

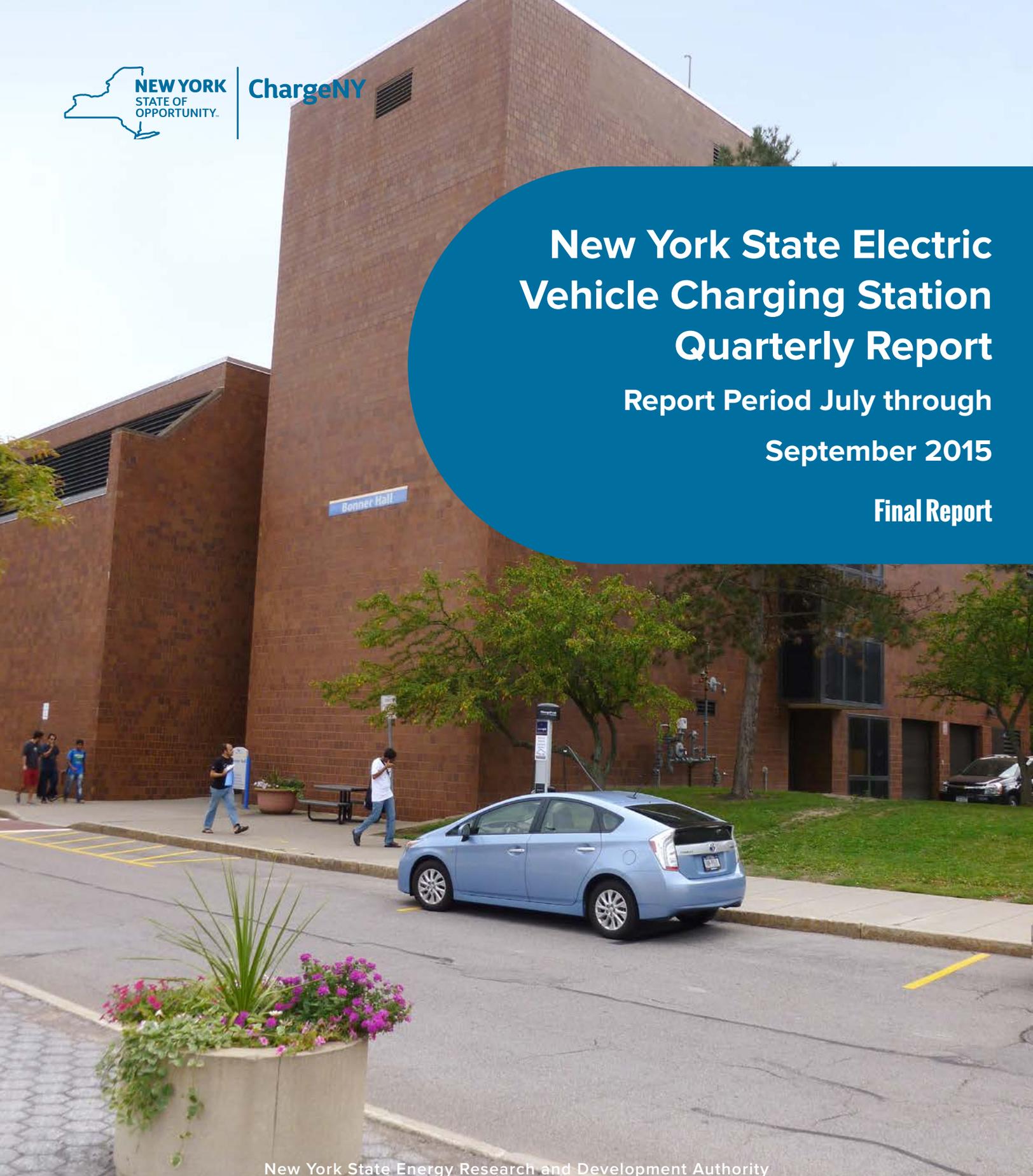


ChargeNY

New York State Electric Vehicle Charging Station Quarterly Report

Report Period July through September 2015

Final Report



New York State Energy Research and Development Authority

December 2015

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NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

Mission Statement:

Advance innovative energy solutions in ways that improve New York's economy and environment.

Vision Statement:

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

New York State Electric Vehicle Charging Station Quarterly Report

Report Period July through September 2015

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1 Introduction

The New York State Energy Research and Development Authority (NYSERDA) made financial grant awards in 2012 and 2013 to more than a dozen organizations to install Level 2 electric vehicle (EV) charging stations (also referred to as electric vehicle supply equipment [EVSE]) across the New York State. These installations support Governor Andrew M. Cuomo's ChargeNY initiative. The initiative set the goal of a statewide network of up to 3,000 public and workplace charging stations to support up to 40,000 plug-in vehicles on the road by 2018. Since the program's inception in 2013, New York State has supported the installation of over 600 charging ports (bringing the statewide total to more than 1,200), revised regulations to clarify charging station ownership rules, and supported research and demonstration projects on new PEV technologies and policies.

The NYSERDA-funded EVSE projects represent a wide range of business models and approaches for providing public charging infrastructure. One NYSERDA program goal is to learn how the stations are used, including which types of locations and business models are the most promising. By doing so, NYSERDA is paving the way for future private sector charging station investment. Charging station usage data and analysis are shared with the public through these quarterly data reports.

2 Charging Station Usage in New York

The NYSERDA Electric Vehicle Charging Infrastructure Report in Appendix A summarizes the usage of EVSE that were installed by the NYSERDA program. Only EVSE with at least one charging event during the past quarter were included in the analysis, which does not reflect the total number of charging stations installed to date through the NYSERDA program. The first page overview in Appendix A is most useful to electric utilities. Subsequent pages present usage statistics based on various station attributes, which are useful to current and future EVSE site owners. Data was collected for every charging port, which means that a charging station with two charging connections (a dual port station) was counted as two ports.

EVSE access types are defined as follows:

- **Public EVSE** are available to any EV.
- **Limited EVSE** are installed specifically for, but may not necessarily be restricted to, a select group (e.g., employees, apartment building tenants, or hotel guests).

EVs are likely connected to a charging station the entire time that they are in EV dedicated parking spaces. However, the vehicles only draw power until the battery pack is finished charging. The Charging Demand plot on the first page of Appendix A shows the total electrical power used by all active NYSERDA-funded stations at different times of day. This data indicates the total electrical grid impact from EVs charging at NYSERDA-funded public stations. It is important to note that this data does not reflect all EV charging in New York State. Public charging stations that were not funded by the NYSERDA project and home charging were not included in this analysis.

The remainder of Appendix A includes the same table and charts for various charging station subsets including: access type, required payment, land use type, region, and venue. Site owners who are considering installing charging stations can use this data and analysis to understand how sites similar to theirs are used and which attributes may lead to better utilization.

The data tables include summary results for **charging events** (total and average per week), **energy consumed** (total, average per week, and average per charging event), **average time with a vehicle connected** (percentage and hours), and **average time with a vehicle drawing power** (percentage and hours). The **energy consumed** is an indication of the electrical energy requirements provided by the host location. The **average time a vehicle is connected** is the duration drivers stay at the location as a consumer, client, or employee.

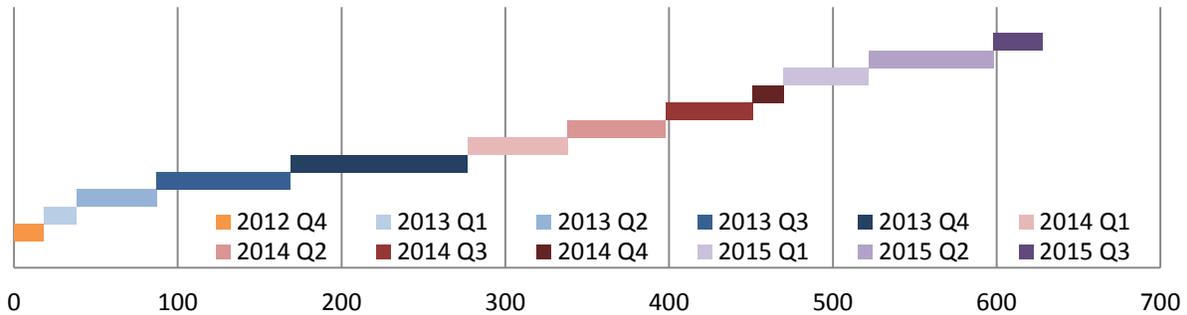
If the average time with a vehicle drawing power is significantly less than the average time a vehicle is connected, then the EV is occupying the station longer than necessary, and should be moved to allow other EVs to charge. Site owners can use all of these metrics to help decide whether installing EVSE is a good investment (directly or indirectly). These results also provide insights into whether or not to charge EV drivers for using the station, and if charging, the most appropriate fee structure to use (fees can be set by session, time, or energy consumed).

The three line charts on the last five pages of Appendix A display the **differences in length of time a vehicle is connected, differences in length of time a vehicle is drawing power, and differences in energy consumed** to show variations in charging behavior within the EVSE groups (e.g., a large portion of retail location charging events are very short, compared to a more uniform distribution of charge event durations for parking lots/garages in New York City). The final bar chart displays the **range of charging events per port per week**, which shows the difference between the most and least utilized ports as compared to the average for those charging stations.

3 Data Comparisons to Previous Quarter

Figure 1 shows the quarterly growth of installed charging stations through NYSERDA’s program. Between December 2012 and September 2015, the NYSERDA EV Charging Station Program funded the installation of 628 charging ports, 30 of which were installed during the last quarter.

Figure 1. Growth in Installed EVSE Ports Supported by NYSERDA Funding



On average, an electric vehicle was connected to these charging stations 4.6% of the time in the past quarter, a 2.2% increase from the previous quarter. Table 1 and Table 2 show the data results by subset for the percentage of time with a vehicle connected for the average this quarter and change from last quarter (highest results are highlighted in green).

Table 1. Percentage of Time with a Vehicle Connected with Access Type, Payments and Land Use

Access Type	2015 Q3 Average	Change from 2015 Q2	Payment	2015 Q3 Average	Change from 2015 Q2	Land Use	2015 Q3 Average	Change from 2015 Q2
Limited	6.0%	20.0%	Free	5.0%	0.0%	Urban	5.9%	-6.3%
Public	4.0%	-11.1%	For Fee	2.6%	4.0%	Suburban	4.2%	7.7%
						Rural	2.2%	46.7%

Table 2. Percentage of Time with a Vehicle Connected by Region and Venue

Region	2015 Q3 Average	Change from 2015 Q2	Venue	2015 Q3 Average	Change from 2015 Q2
Finger Lakes	7.9%	12.9%	Multi-Family	8.0%	73.9%
Long Island	6.8%	36.0%	University/Medical	7.4%	7.2%
Capital District	5.2%	6.1%	Parking (non-NYC)	6.6%	4.8%
Hudson Valley	4.2%	-25.0%	Workplace	4.4%	-22.8%
New York City	4.2%	-10.6%	Parking (NYC)	3.9%	-13.3%
Western NY	3.0%	-31.8%	Leisure Destination	3.4%	-8.1%
Central NY	1.7%	0.0%	Retail Location	2.2%	0.0%
North Country	1.9%	58.3%	Transit	1.9%	35.7%
			Hotel	1.4%	-41.7%

The charging stations installed through the NYSERDA EV Charging Station Program are used much more heavily during weekdays than on weekends. Most stations are in locations for use by the general public, but the greatest use likely comes from EV drivers who park and charge while working nearby. A peak in charging demand around 9 am on weekdays supports that idea.

Although limited access stations are occupied for a higher percentage of time, public access stations average more charging events per port per week and dispense more electricity per charging port. This is because the average length of time a vehicle connects per charge event for public access stations is 3.1 hours, compared to 6.0 hours for the limited access stations. Both groups of stations provide about 2 hours of actual charging per charge event. Thus, the public access stations have a quicker vehicle turnaround and are more readily available for other vehicles to use, while the limited access stations may be occupied well after vehicles are fully charged.

Compared to stations that have a usage fee, free charging stations have double the percentage of time with a vehicle connected and drawing power because they experience almost three times more charging events per week. However, when the “for fee” stations are used, those EV drivers stay connected longer and consume more energy per charge event.

Charging stations in urban and suburban settings are used much more frequently than stations in a rural setting. However, rural charging stations are still used almost once per week on average and provide more electricity per charge event than suburban stations, indicating a value for these charging ports when EV drivers travel to or through rural communities.

Charging stations installed in the Finger Lakes Region (includes Rochester) and the Capital District experience the most charge events per week at 3.3 and 3.0 events, respectively, which is 50% more than the next closest region. Although New York City has the lowest number of charge events per week at 0.9, it had considerably higher amounts of electricity consumed per charging event, most likely due to a large number of EVs with bigger battery packs (Teslas).

Multifamily dwelling stations showed a significant increase in the average percentage of time with a vehicle connected, making them the top performer for that parameter. However, those stations also had one of the lowest average percentage of time with a vehicle drawing power. Given the limited number of charging ports (18) installed at this type of venue, a few EVs might have been plugged in for multiple days, which is a reasonable expectation for this type of venue.

Universities or medical campuses and parking lots outside of New York City continued to be the most used charging station location venues. Significant increases in charging station use were seen by hotels, transit stations, and multifamily dwellings—venues where EV drivers tend to park for longer periods of time. Retail location-based charging stations averaged the highest number of charging events per week, but these were mostly short events where the vehicle was only plugged in for about 1 hour. Six of the top 10 stations with the highest average number of charge events per week were at Price Chopper supermarkets (retail; Figure 2).

Figure 2. Charging Station at Price Chopper in Plattsburgh



4 Data Comparisons to Other Published EVSE Reports

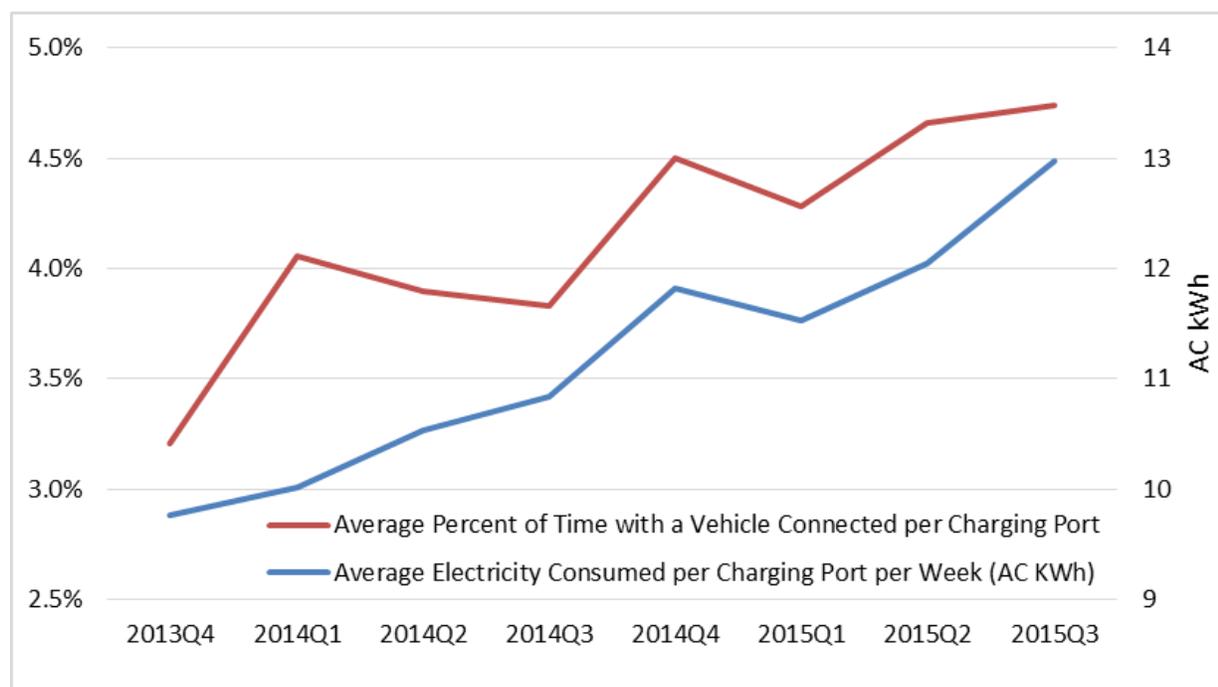
The U.S. Department of Energy launched a large plug-in electric vehicle (PEV) infrastructure demonstration with two large-scale projects, The EV Project and ChargePoint America, to understand how EV drivers use charging stations. Between January 1, 2011, and December 31, 2013, this combined project installed nearly 17,000 alternating current (AC) Level 2 charging stations for residential and commercial use and over 100 dual-port direct current (DC) fast chargers in 22 regions within 15 states plus the District of Columbia. Only the ChargePoint America project included charging station deployments in New York State with around 350 charging units in the New York Metropolitan Area (New York, New Jersey, and Connecticut). More than 8,000 privately owned Nissan Leafs and Chevrolet Volts, as well as more than 300 Smart ForTwo Electric Drive vehicles in Car2Go car-sharing fleets, were enrolled in the project. The purpose was to build a living laboratory to study its use and learn. To accomplish this, Idaho National Laboratory collected and analyzed data from the electric vehicle charging stations and vehicles enrolled in the project. Data collected from vehicles and charging infrastructure over the three-year project period captured almost 125 million miles of driving and 6 million charging events, providing the most comprehensive view of PEV and charging usage to date. The findings were summarized in a recently published report by Idaho National Laboratory entitled “*Plugged In: How Americans Charge Their Electric Vehicles*”.¹ The following conclusions were drawn from this effort and correlate to this ongoing NYSERDA EV Charging Station Program:

1. The median charging frequency per public Level 2 charging station site (excluding workplaces) was 1.4 charges per week, with 75% of the 2,400 public Level 2 sites nationwide averaging four or fewer charging events per week.
 - During the past quarter, the median charging frequency per public Level 2 charging station site (excluding workplaces) was 2.2 charges per week, approximately 50% higher. In addition, 68% of the 203 NYSERDA EV Charging Station Program sites (excluding workplaces) averaged four or fewer charging events per week. This demonstrates slightly higher utilization than The EV Project and ChargePoint America.

¹ <http://avt.inl.gov/pdf/arra/SummaryReport.pdf>

2. While public charging station use was higher in regions with higher PEV sales, there were examples of highly used charging sites in almost every region and at venues that did not seem to be well-suited for charging. Conversely, there were also many charging sites in seemingly ideal locations that did not experience much use.
 - The most PEVs in the State are located in Long Island, Hudson Valley, and New York City. However, the highest charging station use was Rochester/Finger Lakes Region, Long Island, and the Capital District, which does not exactly correlate with the PEV population.
 - Similarly to the observations found in the nationwide projects, charging station use is very dependent on local factors. During this past quarter two retail locations in North Country and Western New York, where there are not many PEVs, experienced some of the highest use. On the other hand, there were charging stations at workplaces in Long Island and the Hudson Valley that were among the least used stations.
3. Public Level 2 charging stations installed in locations where vehicles were typically parked for longer periods of time were often among those most frequently used. These locations included shopping malls, airports and commuter lots, and downtown parking lots or garages with easy access to a variety of venues.
 - This observation was not found in the NYSERDA EV Charging Station Program stations. Multifamily dwellings and parking lots outside of New York City typically have longer dwell times and did show a higher percentage of time with a vehicle connected to the station. However, hotels and transit stations, which also have longer dwell times, had the lowest percentage of time with a vehicle connected to the station among the various venues.
 - For the NYSERDA EV Charging Station Program stations, there was a much stronger correlation between station usage and land use type (associated with population density). Stations in urban settings were used more than suburban settings, and both urban and suburban stations were used more than stations in rural settings.
4. Overall usage of public Level 2 charging stations was low, but it slowly increased over the course of the projects.
 - A slight increase in percentage of time with a vehicle connected to the station and electricity consumed has also been demonstrated in the NYSERDA EV Charging Station Program as shown in Figure 3.

Figure 3. Change in Charging Station Utilization Over Time



5. The installation cost of public Level 2 charging stations ranged from \$600 to \$12,660, with an average cost of \$3,108. Cost primarily depended on the distance from the facility’s electrical panel to the charging station location, and varied regionally due to labor costs.
 - For the NYSERDA EV Charging Station Program, installation cost ranged from \$1,554 to \$25,785 per station, with an average cost of \$7,435.
 - The factor most influencing costs was the number of stations installed per location. Locations where multiple stations were installed had a much lower installation cost per station because that often only required some extra materials and minimal additional time. Individual station installation is also why installation costs are much higher for the NYSERDA EV Charging Station Program than The EV Project and ChargePoint America. Most installations in New York were single stations, where the nationwide projects typically had several stations installed per location.
 - In addition to the distance from the facility’s electrical panel to the charging station location impacting the installation costs, another strong influence on the overall installation costs was the type of surface material the installer had to excavate and repair (dirt, pavement, concrete walkways, etc.) to lay the electrical conduit from the building to the station.

A few additional learnings from the Idaho National Laboratory report are highlighted here. Unlike The EV Project and ChargePoint America, the NYSERDA EV Charging Station Program is not collecting data on individual PEVs or installing DC fast chargers, so it is not possible to correlate the following conclusions with this project’s findings in New York State.

1. The majority of charging was done at home and work, with about half the project participants charging at home almost exclusively. Of those who charged away from home, the vast majority favored three or fewer away-from-home charging locations.
2. Workplace charging was found to be an effective range extender, allowing some Nissan Leaf owners to drive their Leaf to work even on days when their round-trip commute exceeded the vehicle's range based on home charging alone. About 30% of drivers only charged at work on most days. This result shows that workplace charging could make PEVs viable for people without access to home charging.
3. PEV drivers who plugged in away from home tended to drive more EV miles. In fact, drivers who frequently used away-from-home charging stations averaged 72% more daily miles on electricity alone than drivers who never charged away from home.
4. DC fast chargers were used much more frequently than most public Level 2 stations, with a median use frequency of 7.2 events per week. A quarter of the fast chargers averaged over 15 events per week, and one unit averaged 70 events per week. The most highly used DC fast chargers tended to be located close to interstate highway exits. Interestingly, these units were used by local vehicles as much or more than they were used to recharge vehicles traveling on the interstate.

Appendix A: NYSERDA Electric Vehicle Charging Infrastructure Report

NYSERDA Electric Vehicle Charging Infrastructure Report

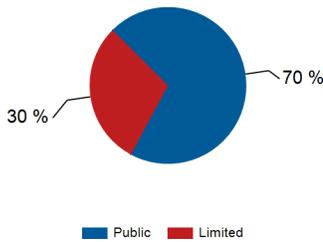
Report period: July 2015 through September 2015

New York State

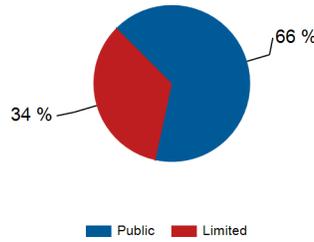
EVSE Usage - By Access Type

	Public	Limited ³	Total
Number of charging ports ¹	306	179	485
Number of charging events ²	8,328	3,506	11,834
Electricity consumed (AC MWh)	50.96	26.38	77.34
Percent of time with a vehicle connected	4.0%	6.0%	4.7%
Percent of time with a vehicle drawing power	2.3%	2.1%	2.2%

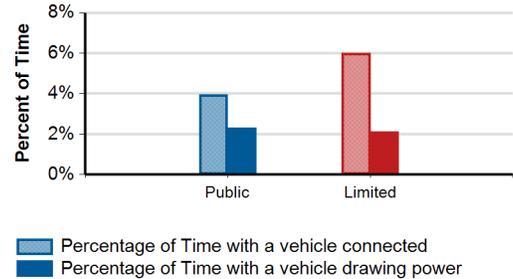
Number of Charging Events



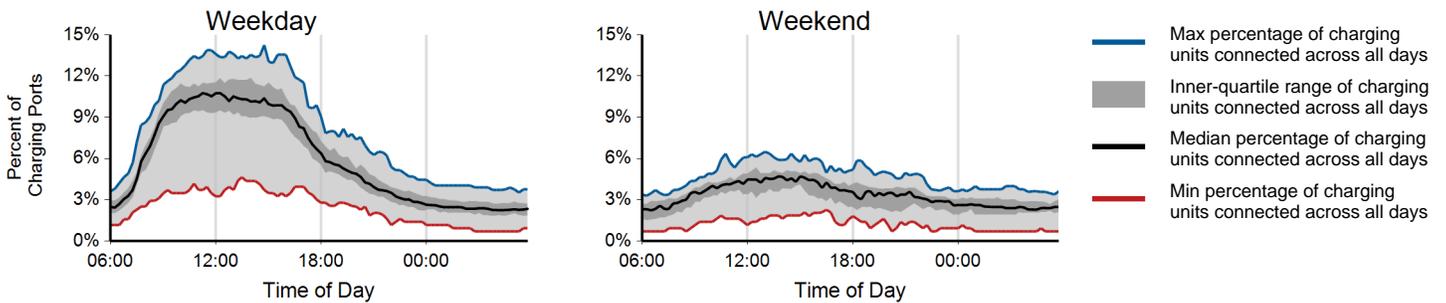
Electricity Consumed



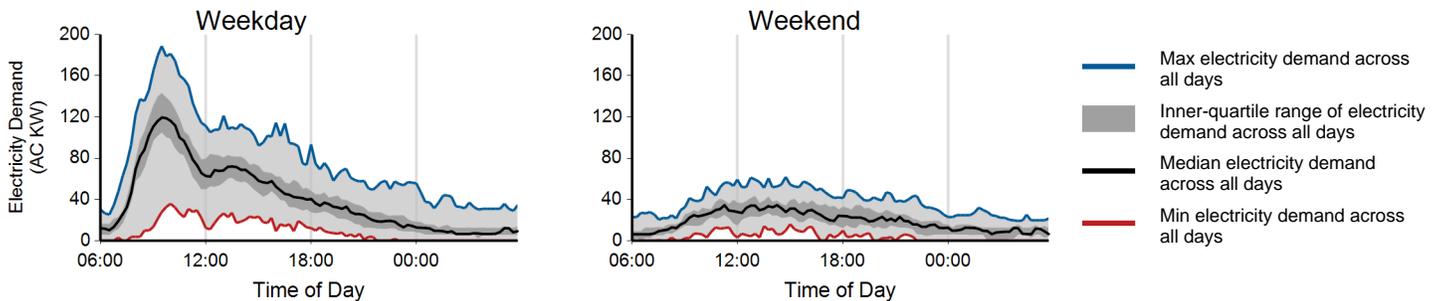
Charging Unit Utilization



Charging Availability: Range of Percentage of All Charging Ports with a Vehicle Connected versus Time of Day⁴



Charging Demand: Range of Aggregate Electricity Demand versus Time of Day⁴ for All Charging Ports



¹ Includes all EVSE ports in use during the reporting period and have reported data to INL.

² A charging event is defined as the period when a vehicle is connected to a charging unit, during which power is transferred.

³ Limited Access EVSE are primarily for use by employees or tenants (including paying guests at hotels) and are placed where these EV drivers would normally park, but others (such as visitors or customers) may be able to plug in on a more limited basis.

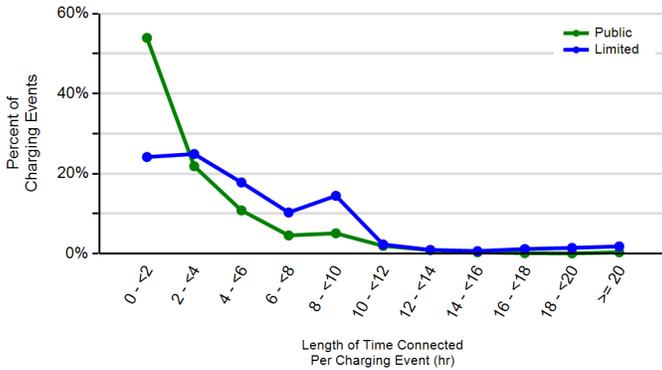
⁴ Weekends start at 6:00am on Saturday and end 6:00am Monday local time.

NYSERDA Electric Vehicle Charging Infrastructure Report

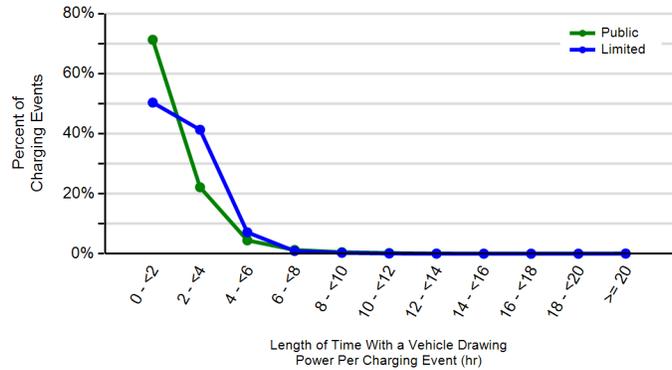
EVSE Usage - By Access Type

	Public	Limited ³
Number of charging ports ¹	306	179
Number of charging events ²	8,328	3,506
Charging energy consumed (AC MWh)	51.0	26.4
Average percent of time with a vehicle connected per charging port	4.0%	6.0%
Average percent of time with a vehicle drawing power per charging port	2.3%	2.1%
Average number of charging events started per charging port per week	2.2	1.7
Average electricity consumed per charging port per week (AC kWh)	13.2	12.6
Average length of time with vehicle connected per charging event (hr)	3.1	6.0
Average length of time with vehicle drawing power per charging event (hr)	1.8	2.1
Average electricity consumed per charging event (AC kWh)	6.1	7.5

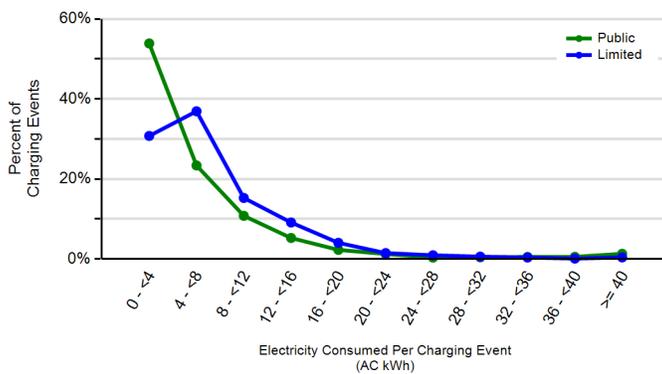
Distribution of Length of Time with a Vehicle Connected per Charging Event



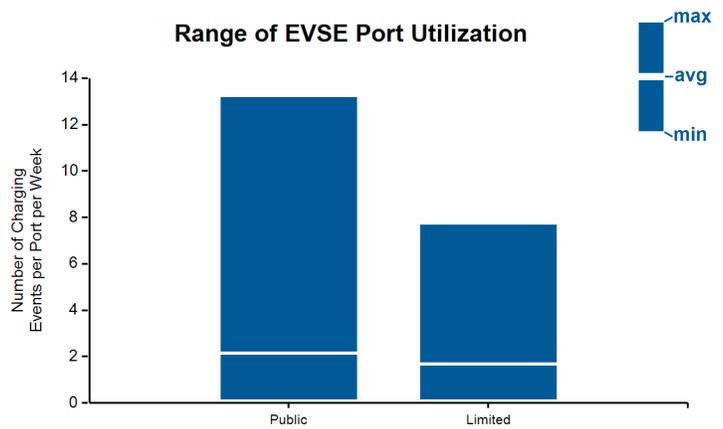
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event



Distribution of AC Energy Consumed per Charging Event



Range of EVSE Port Utilization



¹ Includes all EVSE ports in use during the reporting period and have reported data to INL.

² A charging event is defined as the period when a vehicle is connected to a charging unit, during which power is transferred.

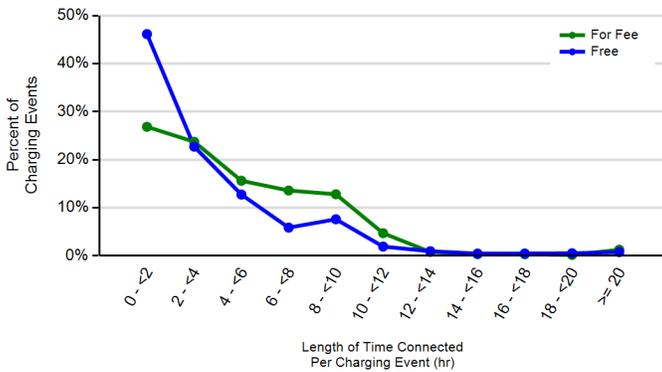
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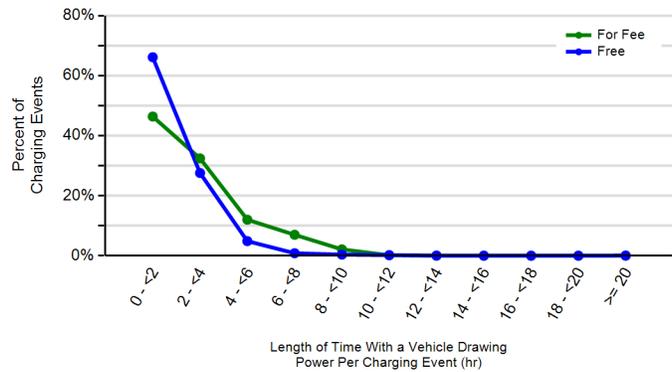
EVSE Usage - By Required Payment

	For Fee	Free
Number of charging ports ¹	59	426
Number of charging events ²	641	11,193
Charging energy consumed (AC MWh)	7.5	69.9
Average percent of time with a vehicle connected per charging port	2.6%	5.0%
Average percent of time with a vehicle drawing power per charging port	1.3%	2.4%
Average number of charging events started per charging port per week	0.8	2.2
Average electricity consumed per charging port per week (AC kWh)	9.7	13.5
Average length of time with vehicle connected per charging event (hr)	5.3	3.9
Average length of time with vehicle drawing power per charging event (hr)	2.6	1.9
Average electricity consumed per charging event (AC kWh)	11.7	6.2

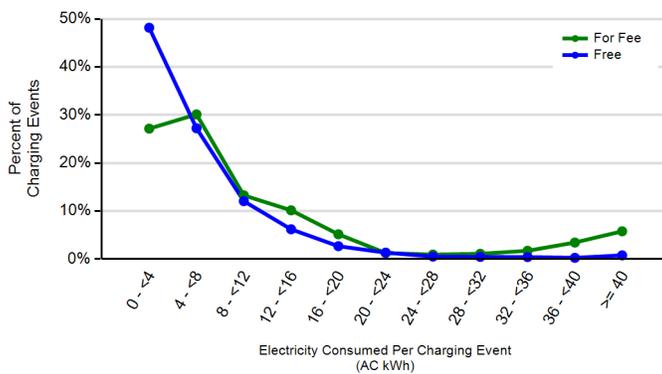
Distribution of Length of Time with a Vehicle Connected per Charging Event



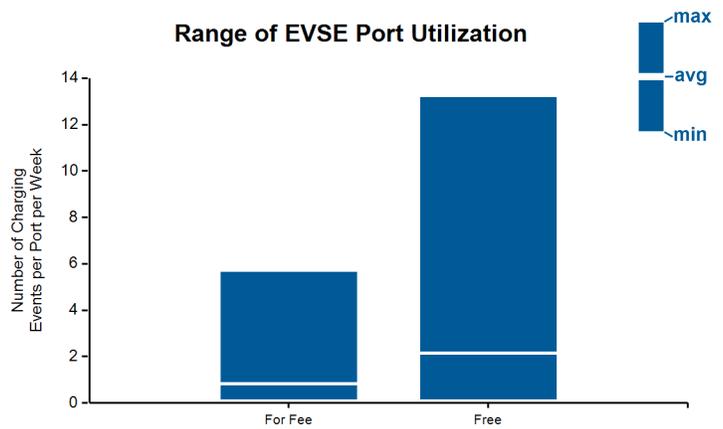
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event



Distribution of AC Energy Consumed per Charging Event



Range of EVSE Port Utilization



¹ Includes all EVSE ports in use during the reporting period and have reported data to INL.

² A charging event is defined as the period when a vehicle is connected to a charging unit, during which power is transferred.

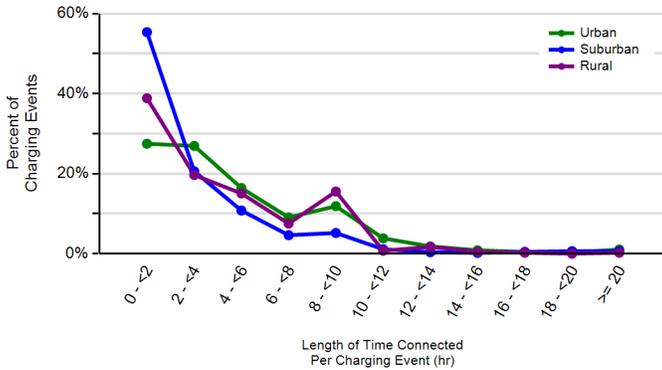
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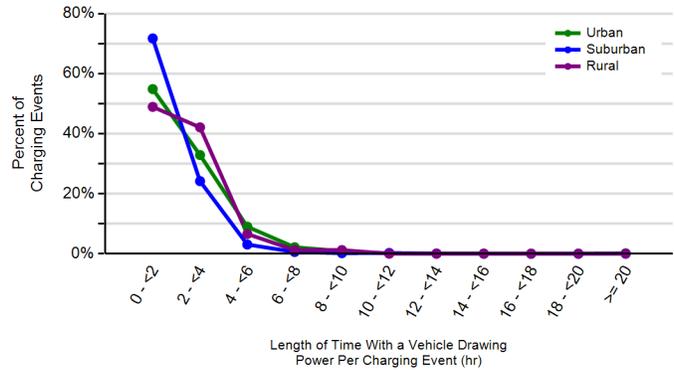
EVSE Usage - By Land Use Type

	Urban	Suburban	Rural
Number of charging ports ¹	167	282	36
Number of charging events ²	4,108	7,314	412
Charging energy consumed (AC MWh)	36.3	37.9	3.2
Average percent of time with a vehicle connected per charging port	5.9%	4.2%	2.2%
Average percent of time with a vehicle drawing power per charging port	2.9%	2.0%	1.2%
Average number of charging events started per charging port per week	1.9	2.2	0.9
Average electricity consumed per charging port per week (AC kWh)	16.9	11.3	7.0
Average length of time with vehicle connected per charging event (hr)	5.2	3.3	4.0
Average length of time with vehicle drawing power per charging event (hr)	2.5	1.5	2.1
Average electricity consumed per charging event (AC kWh)	8.8	5.2	7.7

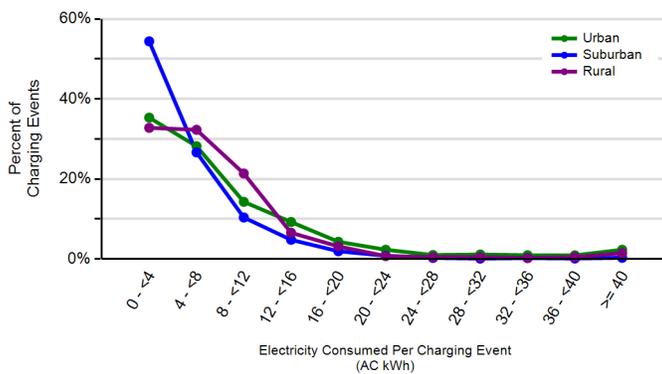
Distribution of Length of Time with a Vehicle Connected per Charging Event



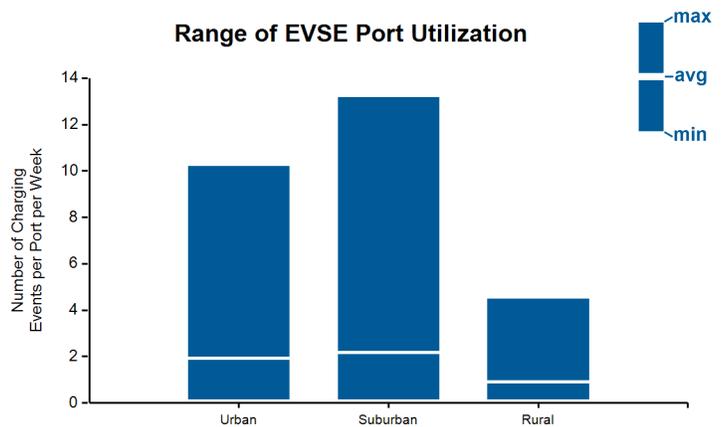
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event



Distribution of AC Energy Consumed per Charging Event



Range of EVSE Port Utilization



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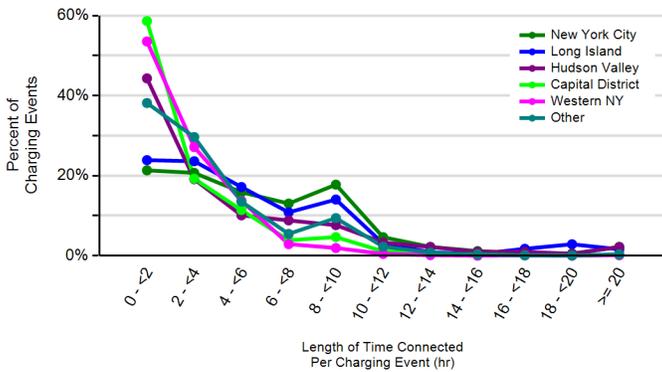
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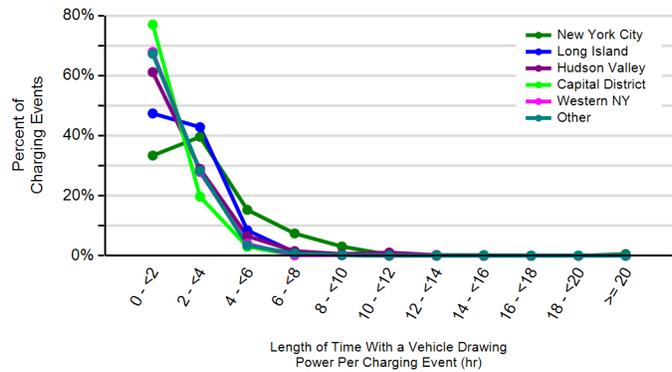
EVSE Usage - By Region

	New York City	Long Island	Hudson Valley	Capital District	Syracuse/Central NY	Rochester/Finger Lakes	North Country	Western NY	Other ³
Number of charging ports ¹	80	64	87	104	22	41	21	51	15
Number of charging events ²	952	1,504	1,429	4,016	240	1,651	438	1,349	255
Charging energy consumed (AC MWh)	13.8	12.0	10.4	19.0	1.3	8.8	2.1	7.6	2.4
Average percent of time with a vehicle connected per charging port	4.2%	6.8%	4.2%	5.2%	1.7%	7.9%	1.9%	3.0%	2.9%
Average percent of time with a vehicle drawing power per charging port	2.3%	2.4%	1.9%	2.5%	0.9%	3.5%	1.3%	2.0%	1.7%
Average number of charging events started per charging port per week	0.9	1.9	1.6	3.0	0.9	3.3	1.6	2.0	1.3
Average electricity consumed per charging port per week (AC kWh)	13.4	15.2	11.4	14.3	4.8	17.8	7.9	11.4	12.3
Average length of time with vehicle connected per charging event (hr)	7.7	6.0	4.5	2.9	3.2	4.0	2.0	2.5	2.2
Average length of time with vehicle drawing power per charging event (hr)	4.2	2.1	2.1	1.4	1.7	1.8	1.3	1.7	3.7
Average electricity consumed per charging event (AC kWh)	14.5	8.0	7.3	4.7	5.3	5.3	4.9	5.6	9.5

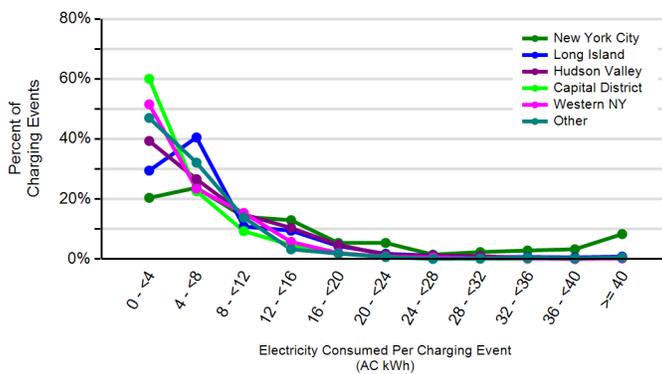
Distribution of Length of Time with a Vehicle Connected per Charging Event⁴



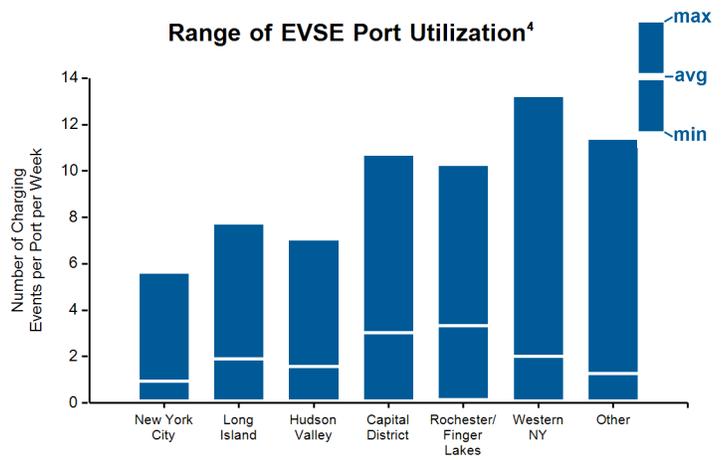
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event⁴



Distribution of AC Energy Consumed per Charging Event⁴



Range of EVSE Port Utilization⁴



¹ Includes all EVSE ports in use during the reporting period and have reported data to INL.

² A charging event is defined as the period when a vehicle is connected to a charging unit, during which power is transferred.

³ Regions with less than 10 EVSE ports are not individually represented, and are combined and reported as 'Other'.

⁴ Only 5 or 6 regions with the most EVSE ports are individually represented, with the remaining regions combined and shown as 'Other'.

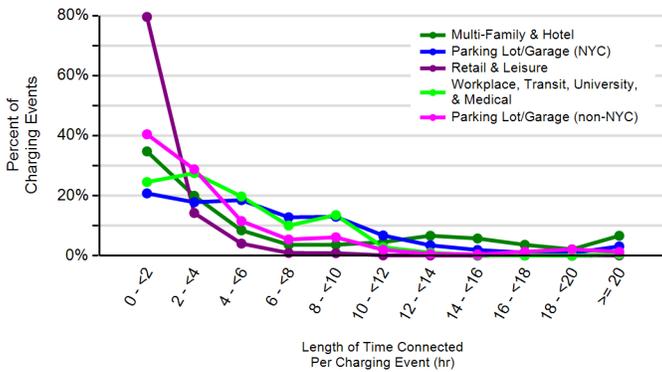
NYSERDA Electric Vehicle Charging Infrastructure Report

Report period: July 2015 through September 2015

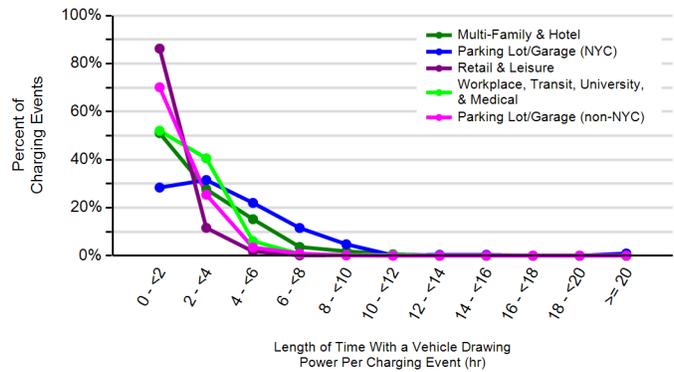
EVSE Usage - By Venue

	Parking Lot/Garage (non-NYC)	Parking Lot/Garage (NYC)	Retail Location	Workplace	Multi-Family	Hotel	University or Medical Campus	Leisure Destination	Transit Station
Number of charging ports ¹	70	62	79	59	18	29	111	22	35
Number of charging events ²	2,037	578	3,223	1,298	114	217	3,485	589	293
Charging energy consumed (AC MWh)	12.1	11.0	11.3	8.6	1.9	2.1	25.4	3.3	1.7
Average percent of time with a vehicle connected per charging port	6.6%	3.9%	2.2%	4.4%	8.0%	1.4%	7.4%	3.4%	1.9%
Average percent of time with a vehicle drawing power per charging port	2.6%	2.4%	1.9%	2.1%	0.9%	0.8%	3.3%	2.1%	1.0%
Average number of charging events started per charging port per week	2.6	0.7	3.3	1.7	0.5	0.6	2.6	2.0	0.8
Average electricity consumed per charging port per week (AC kWh)	15.3	13.7	11.5	11.3	9.0	5.6	18.7	11.3	4.4
Average length of time with vehicle connected per charging event (hr)	4.3	9.1	1.1	4.4	24.7	4.2	4.9	2.8	4.1
Average length of time with vehicle drawing power per charging event (hr)	1.7	5.6	1.0	2.1	2.9	2.3	2.2	1.7	2.3
Average electricity consumed per charging event (AC kWh)	5.9	19.1	3.5	6.6	16.5	9.8	7.3	5.6	5.7

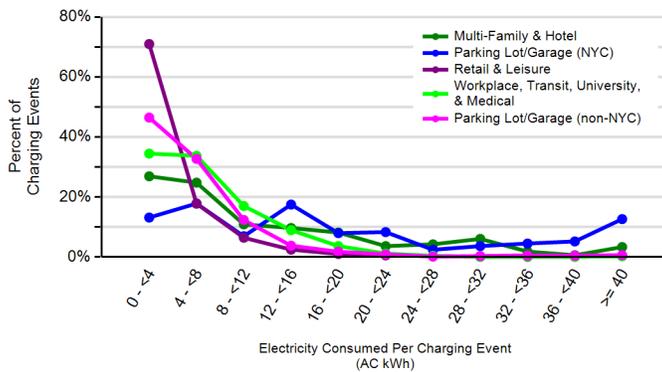
Distribution of Length of Time with a Vehicle Connected per Charging Event



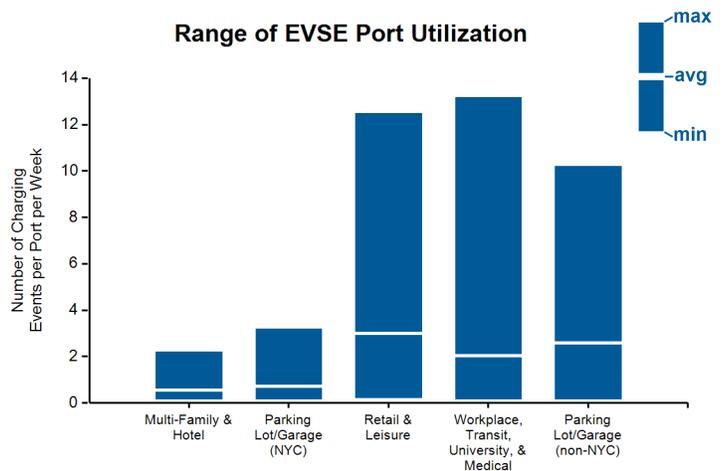
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event



Distribution of AC Energy Consumed per Charging Event



Range of EVSE Port Utilization



¹ Includes all EVSE ports in use during the reporting period and have reported data to INL.

² A charging event is defined as the period when a vehicle is connected to a charging unit, during which power is transferred.

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