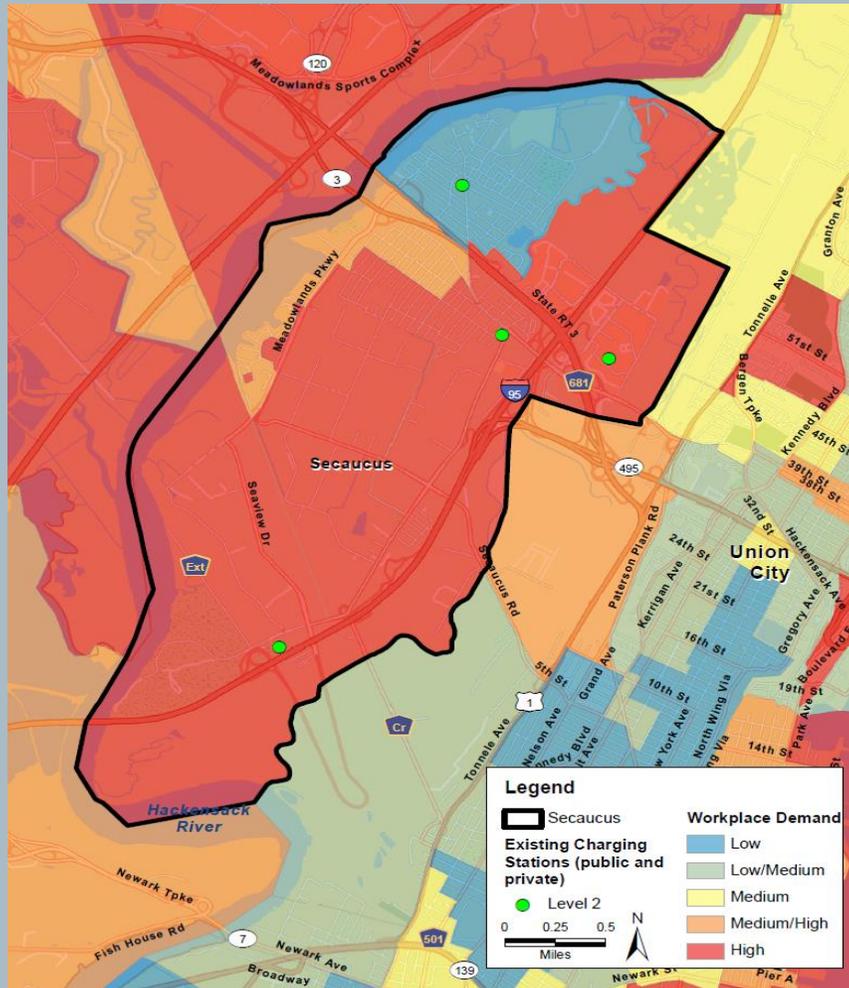
PEV Registrations, as of July 2017 (NJDEP)

Example Findings of Market Outlook

- **Projected growth in PEV market from 2016-2030**
 - Intent is to inform and prioritize planning efforts
 - Analyzed multiple adoption scenarios



Example Findings of Demand Analysis

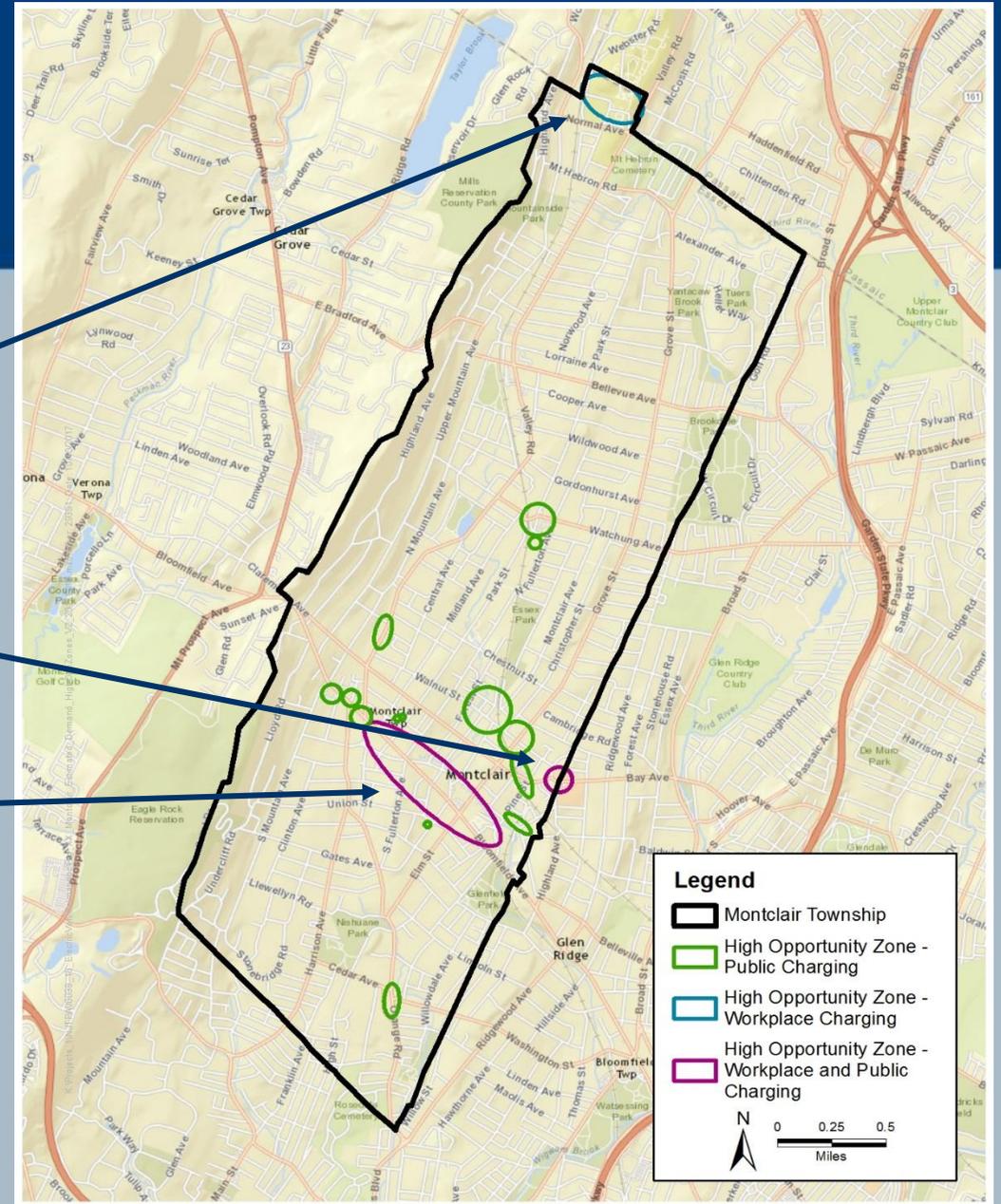


High Opportunity Zones

Montclair State University

Mountainside Hospital

Montclair Center



Readiness Plan Recommendations

Infrastructure Demand Types

- General Market Support
- Residential Charging
- Multi-Unit Dwellings (MUD)
- Workplace Charging
- Opportunity Charging

Planning/Action Areas

- General Plans & Policies
- Permitting & Inspection
- Building Codes
- Zoning & Parking Ordinances
- Fleet Planning

Example Recommendations

- **Conduct targeted outreach to employers, developers, and other landowners to install charging infrastructure at high-priority locations**
 - Near-term, led by the municipality in coordination with the TMA and others
- **Identify AFV grants and other funding opportunities for infrastructure development**
 - Ongoing, led by the municipality
- **Assess the existing municipal fleet, develop a fleet management plan, and explore opportunities for fleet AFVs**
 - Medium-term, led by the municipality

Readiness Planning: Key Takeaways

- Flexibility to respond to local conditions
- Basic information is needed
- Multi-family charging challenges and opportunities
- Importance of stakeholder engagement

Stakeholder Advisory Committees

Who?

- Key stakeholders from each pilot community representing government and business; experts in planning, transportation, and other areas

Why?

- To help guide the project by providing key local input

When?

- Three meetings in each pilot municipality over the course of the project

Technical Advisory Committee

Who?

- Key members of relevant agencies and organizations; experts in planning, transportation, and related areas

Why?

- To help guide the project by providing key input and coordination with other planned or ongoing activities

When?

- Three meetings over the course of the project
- Ad hoc input as needed

AFV Readiness Guidebook

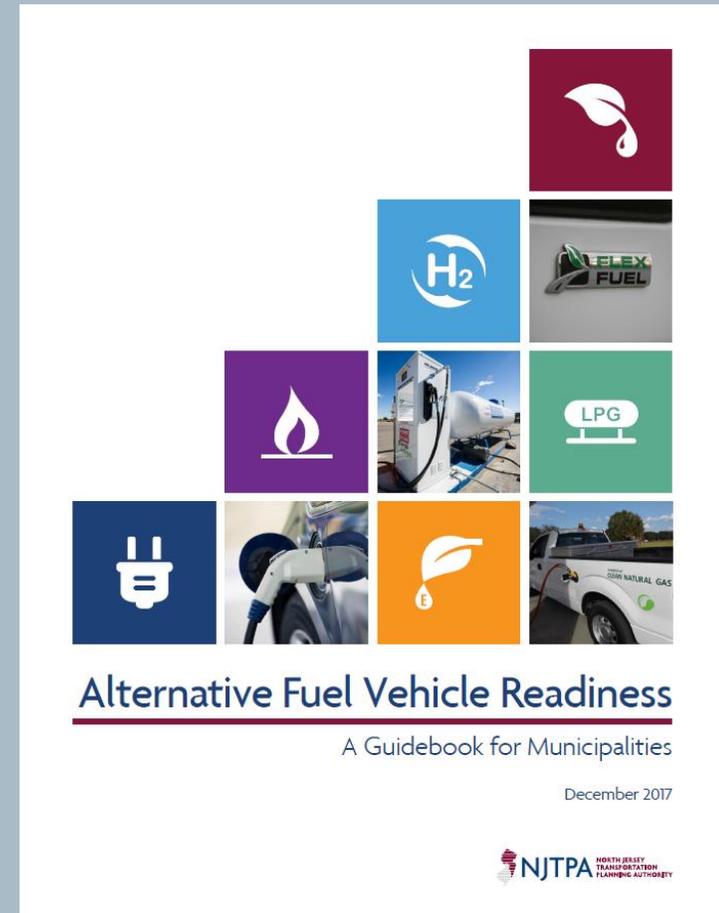
Purpose & Goals

- Incorporating lessons learned from the individual readiness plans
- For all municipalities in the NJTPA region to design and conduct AFV readiness planning efforts
- General enough to assist any community, also offering suggestions and recommendations specific enough for to put into practice

AFV Readiness Guidebook

Approach

- Comprehensive tool, with ideas on how to prioritize
- Same methodologies as the readiness plans, including example facts and figures
- Written primarily for municipal policy makers



AFV Readiness Guidebook

- **Who Should Use the Guidebook and How?**
- **Why Take Action?**
- **What are AFVs and What do they Require?**
 - EVs, NGVs, propane, biodiesel, ethanol, hydrogen
- **What Does it Take to Become AFV Ready?**
 - Steps to pursue a readiness plan
 - Lessons learned from pilot municipalities
 - Examples and resources



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