

# **A Proposal for the Installation of EV Chargers on the UHart Campus**

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# Acronyms

- **DEEP**: Dept of Energy and Environmental Protection
- **NEMA**: National Electrical Manufacturers Association
- **EVSE**: Electric Vehicle Supply Equipment (charging station and associated equipment)
- **ICE**: Internal Combustion Engine
- **RPH**: Range per Hour
- **HEV**: Hybrid Electric Vehicle (Prius)
- **PHEV**: Plug-In Hybrid Electric Vehicle (Prius Prime)
- **EV**: Electric Vehicle (Tesla)
- **BEV**: Battery Electric Vehicle, also known as an EV (Tesla)

# HEV Note

Any discussion about charging vehicles in this deck does not pertain to HEVs – or hybrids, as they're more commonly known – as the electricity required to recharge these vechicle's on-board battery isn't supplied by EVSE.

# The Benefits of Adding EV Stations

- Gives the environmental program extra credibility.
- Makes the campus more desirable for prospective faculty, staff, and students.
- Keeps UHart contemporary with other local academic institutions.
- Gives the impression that UHart keeps abreast of upward trends in transportation.

# A Partial List of Local Colleges/Universities With EV Chargers?

School	Amt of Chargers	Public or Private	Fee	Comment
<a href="#">Asnuntuck Community College</a>	1	Public	Free	None
<a href="#">Trinity College</a>	4	Public	Free	None
<a href="#">Western Connecticut State University</a>	4	Public	Free	None
<a href="#">Central Connecticut State University</a>	3	Public	Free	None
<a href="#">Wesleyan University</a>	10	Mostly private; public discouraged	Free	Mainly for use by the Wesleyan community. Public users must obtain a parking permit or have their vehicle im-mobilized.
<a href="#">UConn at Storrs and the School of Law</a>	Various	Public	Free	The UConn Law School has 2 chargers and the Storrs campus has 2 or more chargers.

# Who Has EV Chargers in the West Hartford Environs?

Perhaps the most interesting attitude towards EV chargers on campus comes from Wesleyan:

*"Add additional electric vehicle charging stations somewhere more central to campus, possibly by admissions. This would serve as a sign of Wesleyan's commitment to sustainability for visitors and potential students, and would encourage more faculty/staff to purchase hybrid and electric vehicles. The two chargers located by athletics are almost always in use, so clearly there is a demand for this on campus. I believe there is also still state money available to subsidize the project."*

– Completed, Best Practices Committee | Wesleyan University

# So, Why is Charging Free in Most Places?

- CT provides incentives<sup>1</sup> to offset the cost of EVSE installation.
- In exchange for the subsidy, the state requires that the site provides free EV charging to the public.
- Hence, free EV charging at places like The UConn Law School Library and Trinity College's Crescent St parking lot, among other locations throughout Hartford.
- Paul Kritzler, Environmental Analyst at DEEP, said that CT is also receiving funds from Volkswagen.
- He's likely referring to the [VW Settlement Information](#).
- Some VW funds are being awarded for EVSE installation. However, as of August 2019, there are no state incentives/subsidies.
- Kritzler said that subsidies may be reinstated in 2020, but was unsure as to a specific date.
- He advised me – and any interested parties – to [sign up](#)<sup>2</sup> for notifications.

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<sup>1</sup> <https://afdc.energy.gov/laws/11497>

<sup>2</sup> <https://visitor.r20.constantcontact.com/manage/optin?v=001Ylysmm7Zby2v8N7gpaNE4FHXjSP7wJj58Iys44A5Z6Z5NY-S8IYebvy6RIHJWPdbEsNxUKhJutkdfCeGJKbxpQ1ZHc7VfHHvGyVbLgM73G4%3D>

# Charging Levels

There are currently three levels of charging, and each varies wildly from the others.

- **Level 1:** Slowest, at about  $1.8\text{kWh}$ , providing about 5 RPH.
- **Level 2:** Most common, at about  $9\text{kWh}$ , providing about 25 RPH.
- **Level 3:** Fastest, at about  $50\text{kWh}$ , providing about 138 RPH.<sup>3</sup>

**Note:** These numbers are typical, but your mileage may vary.

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<sup>3</sup> Tesla superchargers and other Level 3 chargers provide up to  $120\text{kWh}$  of charging, providing about 333 RPH.

# Charging Levels

EV Charging Level Comparison

	Level 1	Level 2	Level 3 (DC Fast Charging)
<b>Power</b>	1.4kW	7kW	50kW
<b>Source</b>	Standard outlet	Special Charging Station	
<b>Charge Rate (Est.)</b>	Est. 5 miles/hour	25 miles/hour	200 miles/hour
<b>Optimal Use-Case</b>	Occasional Use	Everyday Use	Road Tripping

Source: Commercial Electric Vehicle Guidelines: Understanding the Differences Between Charging Station Levels and Speeds

# Form Factors

The most common form factors for charging interfaces in the US:

- **J1772** (Level 1 and Level 2)
- **CCS 1** (Level 3)
- **CHAdeMO** (Level 3)<sup>4 5</sup>

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<sup>4</sup> “CHAdeMO” is a pun on “O cha demo ikaga desuka” in Japanese, meaning, “Let’s have a tea while charging” in English.

<sup>5</sup> **Source:** [http://www.tepco.co.jp/en/press/corp-com/release/betu10\\_e/images/100315e1.pdf](http://www.tepco.co.jp/en/press/corp-com/release/betu10_e/images/100315e1.pdf)

# Form Factors

## EV Charging Basics

Type	Miles of Range Per Hour of Charging (RPH)	Time to Fully Charge	When to Use	Connector
Level 1, Standard Wall Outlet (AC)	5 RPH	<ul style="list-style-type: none"><li>+ 16 hours for an 80-mile battery</li><li>+ 40 hours for a 200-mile battery</li></ul>	<ul style="list-style-type: none"><li>+ Get some charge while you sleep</li><li>Note: slower for cars with large batteries</li></ul>	 Note: you'll need your own cable to plug in to the wall for Level 1
Level 2 Charging Station (AC)	<ul style="list-style-type: none"><li>+ 12 RPH for cars with 3.7 kW on-board charger</li><li>+ 25 RPH for cars with 6.6 kW on-board charger</li></ul>	<ul style="list-style-type: none"><li>+ 3.5 hours for an 80-mile battery</li><li>+ 8 hours for a 200-mile battery</li></ul>	<ul style="list-style-type: none"><li>+ At work</li><li>+ While you sleep</li><li>+ Topping up around town</li></ul>	 J1772 connector
DC Fast Charging	100 RPH or more, depending on the power level of the charger <ul style="list-style-type: none"><li>+ 24 kW (up to 100 RPH)</li></ul>	Depends on the power level of the charger and car model, but could be 80% charged within 30 minutes	<ul style="list-style-type: none"><li>+ Short stops</li><li>+ Express Corridor locations</li></ul>	

Source: [Driver's Checklist: A Quick Guide to Fast Charging](#)

# Form Factors

## Connectors

All EVs except Tesla use the same J1772™ connector for Level 2 charging. Tesla makes adapters that allow their vehicles to charge using J1772 or CHAdeMO connectors.

Not all EVs come with DC fast charging as a standard feature. It's often available as an upgrade package.

When choosing a DC fast charging station, check the connector to make sure it fits your car's charging port. There are three different DC fast charging connector standards in North America, each used by different EVs.

### SAE Combo (CCS) is compatible with

- + BMW
- + VW
- + Chevy
- + All upcoming U.S. and European cars
- + Some of the new cars from Asian manufacturers



### CHAdeMO is compatible with

- + Nissan
- + Mitsubishi
- + Kia



### Tesla is compatible with

- + Tesla
- Note: adapters available for J1772 and CHAdeMO



Source: Driver's Checklist: A Quick Guide to Fast Charging

# Some Basic Electric Math

- $amps \times volts = watts$ .
- A typical household outlet provides about 15amps at 120volts.
- Thus,  $15amps \times 120volts = 1800watts$  per hour, or  $1.8kWh$ .

# How Much Does the Consumer Pay for EV Charging at Home, Which is Level 1?

- Eversource charges me about \$0.19 per *kWh*, and all the outlets in my apartment<sup>6</sup> supply about 1800*watts*, or 1.8*kWh*.
- Thus,  $1.8kWh \times \$0.19 = \$.34$ .

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<sup>6</sup> A typical, Type B household plug, also known as a NEMA 5-15.

# How Much Electricity Does an EV Need to Travel One Mile?

- Charging my car for one hour (*1800watts*) from a standard plug provides me with 5 miles of range.
- Therefore, 1 mile of range requires  $\frac{1800watts}{5miles} = 360watts$ .

# How Much Does the Consumer Pay for EV Charging on the Road, Which is Level 2?

- Every Level 1 or Level 2 charger I've visited in NY and CT, whether at a school or otherwise, has provided free charging.
- I have, however, paid for parking in lots that provide EV charging.  
For example:
  - NY (*Kew Gardens*): \$3 for the first hour; \$2 each additional.
  - CT (*Blue Back Square*): \$1.50 per hour.

# What Will the Least Expensive Level 2 Charger Cost UHart?

**Note:** The following excludes EVSE costs.

- Clipper Creek makes [the cheapest Level 1 charger](#) I've found, at \$379.
- This charger comes with a [cheap lock](#) to keep out unauthorized users.

# What Will the Most Expensive Level 2 Charger Cost UHart?

The following is a summary of an email from Joseph Inglisa, Director, Mid-Atlantic Business Development, SemaConnect, detailing the cost of installing a SemaConnect charger. I imagine it's similar for ChargePoint and others.<sup>10</sup>

1. The list price is \$3,590 per charging station, with volume pricing available.
2. Cable management devices cost \$600 for dual or single configurations.
3. The first year of network service is complimentary, after which the yearly cost is \$240.
4. There are no activation, turn on, or commissioning fees.
5. There are no taxes for shipping to CT; only UPS ground shipping is charged.
6. UHart chooses a kWh or hourly rate to cover or mark up electric costs.
7. UHart isn't obligated to use SemaConnect, in the event that the University offers complimentary charging.
8. SemaConnect sends a quarterly payment based on the aforementioned user pricing.
9. SemaConnect nets out a 5% credit card transaction / management fee.
10. SemaConnect registers the customers' credit card information and deals will all financial transactions.

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<sup>10</sup> Excludes EVSE costs.

# Partial List of Local EV Chargers

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**Location:** Delamar West Hartford

**Brand:** Clipper Creek

**Charger count:** 1



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**Location:** Delamar West Hartford

**Brand:** Clipper Creek

**Charger count:** 1



# Partial List of Local EV Chargers

**Location:** Bloomfield Human Services Community Center

**Brand:** SemaConnect

**Charger count:** 2



# Partial List of Local EV Chargers

**Location:** Bloomfield Human Services Community Center

**Brand:** SemaConnect

**Charger count:** 2



# Partial List of Local EV Chargers

**Location:** West Hartford Town Hall

**Brand:** EVSE LLC

**Charger count:** 2



# Partial List of Local EV Chargers

**Location:** Public parking, Arapahoe Rd at LaSalle Rd

**Brand:** Clipper Creek

**Charger count:** 1



# Partial List of Local EV Chargers

**Location:** Public parking, Arapahoe Rd at LaSalle Rd

**Brand:** Clipper Creek

**Charger count:** 1



# Partial List of Local EV Chargers

**Location:** Bishops Corner

**Brand:** ChargePoint

**Charger count:** 2

**Note signs:** “Violators will be towed”



# Partial List of Local EV Chargers

**Location:** University of Connecticut School of Law

**Brand:** EVSE LLC

**Charger count:** 2



# Partial List of Local EV Chargers

**Location:** Trinity College's Crescent St Parking Lot

**Brand:** Clipper Creek

**Charger count:** 4



# Partial List of EV Charger Manufacturers

- [Blink](#)
- [ChargePoint](#)
- [Clipper Creek](#)
- [EVgo](#)
- [EVSE LLC](#)
- [Juice Bar](#) (based in Norwalk, CT and Hartford, CT)
- [SemaConnect](#)

# Random Installation Notes

# Random Installation Notes

## Funding

- Eversource has provided up to 90% of the infrastructure cost, and they install charging lines and breakers for up to 10 chargers.
- I don't think UHart can charge customers for electricity if the chargers are subsidized with government funds.

# Random Installation Notes

## Barriers

- If chargers are installed onto pedestals, then steel bollards, or barriers, are usually placed in front of them in order to mitigate damage to the stations and the electrical grid.

15 MINUTE  
PARKING  
OR  
2 HOUR  
CHARGING  
ONLY

Visitors will  
be issued

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PARKING  
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# Random Installation Notes

## Barriers

- Wall-mounted chargers might require concrete parking blocks.



# Random Installation Notes

## Outdoors

- Installing the chargers at the intersection of a  $2 \times 2$  parking matrix (±) decreases the chances of being ICE-ed, but is more expensive and complicated to implement.
- Installing them in a location where no trenching, boring, and/or repaving is required, such as in the K-Lot by The Hartford Art School, is perhaps the cheapest option.



# Random Installation Notes

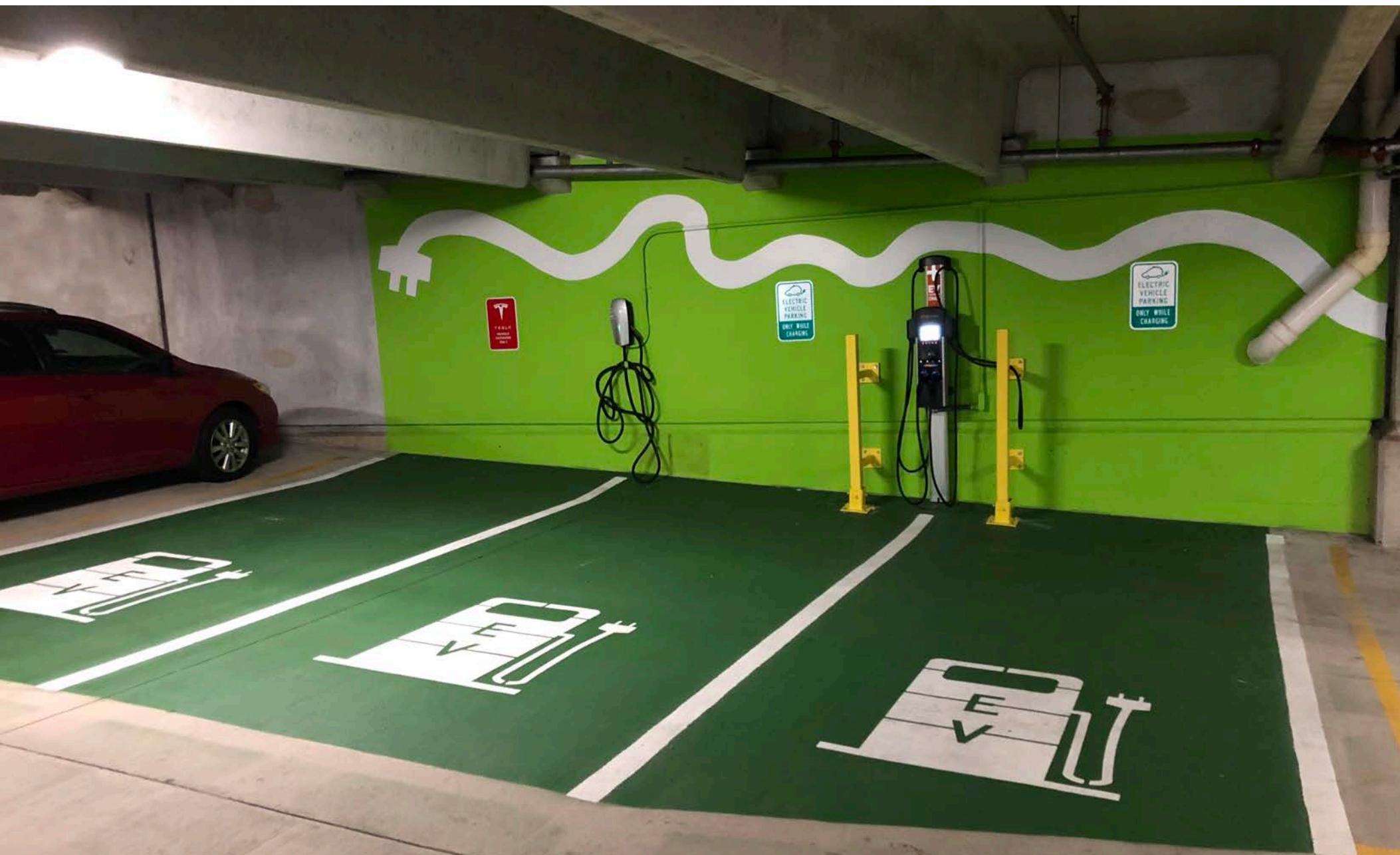
## Indoors

- If chargers with mobile phone app capabilities are installed in a subterranean location, where a 4G signal is not available, then a repeater would need to be installed.

# Random Installation Notes

## Parking Spot Decoration

- Paint the ground a bright green.
- Add clear signage.



Source: [Bethlehem Parking Authority](#)

# Random Installation Notes

## Breakers

- If a single breaker/line is used for 2 chargers, then the electrical load is divided, meaning each vehicle only gets half the charge.

# EV Charging Etiquette

- Local resident should only charge to 80%, so others may charge.
- Non-locals may charge more.
- Limiting Level 2 charging to 2–4 hours is common, because most – if not all – cars will reach an 80% charge in that time.

# Revenue

## Charging Fees

- No university I'm aware of charges for EV charging, likely because most are subsidized.
- In non-university settings, fees are typically charged in minute-based increments of  $kWh$ .
- Hourly fees, however, are typically charged when parking fees are involved.

# Revenue

## Fines

- Discourage ICE-ing and squatters...



Source: [Plugshare](#)

# Revenue

## Fines

- By imposing fines and im-mobilizing cars



Source: [Plugshare](#)

# Interesting Facts

- San Mateo Community College in California has 61 EV chargers.  
**Stanford has 132!**
- **Rivian** is making an all electric pick up truck. Amazon **ordered 100,000.**
- Ford just introduced the **2021 all-electric Mustang Mach-E.**

# Useful Links

- The US Dept of Energy's [Costs Associated With Non-Residential Electric Vehicle Supply Equipment](#)

*Published in late 2015, this document answers just about any question one may have regarding the installation of EVSE onto non-residential properties. Appendix C: Electricity Consumption Examples on page 38 provides examples of pricing and power consumption use.* §

- [Capitol Clean Cities of Connecticut](#)

*The local Clean Cities coalition that brings together a network of contacts in the EV industry.* §

- [EVConnecticut Charging Resources](#) by Dept of Energy & Environmental Protection (DEEP)

*"The resources on this page will help you explore various types of charging station equipment and also provide very useful information on siting a charging station and signage requirements."*

Source: First ¶ at [EVConnecticut Charging Resources](#). §

- [The Different EV Charging Connector Types](#) §
- US Dept of Energy's [Vehicle Technologies Program](#) (October 2011) §