NYSERDA TRANSPORTATION PROGRAM CASE STUDY:

Leviton's Electric Vehicle Charging Station Demonstration

Final

Prepared For:

New York State Energy Research and Development Authority (NYSERDA)
Albany, NY

Jennifer Phelps, NYSERDA Project Manager

Prepared By:

Industrial Economics, Incorporated (IEc)
Cambridge, Massachusetts

Cynthia Manson, Project Manager

NYSERDA Contract 32883 March 2017

Table of Contents

List of Exhibits

1. Introduction

In 2013, New York State's transportation sector consumed more than 1,032 trillion Btus of energy, or 43 percent of the total energy consumed in the state. Approximately 92 percent of transportation energy consumption came from petroleum products. As a result of its reliance on the combustion of petroleum products, New York's transportation sector was responsible for 75 million metric tons of CO_2-equivalent emissions in 2013, or 42 percent of all fuel-borne greenhouse gas emissions in the state.[1]

Within this context, NYSERDA's Transportation Program has identified several objectives:

- To reduce and diversify the energy consumed by the transportation sector;
- To minimize greenhouse gas emissions; and
- To create economic development opportunities in New York State.[2]

The current Transportation Program builds on decades of research conducted with state and federal funding. Beginning in 2016 with the transition to NYSERDA's Clean Energy Fund (CEF), the Transportation Program adopted three focus areas: electric vehicles (EVs), public transportation, and mobility management. The project described in this case study – Leviton Manufacturing Company's EV charging station demonstration – aligns with the EV focus area.

This project was conducted as part of NYSERDA's efforts to support ChargeNY, a statewide initiative that aims to increase the number of plug-in EVs in New York State to more than 30,000 by 2018. ChargeNY also calls for at least 3,000 charging stations across New York State to support that level of EV adoption. Within this context, Leviton, an electrical wiring device and lighting controls company, submitted a proposal to NYSERDA to install 82 charging stations at workplaces across the state over a nine-month period during 2013; the project was later extended to encompass 88 charging stations installed between 2013 and 2016.

Workplace charging stations play a significant role in encouraging the adoption of EVs. In particular, research conducted by the U.S. Department of Energy (DOE) has shown that workplace charging minimizes "range anxiety," which is drivers' concern that an EV battery will run out of power before completing a trip. This research indicates that more than 50 percent of EV charging happens at drivers' homes, followed by 40 percent at the workplace, and the remaining 3-5 percent at other public locations (e.g., retail centers). Further, DOE research has found that 14 percent of EV drivers need workplace charging to complete their daily commutes, while 43 percent of EV drivers need workplace charging

[1] The remaining 58 percent of emissions from fuel consumption are associated with the residential (18 percent), commercial (13 percent), industrial (six percent), and electric generation (22 percent) sectors. NYSERDA. 2015. Patterns and Trends – New York State Energy Profiles: 1999–2013. October 2015. http://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Patterns-and-Trends.

[2] NYSERDA. 2015. Transportation Program: Product Development, Product Demonstration, and Product Deployment, Program Theory and Logic Model Report. August 2015.

some of the time.[3] In addition to providing EV drivers with a means of charging their vehicles during the work day, workplace charging stations also allow drivers to achieve a comfortable temperature inside their vehicles before driving off, while their vehicles are still plugged in, thus reducing climate-control load on the battery.[4] Workplace charging also contributes to the visibility of (and consumers' familiarity with) EVs, which can be important for spurring market adoption.

According to DOE, employees who are offered workplace charging are six times more likely to drive an EV than the average worker.[5] In addition, surveys have found that employees of organizations participating in DOE's "EV Everywhere Workplace Charging Challenge" were 20 times more likely to drive an EV than the average U.S. worker. These surveys found that one in 73 employees at Workplace Challenge organizations drive an EV, compared to the national average of one in 1,400.[6] These surveys have not, however, attempted to clarify the extent to which employees change their purchasing decisions once they have access to charging stations; it could be that the employers who invest in charging stations are those whose employees already own or plan to purchase EVs.

As a result of the growing focus on workplace charging, Leviton proposed to create a sales program for Level 2 charging stations called the Leviton Workplace Initiative. Through this initiative, Leviton would work with electrical distributors and contractors to install charging stations at workplaces across New York State. Site owners, rather than Leviton, would own and manage the charging stations. From 2013 to 2016, NYSERDA provided $972,248 in funding to Leviton, which represents approximately 50 percent of the total project cost. NYSERDA reimbursed Leviton for installation costs up to a per-site funding cap; Leviton and site owners paid 100 percent of costs above that cap. According to Leviton's final project report, most station owners were able to install charging stations for $1,500, compared to an average cost of approximately $15,000.[7] Although Leviton chose to discontinue its Workplace Initiative sales program following the conclusion of this project, Leviton successfully installed 88 workplace charging stations, resulting in reductions in gasoline consumption and

Snapshot of Benefits (2016):
88 Leviton Workplace Initiative Installations

- 15,594 charge events
- 36,014 charging hours
- 123,211 kWh dispensed
- 16,419 gallons of gasoline saved
- 220,033 lbs of CO_2 emissions avoided

Note: Gasoline saved and emissions avoided represent benefits of EV use in general; without Leviton's workplace charging stations, some portion of charging may have happened elsewhere.

Source: Leviton project data. Provided by NYSERDA on February 22, 2017.

[3] U.S. Department of Energy, Idaho National Laboratory. Charging and Driving Behavior of Nissan Leaf Drivers in the EV Project with Access to Workplace Charging. https://avt.inl.gov/sites/default/files/pdf/EVProj/WorkplaceChargingandDriving-Leaf.pdf

[4] U.S. Department of Energy. Plug-In Electric Vehicle Handbook for Workplace Charging Hosts. http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf

[5] U.S. Department of Energy. "Workplace Charging Challenge: Promote Charging at Work." http://energy.gov/eere/vehicles/workplace-charging-challenge-promote-charging-work

[6] U.S. Department of Energy. "Survey Says: Workplace Charging is Growing in Popularity and Impact" http://energy.gov/eere/articles/survey-says-workplace-charging-growing-popularity-and-impact

[7] NYSERDA. 2016. Final Report – NYSERDA Program Opportunity Number (PON) 2301. June 2016.

greenhouse gas emissions as employees increased their use of EVs.[8]

NYSERDA also worked with Leviton to increase awareness of the benefits of workplace charging stations through information dissemination. Specifically, NYSERDA published short charging station case studies on NYSERDA's website, highlighted new charging station installations on social media and at press events, and developed guidance documents for installers (i.e., electricians) and site owners.

Exhibit 2 provides additional detail on the focus of this case study. In particular, the primary intent is to understand the market development impacts of the project, including benefits achieved to date and the potential for increasing EV adoption.[9]

Exhibit 1. Evaluation Scope

Evaluation Question	Data Sources and Analytic Methods
1. How many charging stations were installed through the Leviton Workplace Initiative, and how were they distributed across the state?	• Review of the information provided by Leviton to NYSERDA as part of NYSERDA's standard follow-on reporting requirements • Interviews with former Leviton project manager and NYSERDA • Verification of findings using market research, information provided by DOE, and interviews with the coordinator of the Clean Cities Coalition of Central New York
2. To what extent was information disseminated regarding the benefits of EVs and EV charging station use?	
3. What strategies most effectively increase demand for EVs?	• Review of the information provided by Leviton to NYSERDA as part of NYSERDA's standard follow-on reporting requirements • Interviews with former Leviton project manager and NYSERDA • Exploration of strategies for increasing EV and charging station adoption using market research, results from statewide EV consumer awareness surveys, and interviews with the coordinator of DOE's Workplace Charging Challenge and Dr. Constantine Samaras and Dr. Jeremy Michalek, EV researchers

The following sections of this report discuss the evaluation questions, methods, and findings in detail. Section 2 summarizes the results of the case study analysis for each of the three evaluation questions listed in Exhibit 1. Section 3 then examines the strategic implications of those findings, including the potential for the expansion of EVs and charging stations in new markets, effective approaches that NYSERDA can build on, and remaining barriers to EV and charging station adoption that NYSERDA could address. Section 3 also proposes additional metrics that NYSERDA could use to evaluate future projects, in the context of an emerging market.

[8] Leviton continues to manufacture charging stations, despite having discontinued the direct sales program through its Workplace Initiative.

[9] This case study is part of a suite of six case studies with an overall purpose of: (1) highlighting important transportation research and development accomplishments in New York State; (2) understanding the role that the Transportation Program played in achieving those outcomes; and (3) informing Transportation Program strategy by identifying effective approaches that NYSERDA can build on and remaining market barriers to address.

2. Project Outcomes

The following sections discuss each of the three evaluation questions in detail. First, Section 2.1 discusses the number and distribution of charging stations installed through the Leviton Workplace Initiative. Section 2.2 then discusses Leviton's efforts to disseminate information regarding the benefits of EVs and workplace charging. Finally, Section 2.3 identifies effective strategies for increasing EV demand to inform the Transportation Program's future strategy.

2.1 Charging Station Installations

This evaluation first assessed the number and geographic distribution of charging stations installed through the Leviton Workplace Initiative. Based on Leviton's final project report, Leviton installed 88 charging stations, surpassing its original goal of 82.[10] These stations were installed by 57 site owners, spanning all 10 regions of New York State and a variety of workplaces, including commercial businesses, medical centers, municipal facilities, and universities. Exhibit 2 summarizes the number of charging stations installed in each region of the state.

Exhibit 1. Leviton Workplace Initiative Charging Station Installations

New York State Region	Number of Installations	Percentage of Total Installations
Western New York	2	2%
Finger Lakes	3	3%
Southern Tier	3	3%
Central New York	3	3%
North Country	7	8%
Mohawk Valley	3	3%
Capital District	8	9%
Hudson Valley	20	23%
New York City	7	8%
Long Island	32	36%
Total	**88**	**100%**

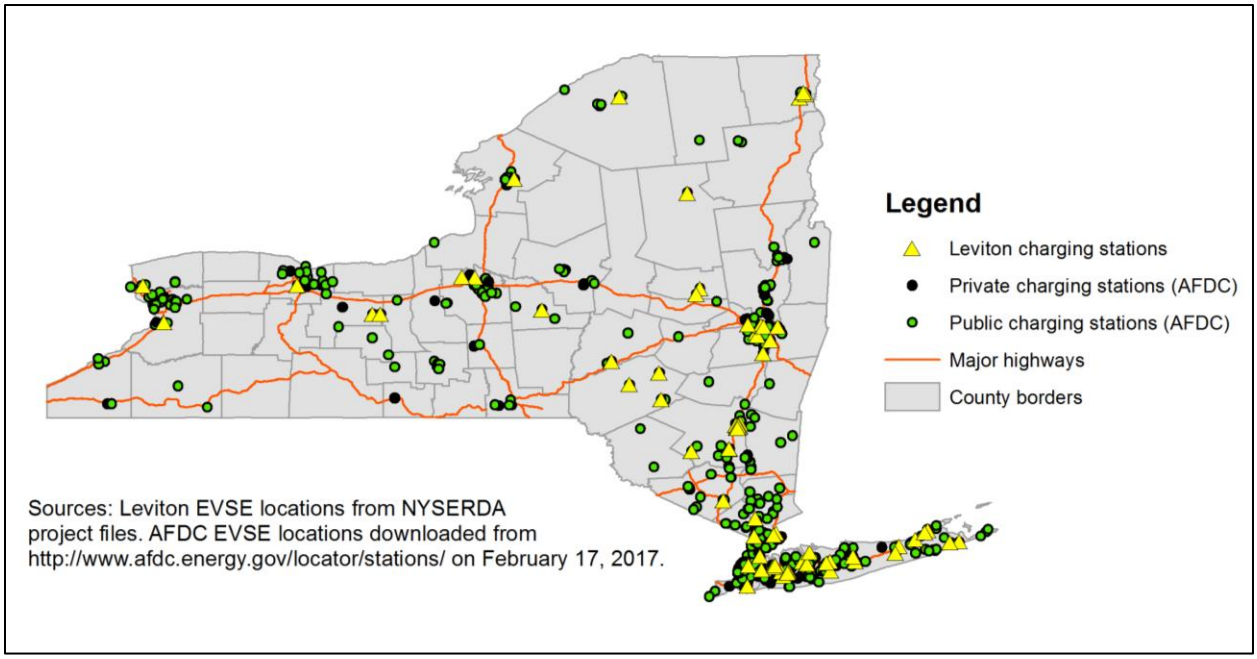
Leviton and NYSERDA generally consider these installations to have been a success. For instance, monitoring data show that the Leviton stations installed at four office buildings operated by RXR Properties in Long Island are used frequently, with 10 to 12 charge events per station per week, despite the fee that employees pay to use the stations.[11] These site owners have provided positive reviews of the stations and indicated that demand for charging has been steadily increasing, prompting RXR to consider installing additional charging stations at the same locations.

[10] NYSERDA. 2016. Final Report – NYSERDA Program Opportunity Number (PON) 2301. June 2016.

[11] NYSERDA. Case Study – RXR Realty – Multi Locations, NY. https://www.nyserda.ny.gov/-/media/Files/Publications/Case-Studies/Transportation/CNY-rxr-cs.pdf

Leviton's installations also contributed significantly to New York State's progress toward ChargeNY goals, although the state will need to accelerate deployment to reach its goals by 2018. As of February 2017, New York State had approximately 1,640 charging stations, which represents more than 50 percent of the ChargeNY goal (3,000 stations by 2018).[12] When ChargeNY was announced in 2013, New York State had approximately 500 charging stations.[13] Since then, NYSERDA has supported the installation of more than 700 new charging stations, accounting for nearly 65 percent of all new installations.[14] The Leviton Workplace Initiative charging stations represent approximately 12 percent of NYSERDA's total, or 56 percent of NYSERDA's workplace installations.[15] Exhibit 3 below maps charging station locations in New York State, highlighting those installed as part of the Leviton Workplace Initiative. Although not evenly distributed across the state, charging station installations mirror EV adoption rates (highest downstate and in western New York) and follow the state's major highways, which helps minimize range anxiety for long-distance travelers.

Exhibit 3. Charging Station Installations in New York State



[12] Alternative Fuels Data Center (AFDC). Alternative Fueling Station Locator. Downloaded February 17, 2017. http://www.afdc.energy.gov/locator/stations/

[13] NYSERDA. New York State Electric Vehicle Supply Equipment (EVSE) Deployment Program; a Charge NY Initiative: 2013 Summary. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2013-EVSE-Program-Summary.pdf

[14] NYSERDA. 2016. New York State Electric Vehicle Charging Station Quarterly Report: Report Period July through September 2016. Final Report. December 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2016-EVSE-Q3.pdf

[15] NYSERDA's workplace installations are estimated as of December 2015, the most recent period for which data are available. Sources: NYSERDA. New York State Electric Vehicle Supply Equipment (EVSE) Deployment Program; a Charge NY Initiative: 2013 Summary. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2013-EVSE-Program-Summary.pdf; NYSERDA. 2015. 2014 Annual Summary: New York State Electric Vehicle (EV) Charging Station Deployment Program. Summary Report. October 2015. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2014-ESVE-Annual-Report.pdf; and NYSERDA. 2016. 2015 Annual Data Summary: New York Electrical Vehicle (EV) Charging Station Deployment. June 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2015-ESVE-Annual-Report.pdf

Despite the initiative's success, interviewees indicated that employers in New York State remain hesitant to invest in charging stations for several reasons:

- **High installation costs:** Charging station installations require a significant initial investment. Without federal, state, or utility incentives, smaller companies may not have sufficient capital to install charging stations.[16]

- **Lack of understanding of the value proposition:** Even when funds are available, some employers may not understand the value proposition of charging stations due to lack of familiarity with EV technology. This may result, in part, from a lack of long-term data on the benefits of charging stations. Specifically, Leviton's former project manager noted in an interview that it is difficult to provide employers with estimates of lifetime costs and benefits because the lifespan of charging stations is uncertain, as the technology has not been on the market long enough to study in depth.

- **Potential space-use or policy conflicts:** In some cases, the installation of charging stations may result in space-use or policy conflicts. For instance, charging stations must be located in parking spaces with access to electricity, which are usually found next to the building. However, parking spaces close to the building must also be reserved for people with disabilities. Interviewees also described potential conflicts with employee union policies. As one example, employees at Syracuse University filed a grievance report following the installation of charging stations through the Clean Cities Coalition, asserting that employees with EVs were being provided free "fuel" since they were not required to pay for charging. Such conflicts can be minimized or avoided if employers consider potential challenges and solutions – such as implementing fee-based charging or upgrading electrical networks – early in the decision process.

2.2 Information Dissemination

Information dissemination was an important part of Leviton's initiative. For each site, Leviton provided site-specific information on charging stations prior to installation, focusing on costs and benefits to both site owners and employees. This information included:

- For site owners:

    - To help site owners understand the economics of charging stations, Leviton provided estimates of the total expected cost of electricity, as well as the cost to charge various models of EVs, compared to gasoline costs for comparable vehicles. In addition, Leviton worked directly with site owners to determine optimal locations and methods for charging station installations to minimize costs. Employers used this information to determine whether, and how much, they wanted to charge employees to use the charging stations.

    - Leviton also provided site owners with a standard set of materials with information on the benefits of EVs and EV charging stations, including potential greenhouse gas emissions

[16] A secondary concern for site owners is the potential for charging station use to result in higher demand charges if electricity use during peak hours increases. This is typically only a concern for fast chargers, not the Level 2 charging stations installed by Leviton.

reductions; reputation effects associated with visibly improving workplace sustainability; and the potential for leadership in cutting-edge, clean transportation technologies. Employers used this information for marketing and to encourage use of charging stations and adoption of EVs among employees.

- For employees: To encourage employees to consider purchasing EVs, Leviton provided information on the availability of federal, state, and utility tax and rebate incentives for EVs, as well as the marketing materials described above.

Interviewees suggested that, for future projects, site owners could benefit from additional information on common operational issues. For example, damage from snow plows is often a concern for outdoor charging stations. To prevent this, site owners suggest adding flags to charging stations to improve visibility in heavy snowfall, and to coordinate with plowing contractors in advance. Heavy rain can also create operational challenges. Although charging stations are designed to operate safely in wet areas, users may be wary of using charging stations surrounded by mud or pools of water. For this reason, routine maintenance is important.

In addition, some drivers may leave vehicles plugged into the charging station even after they are fully charged, preventing others from using the stations. The most common solution to this issue is to implement fee-based charging. For instance, to promote proper charging etiquette, one Leviton demonstration site charged $1 per hour for the first two hours of charging station use and $5 per hour beyond that in order to motivate employees to move their vehicles and make the charging station available to others.[17] Of note, this type of information has become widely available online since the initiation of Leviton's project, in part through guidance documents published by NYSERDA as part of its ChargeNY efforts.[18]

As part of an effort to inform the general public about charging stations, NYSERDA has also published case studies of 21 charging station demonstrations, including two Leviton installations.[19] These case studies provide information on each company's motivations for installing charging stations, station usage, and lessons learned, thus helping to inform site owners and other stakeholders about the benefits of and considerations for charging station installations.

To further encourage the longer-range goal of EV adoption in New York State, NYSERDA could build on the workplace information dissemination strategies employed by Leviton to engage potential EV drivers more directly. Research suggests that employees can benefit from a combination of information on EVs and opportunities to interact with EVs and current EV owners. Specifically, DOE has found that information dissemination is likely to be more successful when potential EV adopters are presented with the opportunity to test drive an EV through "Ride and Drive" events.[20] As discussed in the following section, these events are particularly influential when they feature other employees who own EVs, so that potential adopters can learn from the experience of their peers.

[17] Interview with Neil Miller, Manager of Business Development at Leviton (formerly). Conducted September 8, 2016.

[18] See: https://www.nyserda.ny.gov/Researchers-and-Policymakers/Electric-Vehicles/Info

[19] See: https://www.nyserda.ny.gov/About/Publications/Case-Studies-and-Features/Transportation-Case-Studies

[20] Interview with Sarah Olexsak, Workplace Charging Challenge Coordinator at the U.S. Department of Energy. Conducted September 13, 2016.

2.3 Strategies to Increase EV Demand

Interviewees and the literature all agree that workplace charging stations are essential for increasing EV adoption. In addition to minimizing range anxiety by allowing EV drivers to charge their vehicles during the day, workplace charging stations capitalize on the power of the "peer effect" to promote EV adoption—the idea that individuals are most likely to consider purchasing an EV when they see their peers, such as co-workers, owning and operating an EV.[21] Although Leviton decided to discontinue its direct sales Workplace Initiative after the conclusion of this project, the company continues to manufacture charging stations for workplaces. Their decision suggests that barriers to workplace charging station adoption remain and may require new or continued strategies to address.

To expand NYSERDA's efforts to increase workplace charging station installations, interviewees suggested that early installation efforts should focus on locations where employees are likely to: (1) be interested in cutting-edge technology, and (2) earn incomes high enough to afford new cars, including EVs. DOE suggested targeting technology startups and universities, as well as employers in the healthcare, pharmaceutical, and finance industries. In addition, future workplace charging programs should target suburban locations (where employers live approximately 15 miles or less from the workplace) or office parks not served by convenient public transit, since these areas tend to have ample parking and commutes short enough to minimize range anxiety.[22] Employees in suburban locations are also more likely to have off-street parking where they can install residential charging equipment.[23] Importantly, areas well served by public transit may not be good candidates for charging station demonstrations, as individuals most likely to drive EVs may also be those most likely to take public transit.[24] For these reasons, New York City and other dense urban areas may not be well suited to early EV adoption.

Several factors, including certain market conditions, dampen the demand for EVs. NYSERDA may be able to address some of these barriers through future projects:

- **Lack of awareness and familiarity among consumers and dealerships.** Many consumers remain relatively unfamiliar with EVs and, as a result, express trepidation regarding EV use and ownership. In a recent consumer awareness survey that was open to all New York State residents that own at least one car, 63 percent of the convenience sample said they would consider an EV (fully electric or plug-in hybrid) for their next car purchase.[25] Of the 37 percent that said they were not inclined to consider an EV, 43 percent reported concerns that EVs represented a new technology, or concerns that the technology is not yet ready.[26] Interviewees confirmed that these types of concerns remain common, including concerns surrounding the need to plan trips around

[21] Interview with Constantine Samaras, Assistant Professor at Carnegie Mellon University's Department of Civil and Environmental Engineering. Conducted August 24, 2016; and interview with Sarah Olexsak, Workplace Charging Challenge Coordinator at the U.S. Department of Energy. Conducted September 13, 2016.

[22] Interview with Barry Carr, Syracuse Coordinator at Clean Cities Coalition. Conducted September 14, 2016.

[23] Jeremy Michalek. 2015. Electric Vehicle Adoption Potential in the United States. Carnegie Mellon. June 2015. http://www.cmu.edu/epp/policy-briefs/briefs/Electric-Vehicle-Adoption.pdf

[24] Interview with Jeremy Michalek, Professor of Mechanical Engineering and of Engineering and Public Policy at Carnegie Mellon University. Conducted September 15, 2016.

[25] Essense, 2016. EV Branding and Marketing Development. August 2016. (28)

[26] Essense, 2016. EV Branding and Marketing Development. August 2016. (34)

charging locations and battery range, finding charging stations, safety issues, and finding qualified mechanics. A second consumer awareness survey of likely car buyers in New York State found that only 57 percent of those surveyed considered themselves to be "somewhat" or "very" knowledgeable about EVs.[27]

That same survey showed, however, that drivers are interested in learning more about EVs. Of likely car buyers in New York State, 84 percent indicated they were interested in learning more about EVs.[28] Unfortunately, dealerships, which should serve as a source of information for potential EV adopters, currently lack knowledge about EVs as well. As a result, some dealerships may intentionally or unintentionally discourage consumers from purchasing EVs.[29]

- **Lack of infrastructure and services available for EV drivers.** Although EV infrastructure and services (e.g., charging stations, authorized mechanics) are increasing, coverage is still low compared to the level infrastructure and services available for conventional fuel vehicles. As illustrated in Exhibit 3, some parts of New York State have better coverage than others. In addition, some areas (e.g., New York City) may not currently have the electric grid capacity necessary to support widespread EV adoption.[30] Coordination with utilities may be required to support infrastructure planning that accounts for EVs and incorporates smart charging mechanisms to encourage EV drivers to charge during off-peak hours.[31]

- **Limited coverage in the mainstream media.** Coverage in the mainstream media can help raise consumers' level of comfort and familiarity with new technologies such as EVs. To date, with the exception of Tesla, EVs have received little coverage. Although Tesla manufactures luxury cars that use non-standard charging technology, interviewees believed that its coverage in popular media is likely having a positive effect on EVs of all types.

- **Market factors, including the high purchase price of EVs and low gasoline prices.** The purchase price of EVs remains high relative to conventional fuel vehicles, although prices are decreasing rapidly with advances in battery technology. Low gas prices, however, also dampen demand for EVs. Studies have shown that when gas prices increase to $4-5 per gallon, drivers begin to consider EVs more seriously.[32] Unlike the other barriers listed, NYSERDA cannot influence gas prices.

[27] Edelman Intelligence. 2017. EV Audience Identification and Message Testing Report. January 2017. Supporting data provided via email on March 22, 2017.

[28] Edelman Intelligence. 2017. EV Audience Identification and Message Testing Report. January 2017. Supporting data provided via email on March 22, 2017.

[29] Interview with Neil Miller, Manager of Business Development at Leviton (formerly). Conducted September 8, 2016 & Interview with Jeremy Michalek, Professor of Mechanical Engineering and of Engineering and Public Policy at Carnegie Mellon University. Conducted September 15, 2016.

[30] PlaNYC, 2010. Exploring Electric Vehicle Adoption in New York City. January 2010. http://www.nyc.gov/html/om/pdf/2010/pr10_nyc_electric_vehicle_adoption_study.pdf

[31] PlaNYC, 2010. Exploring Electric Vehicle Adoption in New York City. January 2010. http://www.nyc.gov/html/om/pdf/2010/pr10_nyc_electric_vehicle_adoption_study.pdf

[32] Interview with Neil Miller, Manager of Business Development at Leviton (formerly). Conducted September 8, 2016.

2.4 Overall Results

The Leviton Workplace Initiative successfully installed charging stations at workplaces in all ten regions of New York State and contributed substantial progress toward the ChargeNY goal of 3,000 charging stations by 2018. In 2016, Leviton's installed charging stations dispensed a total of 123,211 kWh, displacing 16,419 gallons of gasoline and reducing CO_2 emissions by an estimated 220,033 pounds.[33] The initiative also prioritized information dissemination to promote EV adoption and charging station use; although interviewees suggested that additional information could have been helpful for site owners and employees, NYSERDA and Leviton worked together to publish case studies and guidance documents that can be used in the future.

The results of this case study, coupled with a review of the literature, indicate that installing charging stations at workplaces should remain a central strategy for the promotion of EVs. Workplace charging is particularly important because it both minimizes range anxiety and increases the potential for "peer effects" to influence purchase decisions. However, market forces, including a current lack of familiarity with EVs among consumers and dealerships and low gas prices, may dampen demand. Future workplace charging station projects should consider targeting industries most likely to be early technology adopters. In addition, NYSERDA should continue to track consumer awareness through statewide surveys to understand the degree to which exposure to charging stations (workplace and other) and accompanying information, such as the materials provided by Leviton or those published online by NYSERDA, have influenced EV demand.

[33] Leviton project data. Provided by NYSERDA on February 22, 2017.

Exhibit 4. Results Summary

Progress Achieved	Gaps in Achievement
Evaluation Question 1: How many charging stations were installed through the Leviton Workplace Initiative, and how were they distributed across the state?	
Leviton installed 88 charging stations, surpassing its original goal of 82. Stations were installed by 57 site owners at a variety of workplaces across all 10 regions of New York State: • Western New York: 2 (2%) • Finger Lakes: 3 (3%) • Southern Tier: 3 (3%) • Central New York: 3 (3%) • North Country: 7 (8%) • Mohawk Valley: 3 (3%) • Capital District: 8 (9%) • Hudson Valley: 20 (23%) • New York City: 7 (8%) • Long Island: 32 (36%)	Some employers remain hesitant to invest in charging stations. Reasons include: • High installation costs • Lack of understanding of the value proposition • Potential space-use or policy conflicts
Evaluation Question 2: To what extent was information disseminated regarding the benefits of EVs and EV charging station use?	
Leviton provided each site with information on: • Total expected electricity cost • Cost to charge various models of EVs, compared to gasoline costs for comparable vehicles • Potential emissions reductions • Reputation effects associated with visibly improving workplace sustainability • Potential for transportation technology leadership • Available federal, state, and utility tax and rebate incentives for EVs	Employers could benefit from additional information on common operational issues (e.g., maintenance of outdoor charging stations in rain and snow conditions, fee-based charging systems). Employees could benefit from testimonials or "Ride and Drive" events with their peers.
Evaluation Question 3: What strategies most effectively increase demand for EVs?	
Workplace charging station installation is an essential strategy for increasing EV demand. Key workplaces to target: • Technology startups, universities, and employers in the healthcare, pharmaceutical, and finance industries • Suburban and office park locations not served by convenient public transit opportunities	EV adoption is limited by: • Lack of familiarity with EVs among consumers and dealerships • Lack of infrastructure and services for EV drivers • Limited coverage in the mainstream media • Market factors, including high purchase prices and low gas prices

3. Strategic Implications

Although state and federal policies often serve as key drivers of EV adoption, NYSERDA's efforts have been, and can continue to be, effective at reducing one of the key market barriers to EV adoption. The results of this case study indicate that there are several approaches NYSERDA can build on in future projects to promote EV adoption. These include:

- **Continuing workplace charging station installation efforts:** Literature documents that workplace charging stations are essential for EV adoption. Given the need for additional information sharing in the emerging EV market, NYSERDA could place particular emphasis on communicating the value proposition of charging stations and various ownership models to potential demonstration sites in the future. NYSERDA can build on its previous efforts by working with the following partners:
    - **Charging station demonstration site owners:** EVs are still a relatively new technology, so available information is limited. NYSERDA could consider encouraging demonstration site owners (including employers who participated in the Leviton Workplace Initiative) to speak about their experiences with charging stations to other organizations in their own professional networks.
    - **EV-focused organizations:** To complement NYSERDA's current focus on reducing technical barriers to EV adoption and increasing charging station visibility, NYSERDA should continue to coordinate efforts with organizations that will more directly promote consumer awareness and EV adoption. Organizations that may be valuable partners include the Clean Cities Coalitions of New York State and the U.S. Department of Transportation's Smart City Challenge. As one example of successful partnership, NYSERDA recently awarded funding to the Clean Cities Coalition to promote workplace charging at local businesses and to engage dealerships in marketing EVs.
    - **Utilities:** Utilities can serve as a strategic partner given their connection to large commercial customers and their necessary role in the charging station installation process.[34] Utilities may be interested in promoting EVs as an opportunity to grow their market while diversifying service offerings.

- **Prioritizing highly visible charging station installations:** Because of the power that peer effects can have on technology adoption, in addition to workplaces, NYSERDA could consider prioritizing installations of charging stations in highly visible locations. For example, NYSERDA could support charging station installations in multifamily residential buildings, where residents may not otherwise have access to at-home charging, or public parking garages in city centers, which can attract a large number of EV drivers and potential EV adopters.

- **Encouraging employee surveys:** Surveys are one of the most effective means of gauging demand for charging stations. According to DOE, employees are often considering purchasing an

[34] In addition, when fast chargers are installed, utilities may be able to work with site owners to integrate storage or smart charging mechanisms to avoid an increase in demand.

EV but hesitate to do so because of the lack of workplace charging.[35] By encouraging project partners to administer employee surveys prior to installing charging stations, NYSERDA can help site owners align their investment with employee demand. In addition, understanding employee demand prior to charging station installation can help NYSERDA more accurately quantify the benefits of its efforts.

The three evaluation questions considered in this case study provide high-level insights into project impacts. Given the need for increased consumer engagement to support widespread EV adoption, NYSERDA could consider asking project partners to collect information on employee engagement. For example, research conducted by DOE shows that information dissemination is particularly effective when paired with opportunities to interact with EVs and current EV drivers; to encourage that type of interaction, NYSERDA could ask project partners to report on employees' adoption of or level of interest in EVs (as determined by employee surveys) or attendance at "Ride and Drive" events. With this type of information, NYSERDA could better leverage workplace charging station installations to promote EV adoption. In addition, NYSERDA should continue to track consumer awareness statewide by replicating baseline surveys conducted in 2016. These surveys can help NYSERDA understand the degree to which exposure to charging stations and information dissemination materials are effective at increasing EV demand.

[35] Interview with Sarah Olexsak, Workplace Charging Challenge Coordinator at the U.S. Department of Energy. Conducted September 13, 2016

4. References

Alternative Fuels Data Center (AFDC). Alternative Fueling Station Locator. Downloaded February 17, 2017. http://www.afdc.energy.gov/locator/stations/

Edelman Intelligence. 2017. EV Audience Identification and Message Testing Report. January 2017. Supporting data provided via email on March 22, 2017.

Elizabeth J. Traut, TsuWei Charlie Cherng, Chris Hendrickson, and Jeremy J. Michalek. 2013. U.S. Residential Charging Potential for Electric Vehicles. Transportation Research. 2013. http://www.cmu.edu/me/ddl/publications/2013-TRD-Traut-etal-Residential-EV-Charging.pdf

Essense, 2016. EV Branding and Marketing Development. August 2016.

Interview with Adam Ruder, Program Manager at NYSERDA. Conducted August 10, 2016.

Interview with Barry Carr, Syracuse Coordinator at Clean Cities Coalition. Conducted September 14, 2016.

Interview with Constantine Samaras, Assistant Professor at Carnegie Mellon University's Department of Civil and Environmental Engineering. Conducted August 24, 2016.

Interview with Jeremy Michalek, Professor of Mechanical Engineering and of Engineering and Public Policy at Carnegie Mellon University. Conducted September 15, 2016.

Interview with Neil Miller, Manager of Business Development at Leviton (formerly). Conducted September 8, 2016.

Interview with Sarah Olexsak, Workplace Charging Challenge Coordinator at the U.S. Department of Energy. Conducted September 13, 2016.

Jeremy Michalek. 2015. Electric Vehicle Adoption Potential in the United States. Carnegie Mellon. June 2015. http://www.cmu.edu/epp/policy-briefs/briefs/Electric-Vehicle-Adoption.pdf

Leviton project data. Provided by NYSERDA on February 22, 2017.

National Renewable Energy Laboratory. 2014. California Statewide Plug-In Electric Vehicle Infrastructure Assessment. November 2014. http://www.nrel.gov/docs/fy15osti/60729.pdf

NYSERDA. 2015. 2014 Annual Summary: New York State Electric Vehicle (EV) Charging Station Deployment Program. Summary Report. October 2015. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2014-ESVE-Annual-Report.pdf

NYSERDA. 2015. Site Owners of Electric Vehicle Charging Stations on Commercial Properties: Best Practices Guide. December 2015. https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Transportation/ChargeNY-Site-Owners-EV-Charge-Stations-Commercial-Best-Practices.pdf

NYSERDA. 2015. Workplace Charging. August 2015. https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Transportation/ChargeNY-Workplace-Charging-Policy-Brochure.pdf

NYSERDA. 2015. Workplace Electric Vehicle Charging Policies. December 2015. https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Transportation/ChargeNY-Workplace-EV-Charging-Policies.pdf

NYSERDA. 2016. 2015 Annual Data Summary: New York Electrical Vehicle (EV) Charging Station Deployment. June 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2015-ESVE-Annual-Report.pdf

NYSERDA. 2016. Final Report – NYSERDA Program Opportunity Number (PON) 2301. June 2016.

NYSERDA. 2016. New York State Electric Vehicle Charging Station Quarterly Report: Report Period July through September 2016. Final Report. December 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2016-EVSE-Q3.pdf

NYSERDA. Case Study – RXR Realty – Multi Locations, NY. https://www.nyserda.ny.gov/-/media/Files/Publications/Case-Studies/Transportation/CNY-rxr-cs.pdf

NYSERDA. New York State Electric Vehicle Supply Equipment (EVSE) Deployment Program; a Charge NY Initiative: 2013 Summary. https://www.nyserda.ny.gov/-/media/Files/Publications/EV-Charging-Station-Data/2013-EVSE-Program-Summary.pdf

PlaNYC, 2010. Exploring Electric Vehicle Adoption in New York City. January 2010. http://www.nyc.gov/html/om/pdf/2010/pr10_nyc_electric_vehicle_adoption_study.pdf

U.S. Department of Energy. 2013. Plug-In Electric Vehicle Handbook for Workplace Charging Hosts. August 2013. http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf

U.S. Department of Energy. 2014. Charging and Driving Behavior of Nissan Leaf Drivers in the EV Project with Access to Workplace Charging. November 2014. https://avt.inl.gov/sites/default/files/pdf/EVProj/WorkplaceChargingandDriving-Leaf.pdf

U.S. Department of Energy. 2014. Survey Says: Workplace Charging is Growing in Popularity and Impact. November 2014. http://energy.gov/eere/articles/survey-says-workplace-charging-growing-popularity-and-impact

U.S. Department of Energy. 2015. Workplace Charging Challenge Mid-Program Review: Employees Plug-In. December 2015. http://energy.gov/sites/prod/files/2015/12/f27/105313-5400-BR-0-EERE%20Charging%20Challenge-FINAL_0.pdf

U.S. Department of Energy. 2016. Higher Education PEV Charging Webinar. March 2016. http://energy.gov/sites/prod/files/2016/04/f30/WPCC_HigherEducationWebinarSlides_0316.pdf

U.S. Department of Energy. 2016. Top 15 Ways to Promote PEVs at Work. 2016. http://energy.gov/eere/vehicles/top-15-ways-promote-pevs-work

U.S. Department of Energy. 2016. Utilities Power Change: Engaging Commercial Customers in Workplace Charging. 2016. http://energy.gov/eere/vehicles/utilities-power-change-engaging-commercial-customers-workplace-charging

U.S. Department of Energy. 2016. Workplace Charging Challenge: Join the Challenge. 2016. http://energy.gov/eere/vehicles/workplace-charging-challenge-join-challenge

U.S. Department of Energy. 2016. Workplace Charging Challenge: Promote Charging at Work. 2016. http://energy.gov/eere/vehicles/workplace-charging-challenge-promote-charging-work

U.S. Department of Energy. 2016. Workplace Charging Credit for Green Building Certification. 2016. http://energy.gov/eere/vehicles/workplace-charging-credit-green-building-certification

U.S. Department of Energy. 2016. Workplace Charging Toolkit: Workshop Best Practices. 2016. http://energy.gov/eere/vehicles/workplace-charging-toolkit-workshop-best-practices