NEW YORK
STATE OF
OPPORTUNITY | ChargeNY
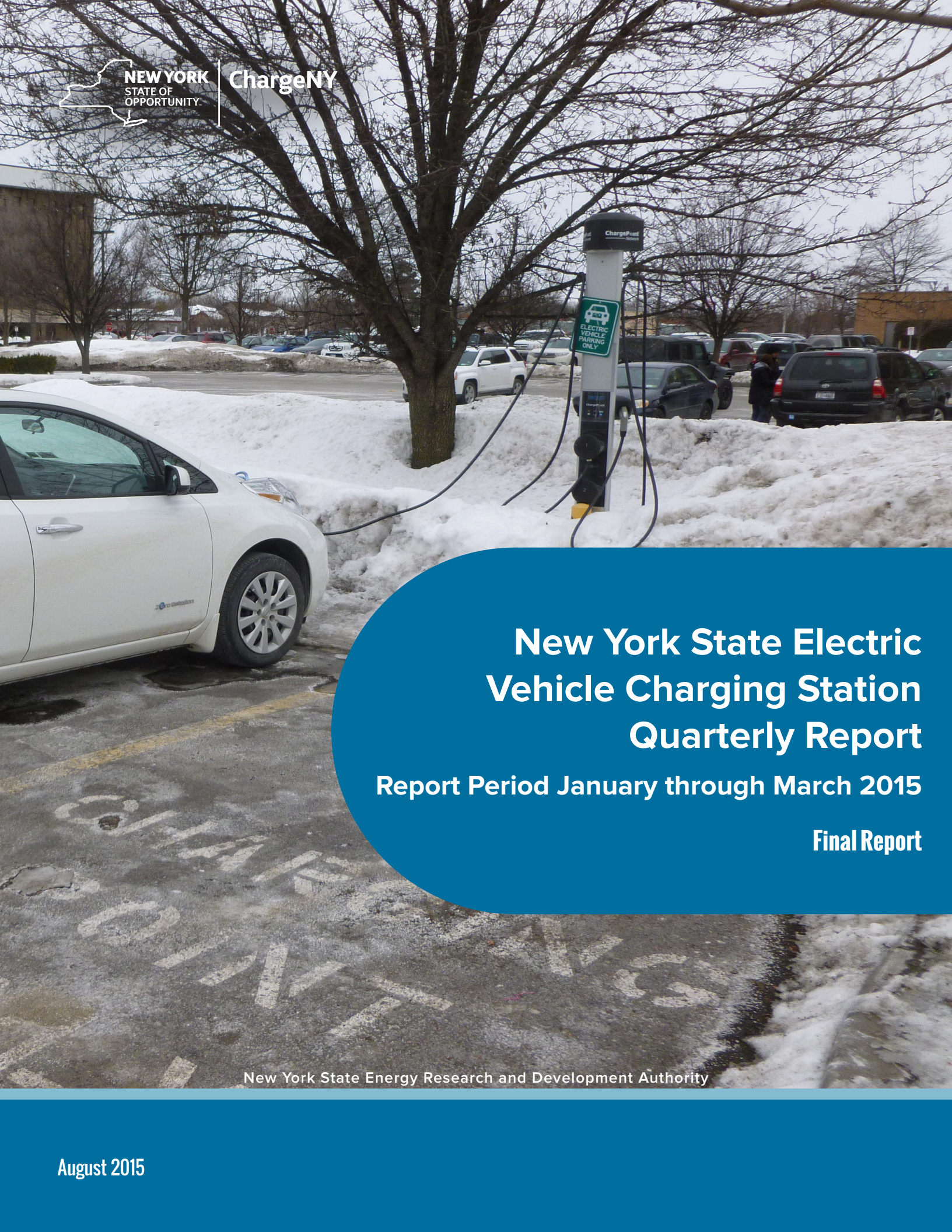
New York State Electric Vehicle Charging Station Quarterly Report

Report Period January through March 2015

Final Report

August 2015

NYSERDA's Promise to New Yorkers:

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 January through March 2015

Final Report

Prepared for:

New York State Energy Research and Development Authority

Albany, NY

Adam Ruder
Program Manager

Prepared by:

Energetics Incorporated

Clinton, NY

and

Idaho National Laboratory

Boise, ID

August 2015

Notice

This report was prepared by Energetics, Incorporated in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereafter "NYSERDA"). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

NYSERDA makes every effort to provide accurate information about copyright owners and related matters in the reports we publish. Contractors are responsible for determining and satisfying copyright or other use restrictions regarding the content of reports that they write, in compliance with NYSERDA's policies and federal law. If you are the copyright owner and believe a NYSERDA report has not properly attributed your work to you or has used it without permission, please email print@nyserda.ny.gov

Table of Contents

List of Figures

List of Tables

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 500 charging stations (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.
- **Private EVSE** are exclusively for a company's fleet vehicles' use.
- **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 remaining five pages of data analysis in Appendix A include the same table and charts for various charging station subsets including: access type, required payment, land use type, region, and venue (the last four subsets exclude private EVSE because their use is specific to the particular host site's operations). 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 March 2015, the NYSERDA EV Charging Station Program funded the installation of 528 charging ports, 52 of which were installed during the last quarter.

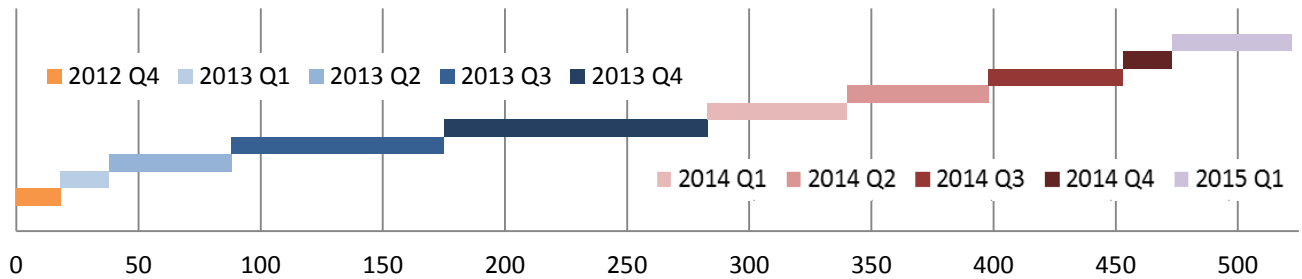**Figure 1. Growth in Installed EVSE Ports Supported by NYSERDA Funding**

Table 1 and Table 2 show the data results 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 Q1 Average	Change from 2014 Q4	Payment	2015 Q1 Average	Change from 2014 Q4	Land Use	2015 Q1 Average	Change from 2014 Q4
Private	47.8%	3.7%	Free	4.6%	-6.1%	Urban	6.6%	-9.6%
Public	4.7%	-7.8%	For Fee	2.7%	3.8%	Suburban	3.1%	0.0%
Limited	3.1%	6.9%				Rural	2.2%	83.3%

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

Region	2015 Q1 Average	Change from 2014 Q4	Venue	2015 Q1 Average	Change from 2014 Q4
Finger Lakes	9.0%	18.4%	Parking (non-NYC)	7.3%	-11.0%
Western NY	5.6%	-24.3%	Workplace	5.9%	-6.3%
Capital District	4.5%	-2.2%	University/Medical	5.6%	-9.7%
New York City	4.0%	-7.0%	Leisure Destination	4.3%	38.7%
Long Island	3.3%	0.0%	Parking (NYC)	3.5%	-12.5%
Hudson Valley	2.8%	64.7%	Retail Location	2.2%	15.8%
North Country	1.4%	7.7%	Hotel	1.9%	5.6%
Central NY	1.1%	-50.0%	Transit	0.8%	166.7%

Fewer charging ports were used in the first quarter of 2015 as compared to the fourth quarter of last year, but many of the charging ports not recently used were only sporadically used in prior quarters. Most charging stations used regularly in past quarters continue to see steady use.

For two consecutive quarters, charging stations in the Hudson Valley have experienced significant increases in the amount of time that EVs are plugged in. The Finger Lakes Region, and the City of Rochester charging stations in particular, continue to experience the highest use per charging port of any region.

The few private charging stations for fleets experienced long connectivity times which led to a high percentage of use and relatively high energy consumed for a small group of stations. Public stations are being used slightly more than limited stations, but have very similar average lengths of time with a vehicle connected per charging event (approximately 4 hours), average length of time with a vehicle drawing power per charging event (approximately 2 hours), and average electricity consumed per charging event (approximately 6.5 kilowatt-hours [kWh]).

Free charging stations are used more frequently, but charging events at stations with a fee are longer (7.1 hours versus 3.9 hours) and dispense more electricity (13.9 kWh versus 6.1 kWh). Note that the majority of stations with a fee are located at parking garages in New York City.

From longest to shortest average lengths of time with a vehicle connected per charging event the order for different venues is: parking lot/garage in New York City (8.7 hours), workplace (6.5 hours), transit station (5.3 hours), hotel (4.6 hours), parking lot/garage not in NYC (4.3 hours), university or medical campus (4.2 hours), leisure destination (4.0 hours), and retail location (1.6 hours).

Compared to the previous quarter (October through December 2014), the number of charging events decreased from 9,814 to 7,469 and the total electricity consumed decreased from 112.7 AC MWh to 67.9 AC MWh. The majority of this decrease (1,677 charge events and 40.4 AC MWh) is due to a change in use by the private stations serving fleets. The severe cold weather during the first quarter of 2015 impacted the driving range of electric vehicles. Fleets, which attempt to maximize the available range of the electric vehicles to make them cost effective, were the most affected in how they could utilize EVs.

4   Data Comparisons to Other Published EVSE Reports

The EV Project, funded by the U.S. Department of Energy (DOE) through the American Recovery and Reinvestment Act (ARRA), deployed 13,000 home and public charging stations in metropolitan areas across the county. Idaho National Laboratory collected and analyzed EV Project data to evaluate the effectiveness of charging infrastructure in various commercial and public settings. ChargePoint, the world's largest network of electric vehicle (EV) charging stations, was also awarded a DOE ARRA project under which 4,600 home, public, and commercial charging points were installed in 10 regions across the U.S. Data analysis currently conducted for the NYSERDA EVSE deployment project is very similar to what was done for the EV Project and ChargePoint. This section examines the hourly use of the charging stations during weekdays. The EV Project and ChargePoint data is from the first quarter (Q1) of 2013, which is the same time of year as the NYSERDA data for this quarterly report but two years earlier because that was the most recent year data was analyzed for the EV Project and ChargePoint. Table 3 lists project areas with at least 100 installed and monitored public Level 2 charging stations.

Table 3. EV Projects Across the United States

Project	Region/Area	Public Chargers used in Q1	Charge Events	Events per Charger
EV Project	Dallas/Fort Worth Metro	173	1,406	8
EV Project	Phoenix Metro	314	2,727	9
EV Project	Corvallis, Eugene, Portland, & Salem Metros	374	5,013	13
EV Project	Seattle & Olympia Metros	245	3,804	16
ChargePoint	Texas	201	3,343	17
EV Project	Nashville Metro	188	3,263	17
ChargePoint	Florida	239	4,751	20
ChargePoint	New York City Area (NY, NJ, and CT))	136	3,040	22
NYSERDA	New York State	306	6,841	22
EV Project	Los Angeles Metro	221	5,371	24
ChargePoint	Washington D.C.	128	3,631	28
ChargePoint	Michigan	162	4,697	29
ChargePoint	Boston Area	134	3,901	29
EV Project	San Francisco	114	3,598	32
EV Project	San Diego	302	10,932	36
ChargePoint	Washington State	111	4,134	37
ChargePoint	Sacramento/San Francisco	483	30,807	64
ChargePoint	Los Angeles	248	16,297	66

Based on events per charger, the NYSERDA project EV installations are used more than about half of the regions selected for the EV Project and ChargePoint America with more than 100 EV chargers (all nine EV Project and ChargePoint America regions with less than 100 EV chargers had fewer events per charger than the NYSERDA project). There may be some impact from the different timeframe from which this data was obtained (2013 vs. 2015), but this indicates that the NYSERDA-funded charging stations throughout New York State covering rural, suburban, and urban settings are performing well. Note that the charging stations for the EV Project and ChargePoint America were installed in urban cities with a progressive climate of EV drivers due to the selection process of those projects.

Figure 2 plots the mean utilization of all active charging stations in each region throughout the day during weekdays in the first quarter of the year (2013 for EV Project and ChargePoint, 2015 for NYSERDA). EV Project and ChargePoint regions were selected for this comparison due to similarities in the number of deployed chargers, charge events per charger, and/or climate.

Figure 2. Percentage of Charging Ports with a Vehicle Connected on Weekdays

8
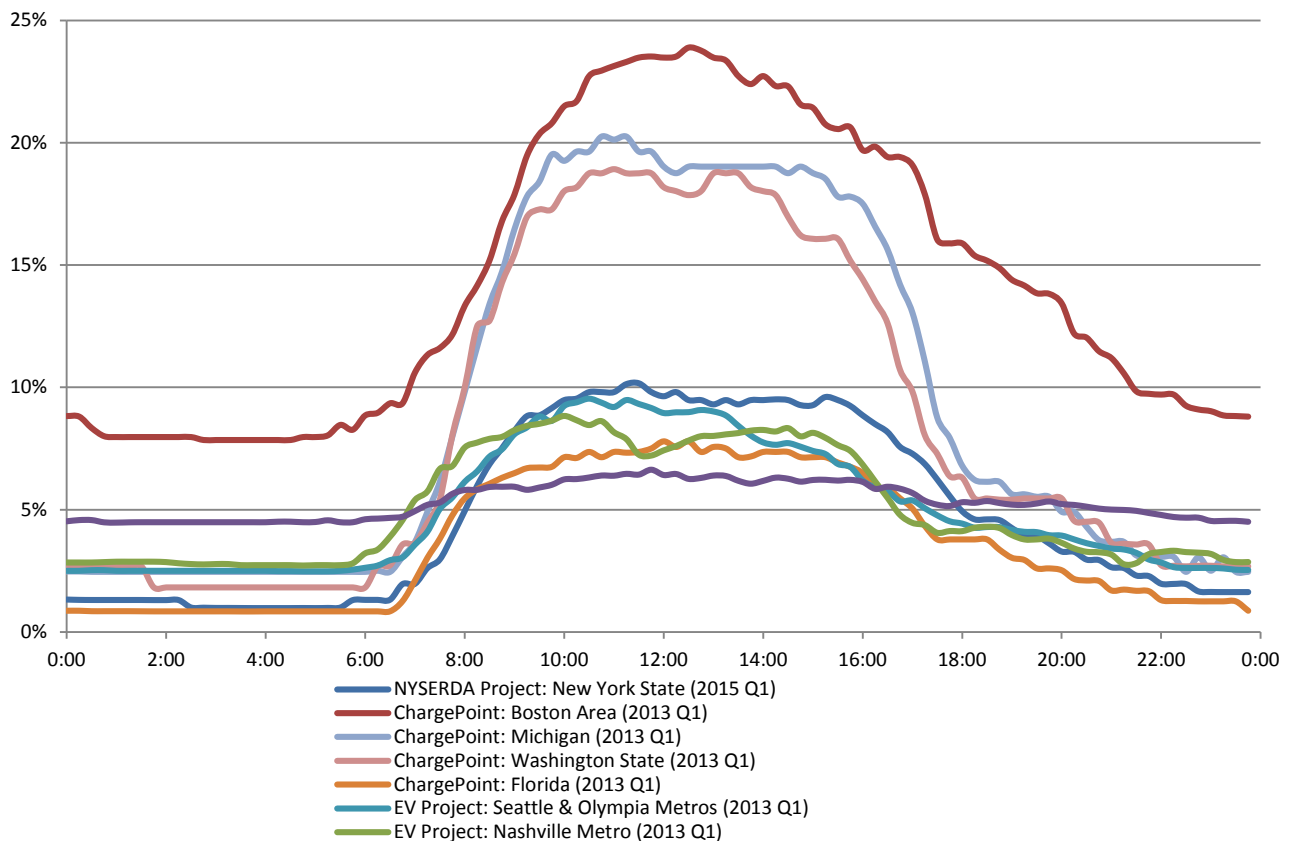
The Boston area, Michigan, and Washington State (ChargePoint) are the three regions with the highest average events per charger in Figure 1. Unsurprisingly, they all experienced a much higher peak and average percentage of use than the other regions. All regions showed a similar increase in use between 7 am and 6 pm with the midpoint of the long peak period at approximately 12:30 p.m. The charging stations in the Oregon cities— Corvallis, Eugene, Portland, and Salem—had the least change in use throughout the day and were more heavily used at night-time than most other regions. This is an indication that those chargers were installed in public locations that also serve residences. The NYSERDA project's use curve shows a significant variation between day and night, which was expected because the majority of installations were not where EV drivers would park for their residence. Comparing the weekday use curve to weekend in Figure 3, the weekend peak is a little later in the day (about 2 p.m.) and most regions don't reach their lowest levels of use until after 11 p.m. (later than seen for weekdays). Also, the usage peak during weekdays is more defined than for weekends.

Figure 3. Percentage of Charging Ports with a Vehicle Connected on Weekends
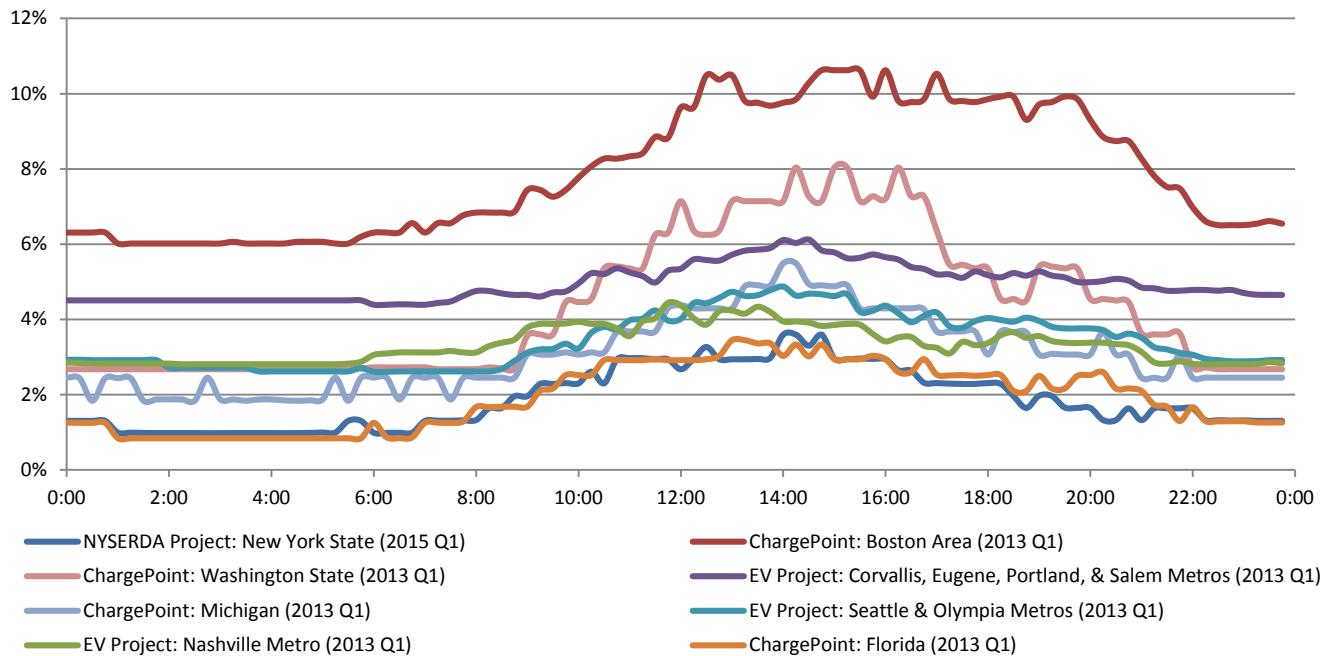
Appendix A: NYSERDA Electric Vehicle Charging Infrastructure Report

NYSERDA Electric Vehicle Charging Infrastructure Report

Report period: January 2015 through March 2015

New York State

EVSE Usage - By Access Type

	Public	Limited[3]	Private	Total
Number of charging ports[1]	226	80	30	336
Number of charging events[2]	5,518	1,323	628	
Electricity consumed (AC MWh)	36.55	8.45	22.91	67.91
Percent of time with a vehicle connected	4.7%	3.1%	47.8%	
Percent of time with a vehicle drawing power	2.3%	1.6%	46.1%	6.0%

Number of Charging Events

8 %
18 %
74

Public — Limited — Private

Electricity Consumed

54 %
34 %
12 %

Public — Limited — Private
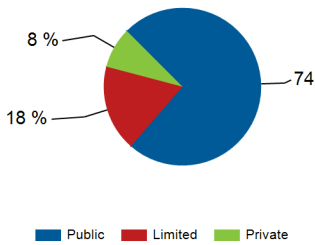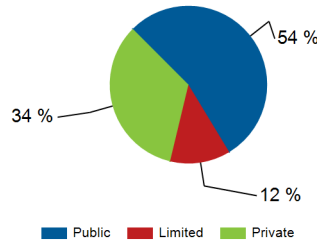
Charging Unit Utilization

Percentage of Time with a vehicle connected
Percentage of Time with a vehicle drawing power
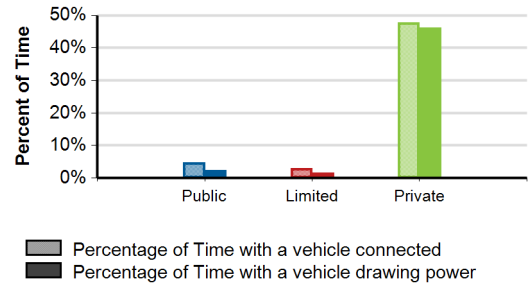
Charging Availability: Range of Percentage of All Charging Ports with a Vehicle Connected versus Time of Day[4]

Weekday

Weekend

Max percentage of charging units connected across all days

Inner-quartile range of charging units connected across all days

Median percentage of charging units connected across all days

Min percentage of charging units connected across all days
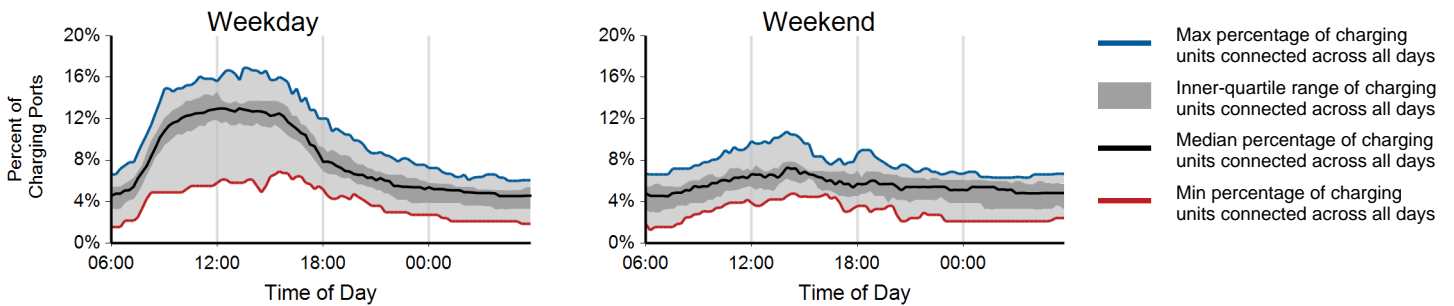
Charging Demand: Range of Aggregate Electricity Demand versus Time of Day[4] for All Charging Ports
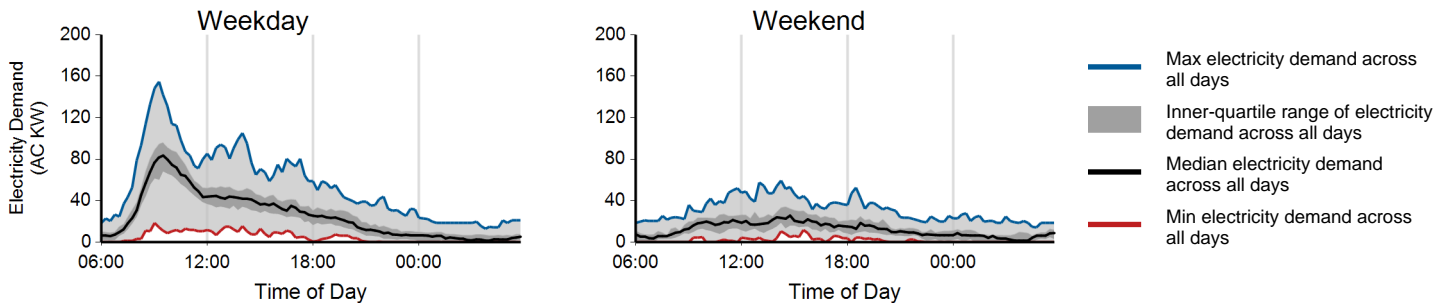
Weekday

Weekend

Max electricity demand across all days

Inner-quartile range of electricity demand across all days

Median electricity demand across all days

Min electricity demand across all days

[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
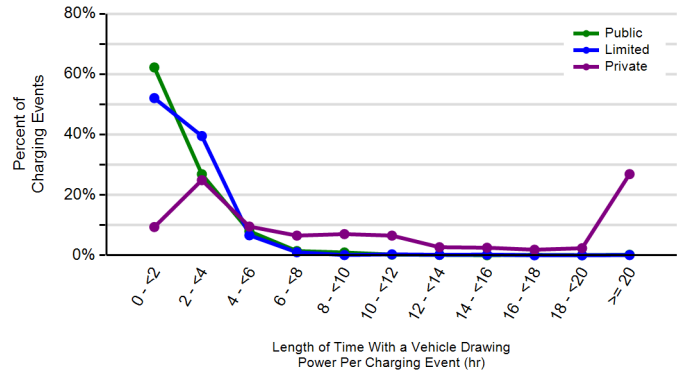
Report period: January 2015 through March 2015

EVSE Usage - By Access Type	Public	Limited[3]	Private
Number of charging ports[1]	226	80	30
Number of charging events[2]	5,518	1,323	628
Charging energy consumed (AC MWh)	36.6	8.4	22.9
Average percent of time with a vehicle connected per charging port	4.7%	3.1%	47.8%
Average percent of time with a vehicle drawing power per charging port	2.3%	1.6%	46.1%
Average number of charging events started per charging port per week	1.9	1.3	1.7
Average electricity consumed per charging port per week (AC KWh)	12.7	8.2	61.8
Average length of time with vehicle connected per charging event (hr)	4.1	4.0	47.5
Average length of time with vehicle drawing power per charging event (hr)	2.1	2.1	45.8
Average electricity consumed per charging event (AC kWh)	6.6	6.4	36.5

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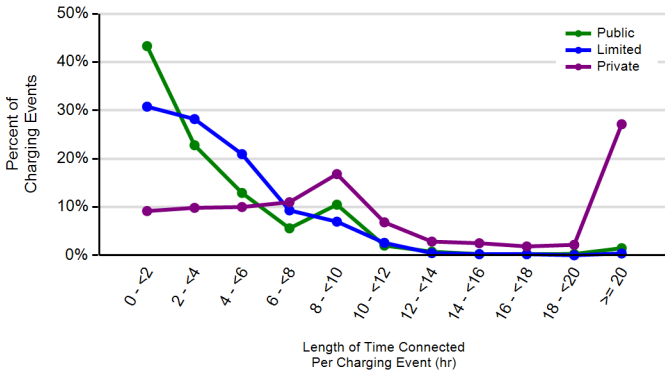
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event

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.

[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.

NYSERDA Electric Vehicle Charging Infrastructure Report
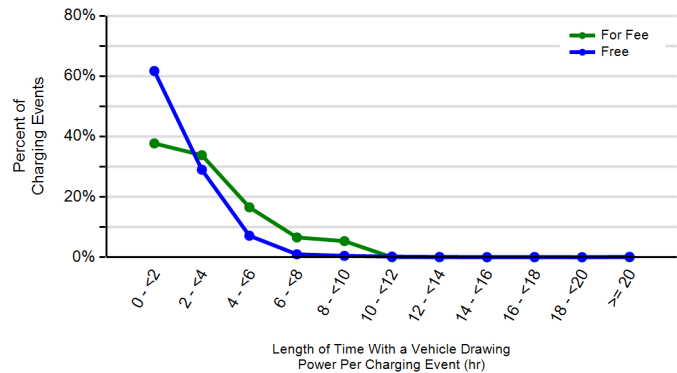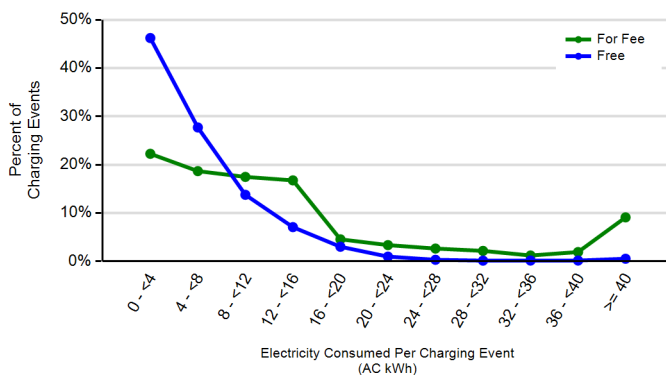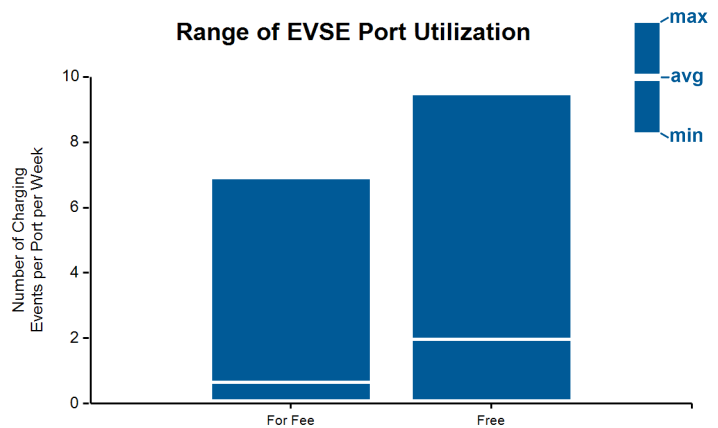
Report period: January 2015 through March 2015

EVSE Usage - By Required Payment[3]	For Fee	Free
Number of charging ports[1]	51	255
Number of charging events[2]	418	6,423
Charging energy consumed (AC MWh)	5.8	39.2
Average percent of time with a vehicle connected per charging port	2.7%	4.6%
Average percent of time with a vehicle drawing power per charging port	1.2%	2.4%
Average number of charging events started per charging port per week	0.7	2.0
Average electricity consumed per charging port per week (AC KWh)	9.0	12.0
Average length of time with vehicle connected per charging event (hr)	7.1	3.9
Average length of time with vehicle drawing power per charging event (hr)	3.1	2.0
Average electricity consumed per charging event (AC kWh)	13.9	6.1

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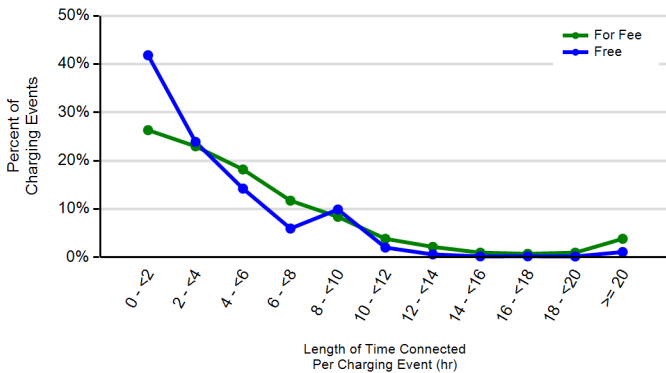
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event

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.
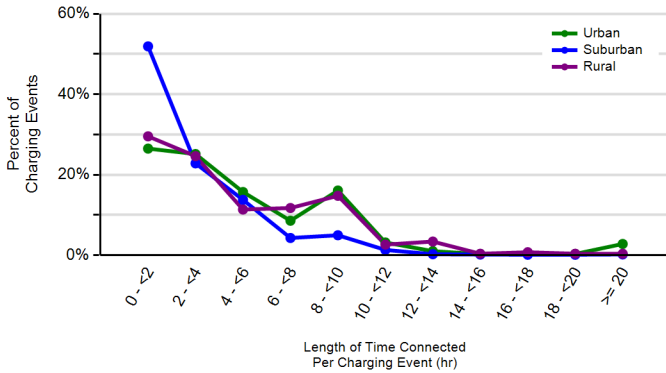
[3] Only includes data from EVSE providing Public or Limited access.

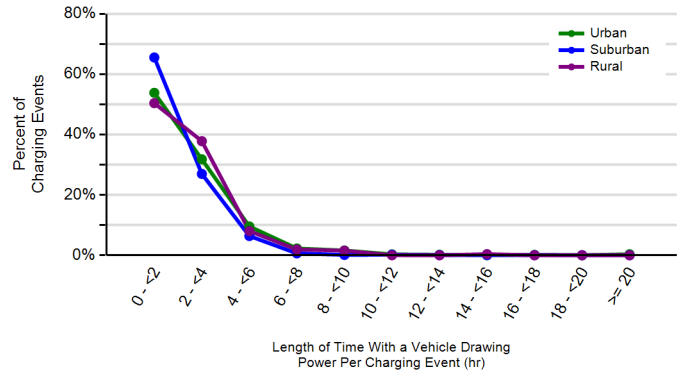# NYSERDA Electric Vehicle Charging Infrastructure Report

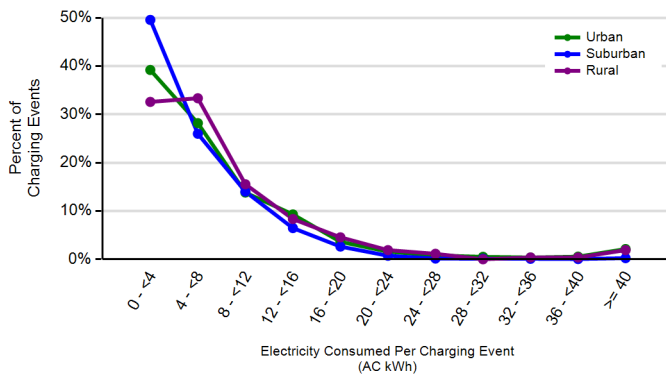| EVSE Usage - By Land Use Type[3]	Urban	Suburban	Rural
Number of charging ports[1]	111	168	27
Number of charging events[2]	2,736	3,841	264
Charging energy consumed (AC MWh)	21.5	21.4	2.1
Average percent of time with a vehicle connected per charging port	6.6%	3.1%	2.2%
Average percent of time with a vehicle drawing power per charging port	2.8%	1.9%	1.0%
Average number of charging events started per charging port per week	1.9	1.8	0.8
Average electricity consumed per charging port per week (AC KWh)	15.2	10.0	6.1
Average length of time with vehicle connected per charging event (hr)	5.8	2.9	4.8
Average length of time with vehicle drawing power per charging event (hr)	2.5	1.8	2.3
Average electricity consumed per charging event (AC kWh)	7.8	5.6	8.0

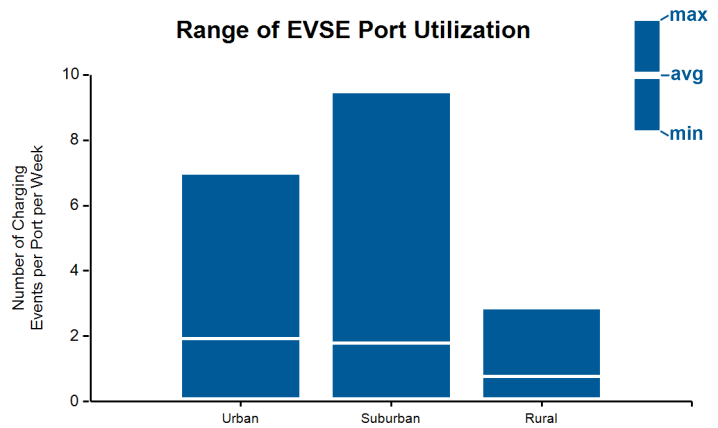### Distribution of Length of Time with a Vehicle Connected per Charging Event

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.

[3] Only includes data from EVSE providing Public or Limited access.

NYSERDA Electric Vehicle Charging Infrastructure Report

| EVSE Usage - By Region[3]	New York City	Long Island	Hudson Valley	Capital District	Syracuse/Central NY	Rochester/Finger Lakes	North Country	Western NY	Other[4]
Number of charging ports[1]	47	22	33	86	14	27	19	45	13
Number of charging events[2]	543	430	659	2,559	107	1,038	219	1,132	154
Charging energy consumed (AC MWh)	7.0	2.8	3.3	15.0	0.8	6.0	1.2	8.1	0.9
Average percent of time with a vehicle connected per charging port	4.0%	3.3%	2.8%	4.5%	1.1%	9.0%	1.4%	5.6%	2.4%
Average percent of time with a vehicle drawing power per charging port	1.6%	1.7%	1.7%	2.5%	0.9%	3.8%	0.9%	3.0%	1.0%
Average number of charging events started per charging port per week	0.9	1.5	1.6	2.3	0.6	3.1	0.9	2.0	0.9
Average electricity consumed per charging port per week (AC KWh)	11.6	10.0	7.9	13.6	4.3	17.5	4.8	13.9	5.5
Average length of time with vehicle connected per charging event (hr)	7.5	3.6	3.0	3.2	3.0	5.0	2.5	4.8	1.9
Average length of time with vehicle drawing power per charging event (hr)	3.0	1.8	1.8	1.8	2.6	2.1	1.6	2.6	4.3
Average electricity consumed per charging event (AC kWh)	12.9	6.5	5.0	5.9	7.2	5.7	5.3	7.1	6.0

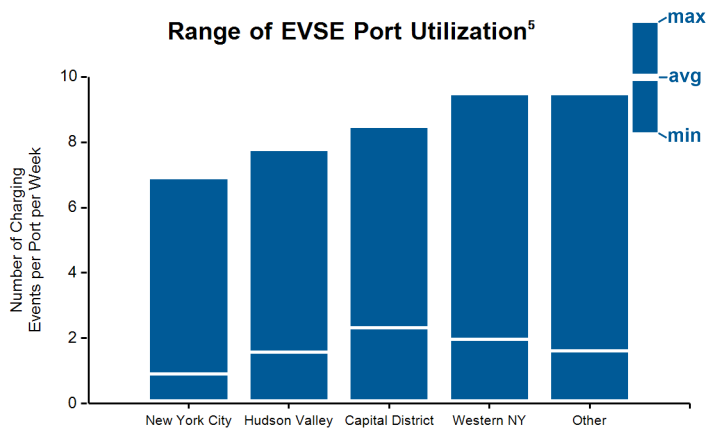**Distribution of Length of Time with a Vehicle Connected per Charging Event**
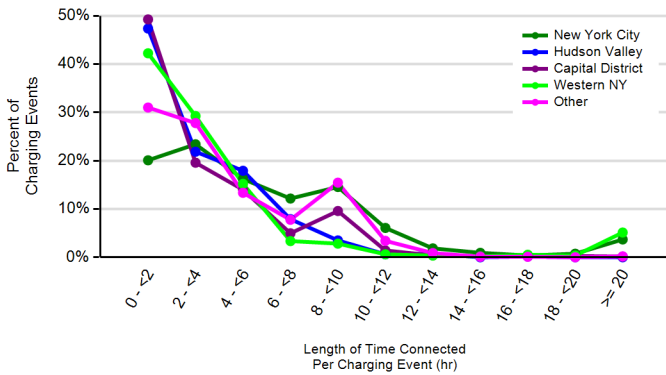
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event[5]
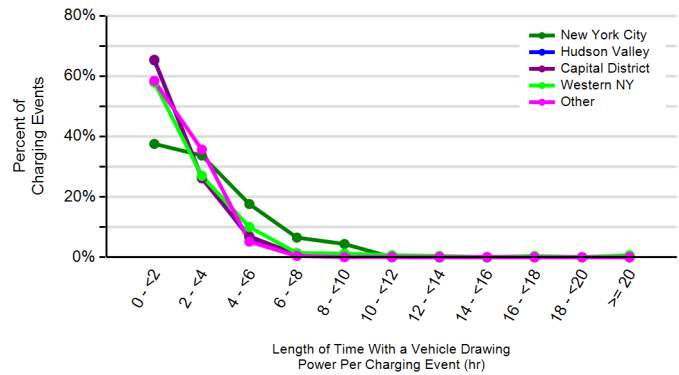
Distribution of AC Energy Consumed per Charging Event
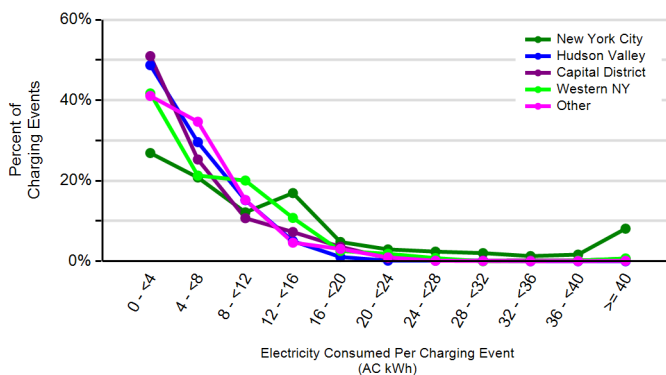
Range of EVSE Port Utilization[5]

[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] Only includes data from EVSE providing Public or Limited access.

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

[5] Only the 4 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: January 2015 through March 2015

| EVSE Usage - By Venue[3]	Parking Lot/Garage (non-NYC)	Parking Lot/Garage (NYC)	Retail Location	Workplace	Hotel	University or Medical Campus	Leisure Destination	Transit Station
Number of charging ports[1]	40	39	60	49	27	61	13	13
Number of charging events[2]	1,466	335	1,761	952	243	1,728	296	42
Charging energy consumed (AC MWh)	8.2	5.9	8.0	6.7	2.4	11.5	1.8	0.2
Average percent of time with a vehicle connected per charging port	7.3%	3.5%	2.2%	5.9%	1.9%	5.6%	4.3%	0.8%
Average percent of time with a vehicle drawing power per charging port	3.4%	1.5%	1.8%	2.5%	1.2%	2.8%	2.0%	0.6%
Average number of charging events started per charging port per week	2.9	0.7	2.3	1.5	0.7	2.2	1.8	0.3
Average electricity consumed per charging port per week (AC KWh)	16.3	11.9	10.4	10.6	7.1	14.6	10.7	1.3
Average length of time with vehicle connected per charging event (hr)	4.3	8.7	1.6	6.5	4.6	4.2	4.0	5.3
Average length of time with vehicle drawing power per charging event (hr)	2.0	3.6	1.3	2.8	2.9	2.1	1.9	3.6
Average electricity consumed per charging event (AC kWh)	5.6	17.7	4.6	7.0	10.1	6.6	6.1	5.1

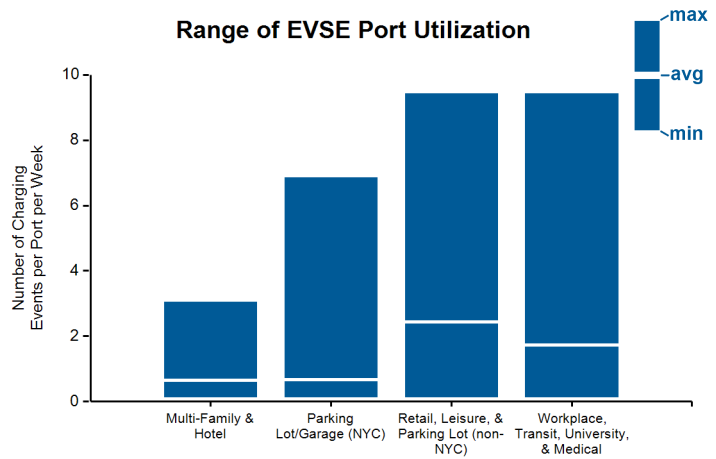### Distribution of Length of Time with a Vehicle Connected per Charging Event
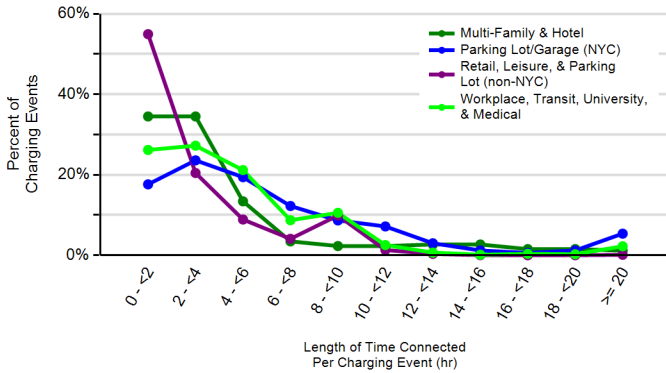
Distribution of Length of Time with a Vehicle Drawing Power per Charging Event
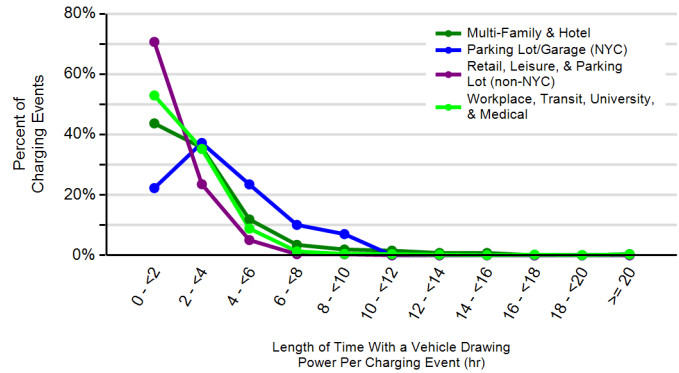
Distribution of AC Energy Consumed per Charging Event
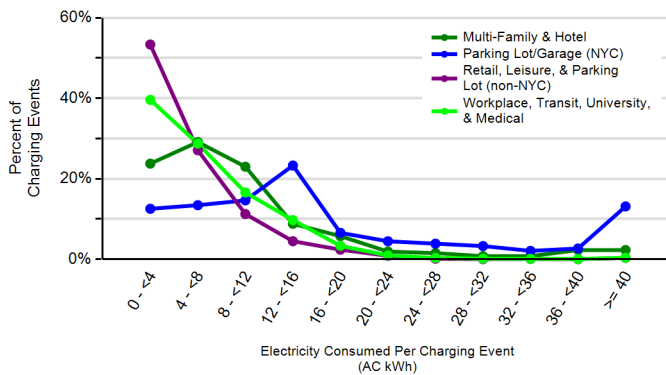
Range of EVSE Port Utilization

[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.

[3] Only includes data from EVSE providing Public or Limited access.

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

NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York State since 1975.

To learn more about NYSERDA's programs and funding opportunities, visit nyserda.ny.gov or follow us on Twitter, Facebook, YouTube, or Instagram.