

Charging Up Mass.: The State of EV Super-Fast Charging Glen Berkowitz April 17, 2024



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Overview

A. Decarbonize Transport

- B. EV 101: Batteries and Charging
- C. National Electric Vehicle Infrastructure Program
- D. Looking Ahead
- E. Q&A













TRANSPORTATION SECTOR 2019 BREAKDOWN

81%

OF TRANSPORTATION EMISSIONS FROM HIGHWAY VEHICLES

GASOLINE HIGHWAY

DIESEL HIGHWAY

NON-HIGHWAY

ALTERNATIVE FUEL VEHICLES

Source: MA Priority Action Climate Plan. 2024.





Daily Global Sea Surface Temperatures



Source: Climate Reanalyzer, Climate Change Institute at the University of Maine, based on data from NOAA Optimum Interpolation Sea Surface Temperature (OISST) • Note: Data through April 8, 2024. • By The New York Times



Average Age of Automobiles and Trucks in Operation

Source: USDOT Bureau of Transportation Statistics

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- A. Decarbonize Transport
- **B. EV 101: Batteries and Charging**
- C. National Electric Vehicle Infrastructure Program
- D. Looking Ahead
- E. Q & A





EV charging levels





L1

AC



L2

AC

L3

DC

Understanding electricity



+

AC Alternating Current

VS.



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+

DC Direct Current



Form factors



Tesla, Model:

- S
- X
- 3
- Y

- Nissan
- Hyundai Kona
- Kia Niro
- Chevy Bolt
- GM Ultium
- VW / Audi

- Tesla Giga China
- BMW
- F-150 Lightning
- VW / Audi
- Rivian



Model	Tesla	Tesla	Tesla
	S	Y	Y
# Cells	7,140	4,400	830

Source: Researchgate

Lithium-ion battery

An electric vehicle is powered by thousands of lithium-ion battery cells



Source: Vox



Onboard charger module

1300

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Source: Weber State University

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A DECTOR





Source: Weber State University

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EV charging levels–Summary

Overview

C. National Electric Vehicle Infrastructure Program

(i) State of charging (DC)

- (ii) NEVI Objectives/Requirements
- (iii) Charging Plug/Ports
- (iv) Nationally
- (v) Massachusetts
- (vi) Maine

Tesla Dominates With 63.2% of All US DC Fast Charger Ports

Analysis & Chart: EVAdoption, LLC | June 1, 2023 | Source: Alternative Fuels Data Center (AFDC), May 31, 2023

As of May 31, 2023, 30,418 public DC

of deployed public DC fast charger ports:

J.D. Power 2022 U.S. Electric Vehicle Experience – Public Charging Satisfaction StudySM

Source: J.D. Power 2022 U.S. Electric Vehicle Experience – Public Charging Satisfaction Study^{5M}

ChargePoint Electrify America		EVgo			
Ν	%	Ν	%	Ν	%
21	47.7%	228	60.2%	120	55.6%
6	13.6%	52	13.7%	37	17.1%
27	61.4%	280	73.9%	157	72.7%
0	0.0%	2	0.5%	3	1.4%
4	9.1%	13	3.4%	5	2.3%
4	9.1%	17	4.5%	3	1.4%
0	0.0%	0	0.0%	6	2.8%
3	6.8%	25	6.6%	16	7.4%
5	11.4%	15	4.0%	22	10.2%
16	36.4%	72	19.0%	55	25.5%
1	2.3%	27	7.1%	4	1.9%
44	100%	379	100%	216	100%
	Charg N 21 6 27 0 4 4 4 0 3 5 16 3 5 16	Point N % 21 47.7% 6 13.6% 27 61.4% 0 0.0% 4 9.1% 4 9.1% 0 0.0% 4 9.1% 16 36.8% 16 36.4% 1 2.3% 44 100%	ChargePoint Electrify N % N 21 47.7% 228 6 13.6% 52 27 61.4% 280 0 0.0% 2 4 9.1% 13 4 9.1% 13 4 9.1% 17 0 0.0% 0 3 6.8% 25 5 11.4% 15 16 36.4% 72 1 2.3% 27 44 100% 379	ChargePointElectrify AmericaN%N 21 47.7% 228 60.2% 60.2% 6 13.6% 52 13.7% 280 73.9% 27 61.4% 280 73.9% 27 0 0.0% 2 0 0.0% 2 4 9.1% 13 4.5% 0 0 0.0% 0 4 9.1% 17 4.5% 0 0.0% 0 11.4% 15 4.0% 16 36.4% 72 19.0% 100% 44 100% 379 100% 379	ChargePointElectrify AmericaEVN $\%$ N $\%$ N21 47.7% 228 60.2% 120 6 13.6% 52 13.7% 37 27 61.4% 280 73.9% 157 0 0.0% 2 0.5% 3 4 9.1% 13 3.4% 5 4 9.1% 17 4.5% 3 0 0.0% 0 0.0% 6 3 6.8% 25 6.6% 16 5 11.4% 15 4.0% 22 16 36.4% 72 19.0% 55 1 2.3% 27 7.1% 4 44 100% 379 100% 216

Table 3. Functional State of EVSEs by the Top 3 EV Service Providers

Source: Car and Driver

Charger Hardware		Unit Cost per Port	Install Cost per Port ^a	References
L1 residential	Low: High:	\$0 \$0 ^b	\$100 \$1,000	(Fixr.com 2022; Courtney 2021; HomeAdvisor 2022)
L2 residential	Low: High:	\$400 \$1,200	\$500 \$1,700	(Borlaug et al. 2020; Fixr.com 2022; Courtney 2021; HomeAdvisor 2022)
L2 commercial	Low: High:	\$2,200 \$4,600	\$2,200 \$6,000	(Nicholas 2019; Nelder and Rogers 2019; Borlaug et al. 2020; Bloomberg New Energy Finance 2020; Pournazeri 2022)
DC 150 kW	Low: High:	\$66,400 \$102,200	\$45,800 \$94,000	(Nicholas 2019; Nelder and Rogers 2019; Borlaug et al. 2020; Bloomberg New Energy Finance 2020; Borlaug et al. 2021; Gladstein, Neandross & Associates 2021; Bennett et al. 2022)
DC 250 kW	Low: High:	\$91,400 \$134,800	\$54,750 \$105,950	Inferred from DC 150-kW and 350-kW costs
DC 350+ kW	Low: High:	\$116,400 \$167,400	\$63,700 \$117,900	(Nicholas 2019; Bloomberg New Energy Finance 2020; Borlaug et al. 2021; Gladstein, Neandross & Associates 2021; Bennett et al. 2022)

^a These ranges do not span the set of all possible situations. They are meant to be plausible optimistic (low) and pessimistic (high) estimates for assessing network capital costs at scale. In some cases, it was not possible to verify exactly what was included within each study's estimate for installation costs, thus some discrepancies may be present across sources.

this analysis.

Table 5. EVSE Capital Cost Assumptions

Overview

- C. National Electric Vehicle Infrastructure Program
 - (i) State of charging (DC)

(ii) NEVI Objectives/Standards

- (iii) Charging Plug/Ports
- (iv) Nationally
- (v) Massachusetts
- (vi) Maine

NEVI Objectives

National EV Infrastructure Program

- Bipartisan Infrastructure Law provides states with \$7.5 billion to help make EV charging more accessible
- \$5 billion in formula funds to strategically deploy EV charging stations to facilitate long-distance trips.
- Make L3 DC charging more available and reliable
- Reduce range anxiety

FHWA Formula Funds			
Year	Nationwide (billions)	Massachusetts (millions)*	
FFY22	\$1.0	\$9.4	
FFY23	\$1.0	\$13.5	
FFY24	\$1.0	\$13.5	
FFY25	\$1.0	\$13.5	
FFY26	\$1.0	\$13.5	
Total	\$5.0	\$63.5	

NEVI Standards

(Minimum Requirements. Partial list.)

- Federal share: 80%
- Spacing: 50 miles key highways or w/in 1 mi.
- Station: 4 ports (plugs), simultaneously
- DC Power Level: 150kW (600 mi/hr)
- Uptime: 97%
- Long-term stewardship: 5 years O&M
- Display: pricing, credit card reader
- Connector Type: CCS (and non-proprietary)

NEVI MA: Key highways

Overview

- C. National Electric Vehicle Infrastructure Program
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November 2022: Patent released

(12) United States Design Patent Ferguson et al.

- (54) VEHICLE CHARGE CONNECTOR
- (75) Inventors: Joshua Willard Ferguson, Alameda,
 CA (US); Christopher Hugo Van Dyke,
 San Francisco, CA (US)
- (73) Assignee: Tesla Motors, Inc., Palo Alto, CA (US)
- (**) Term: **14 Years**
- (21) Appl. No.: 29/427,078
- (22) Filed: Jul. 13, 2012

Related U.S. Application Data

(63) Continuation-in-part of application No. 13/490,164,filed on Jun. 6, 2012, which is a continuation of application No. 13/489,617, filed on Jun. 6, 2012.

North American Charging Standard (NACS)

NACS Timeline

OEMs announced NACS adoption

Source: TTI

NEVI Standards (redux) (Minimum Requirements. Partial list.)

- State Plan Vision and Goals: support convenient, affordable, reliable, and equitable EV network.
- Federal share: 80%
- Spacing: 50 miles key highways or w/in one mile
- Station: 4 ports (plugs), simultaneously
- DC Power Level: 150kW (600 mi/hr)
- Uptime: 97%
- Display: pricing, credit card reader
- Long-term stewardship: 5 years O&M
- Connector Type: CCS (not Tesla; non-prop. ok)

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Over half the states have yet to request bids for EV chargers

Current charger procurement status for the National Electric Vehicle Infrastructure Program, by state

Note: The District of Columbia is not yet requesting bids. Nevada, New York and Vermont are procuring some chargers outside of a public request for bids, but plan to solicit bids in the future. Source: State DOT websites and NEVI plans, Atlas Public Policy, Tritium James Bikales/POLITICO

The 1st! I-70, Columbus, Ohio

NEVI Nationally

"You have to go slow to go fast"

- State transportation agencies are building the capacity to deploy electric vehicle charging stations
- February: 7 charging stations operational in 4 states
- March: 8 in 5: Maine opened NEVI station in Rockland
- Benefits to a slow roll. Fed \$ available until used. Port switchover. OEM adoption.

41

Results: over 50%

Go to gas stations and truck stops

Site hosts

Gas Station/Convenience Store

Travel Center/Truck Stop

Unknown

Hotel/Resort/Inn

Restaurant/Quick-service restaurant

Note: A total of 425 chargers have been tracked. Data is current as of March 31, 2024 Source: EVAdoption Claudine Hellmuth/POLITICO

Charging sites	Percent of total	
121	29%	
108	25%	
79	19%	
24	6%	
16	4%	

\$265M awarded

Top 3 Awardees

- \$92M: gas stations and truck stops
- \$12M: BP Pulse
- \$23M: Tesla

Source: EnergyWire, Politico

NEVI Massachusetts

- •State Plan Vision and Goals: support convenient, affordable, reliable, and equitable EV network.
- •RFR: December 19, 2023
- •Bid info meeting: January 4, 2024
- •Ports: CCS and NACS/J3400
- •Deadline initial submissions: January 11, 2024
- •Short-listed issued: February 27, 2024
- •Estimated selections: April 23, 2024
- •Estimated Board award: May 15, 2024

Maura Healey, Governor Kimberley Driscoll, Lieutenant Governor Monica Tibbits-Nutt, Secretary & CEO

Bid # BD-24-1030-CP01-CP01-96365 (MassDOT RFR NATIONAL ELECTRIC VEHICLE INFRASTRUCTURE (NEVI) PROGRAM PROCUREMENT)

MassDOT has selected the following responders to be added to the short list of prequalified firms.

- Tesla Inc.
- **BP Products North America Inc.**
- Applegreen Electric US Inc.
- Equilion Enterprises LLC ("Shell")
- Evgo Services LLC:
- Global Montello Group Corp.
- Weston and Sampson Engineers, Inc.
- Universal EV LLC

Contracting Structure

- with respect to Designers, M.G.L. ch. 7C, § 58
 - Initial Response
 - Response
- additional design firms) and ch. 30, §39M (construction/installation)
- Reference Information Documents ("RIDs")
 - All RIDs are posted on a Dropbox site, found at yao24frbtrergiy&dl=0

Request for Responses issued pursuant to 801 CMR 21.00 and,

Subcontracts procured in accordance with M.G.L. ch. 7C (any

https://www.dropbox.com/scl/fo/kv8bcrm2eawlkfgte3eji/h?rlkey=ymlbjiyjm7

Contracting Structure

RFR

- MassDOT issues this RFR for Pre-**Development Services** and, potentially, **Development Services** for the Gap Zones and Additional Sites, if any
- MassDOT will select a maximum of five Developers for a Pre-**Development Services** Agreement

Pre-Development Services Agreement

- MassDOT and selected Developers will enter into a Pre-Development Services Agreement
- · Concurrent with Pre-**Development Services**, MEPA/NEPA reviews of specific sites will be completed

Task Order Solicitation

• After the final MEPA/ NEPA determination, MassDOT will issue a Site-Specific Task Order Solicitation to Developers for one or more specific sites

Site-Specific Task Order

• The successful Developer will enter into a Site-Specific Task Order to perform development services at the specific site(s)

Limited Notice to Proceed

- Developer cannot commence Development Services until MassDOT has issued LNTP to the Developer
- Developer is given authority to submit a work plan to the Utility
- Any other Design and Installation Work performed by the Developer after LNTP and before Notice to Proceed is at the Developer's own risk unless approved by MassDOT

Notice to Proceed

- Upon approval of the work order by the Utility, and after providing evidence of steps the Developer has taken with respect to the rights of any third party, the Developer delivers to MassDOT an Updated Financial Model, an updated Baseline Schedule, and (if the Site is a MassDOTowned Site) a certificate demonstrating the Developer's control of the Site
- Upon approval, MassDOT will issue NTP for all D&I Work

This procurement will initially address the four gaps (the "Gap Zones") identified in Figure 1 in the RFR

Project Description

NEVI Maine - Round 5

- RFP Issued: 3/23/23
- Bid's due: 6/22/23
- Award date: 7/31/23
- NTP: 8/31/23
- First station open: April 2, 2024

7/31/23

EFFICIENCY MAINE TRUST Request for Proposals (RFP) for DC Fast Charging Stations – Maine Phase 5

RFP EM-011-2023

In the matter of the above-referenced request for proposals, the Efficiency Maine Trust is pleased to announce and provide notice of award to the following bidders:

- 1. Tesla, 281 Civic Center Drive, Augusta, Maine 04330
- 2. ReVision Energy, 225 High Street, Ellsworth, Maine 04605
- D&C Properties (Sundog Solar), 423 East Main Street, Searsport, Maine 04974 3.
- Tesla, 75 Maverick Street, Rockland, Maine 04841 4.
- 5. Irving, 1555 Atlantic Highway, Waldoboro, Maine 04572
- 6.

Midcoast Regional Redevelopment Authority, 11 Atlantic Avenue, Brunswick, Maine 04011

1.00

U.S. PEV Adoption Scenarios (light-duty)

Source: NREL

Endnotes

Source: Synapse Energy Economics, Inc.

Q&A

Spares

AC and DC charging curves

DC fast charging station

EV BATTERY % (STATE OF CHARGE)