Non-Residential Electric Vehicle Supply Equipment (EVSE) Costs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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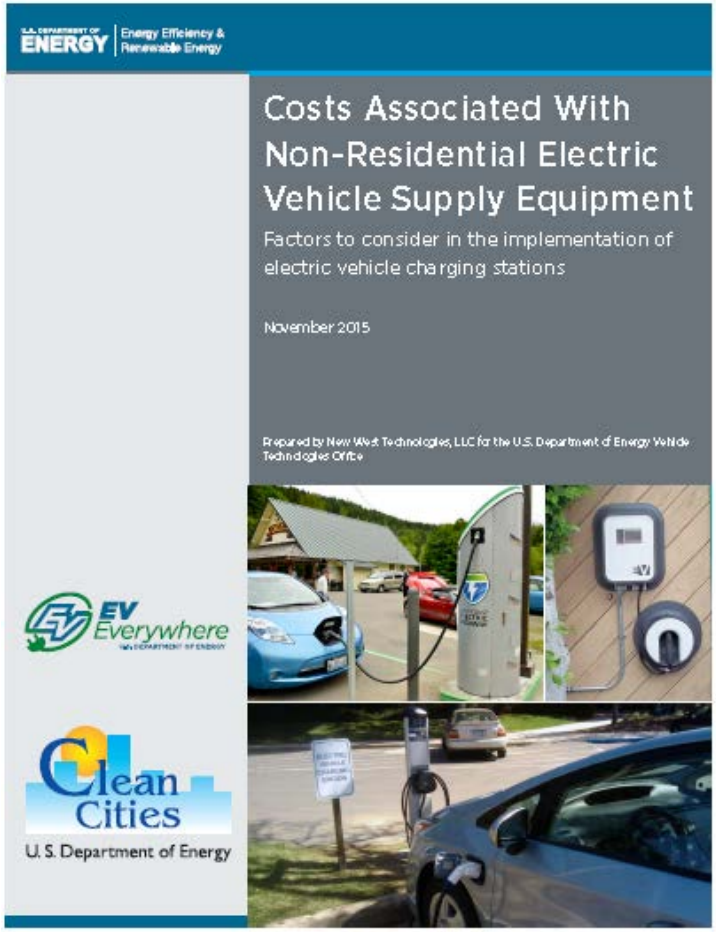
Costs Associated with Electric Vehicle Supply Equipment

1. EVSE Overview
2. EVSE Cost Study Overview/Scope
   a) Hardware/Unit Costs
   b) Installation Costs
   c) Operation and Maintenance Costs
3. Incentives
4. EVSE Cost Reduction Tactics

Sources:

- EV Project (2011-2013)
- Electric Power Research Institute (EPRI) Report (2010-2013)
- West Coast Electric Highway (WCEH) (2011-2015)
- Industry Interviews (2014-2015)



For more information, visit http://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf

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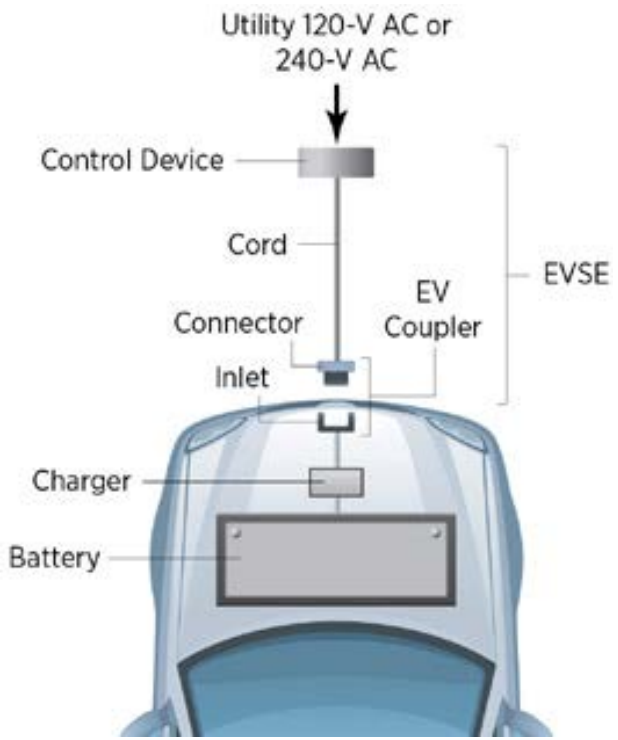
Electric Vehicle Supply Equipment (EVSE) Overview

EVSE consists of all the equipment needed to deliver electrical energy from an electricity source to a plug-in electric vehicle battery.



Charging Level	Vehicle Range Added per Charging Time and Power	Supply Power
AC Level 1	4 mi/hour @ 1.4kW 6 mi/hour @ 1.9kW	120VAC/20A *(12-16A continuous)*
AC Level 2	10 mi/hour @ 3.4kW 20 mi/hour @ 6.6kW 60 mi/hour @ 19.2 kW	208/240VAC/20-100A *(16-80A continuous)*
DC Fast Charging	24 mi/20minutes @24kW 50 mi/20minutes @50kW 90 mi/20minutes @90kW	208/480VAC 3-phase *(input current proportional to output power;* *~20-400A AC)*

Photo from Angela Costanzo, NREL

Photo from WSDOT

EVSE Cost Overview/Scope

- ✓ EVSE Unit Hardware
- ✓ Installation Costs
  - Contractor labor and materials for
    - Connecting EVSE to the electrical service
    - New electrical service or upgrades (if needed)
    - Meeting Americans with Disabilities Act (ADA) requirements
    - Misc. (traffic protection, signage, lighting)
  - Permitting and inspection
  - Engineering review and drawings
- ✓ Operation and Maintenance Cost
  - Electricity consumption and demand charges
  - EVSE network subscription
  - Management time
  - Billing transaction costs
  - Maintenance and repairs

Hardware/Unit Cost

EVSE unit cost primarily depends on the

1. Charging Level and Amperage Rating
2. # of Charging Ports
3. Mounting system (wall/pedestal)
4. Networked/Non-networked
5. Additional Features

EVSE Type	EVSE Unit* Cost Range (single port)
Level 1	$300-$1,500
Level 2	$400-$6,500
DCFC	$10,000-$40,000

*EVSE unit costs are based on units commercially available in 2015.

Additional Features

- Communications Capabilities
- Access Control
- Point of Sale (POS)
- Energy Monitoring
- Energy Management and Demand Response
- Advanced Display Screen
- Retractable Cord
- Automated Diagnostics

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Installation Cost

Installation costs are influenced by

- Required electrical work
- Trenching or boring,
- Permitting/inspection,
- Labor rates, and
- ADA requirements.

EVSE Type	Average Installation Cost (per unit)	Installation Cost Range (per unit)
Level 1	*not available*	$0-$3,000** *Industry Interviews*
Level 2	~$3,000 *EV Project*	$600-$12,700 *EV Project*
DCFC	~$21,000 *EV Project*	$4,000-$51,000 *EV Project and Orlando Utilities Commission*

**The $0 installation cost assumes the site host is offering an outlet for PEV users to plug in their Level 1 EVSE cordsets and that the outlet already has a dedicated circuit.

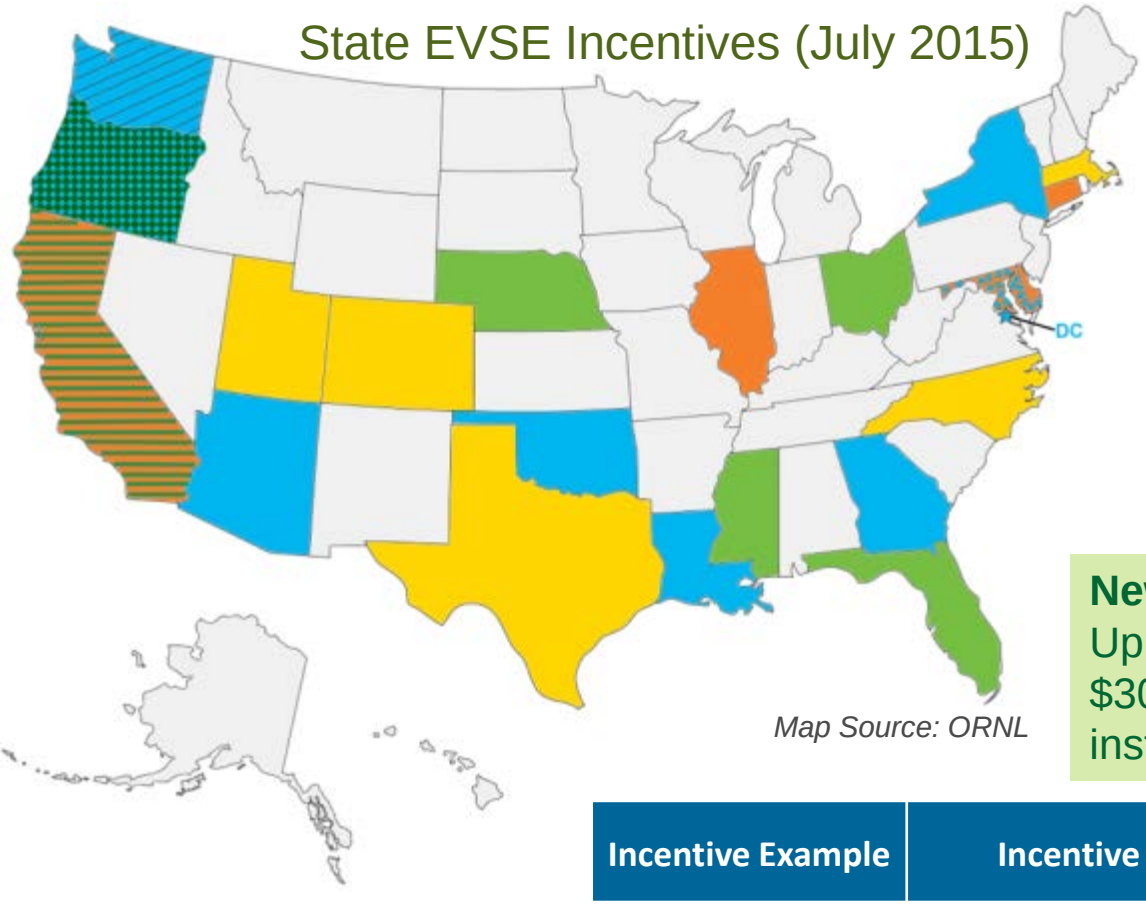
EVSE installation costs vary significantly based on site specific factors. **A site evaluation is critical** for estimating EVSE installation costs.

Operation and Maintenance (O&M) Costs

- Electricity
  - Commercial electricity rates: $0.08-$0.15 per kWh
  - Annual cost varies by power usage
  - Demand Charges: once site's power usage crosses the utilities threshold (20-50kW), demand charges may apply ($0-$2,000+ per month)
- Charging Network Fees
  - EVSE can be networked or non-networked (networked EVSE can provide energy monitoring, usage analysis, access control, and a payment system)
  - $100-$900 annually (plus, possibly, cellular/Wi-Fi network communications and back office support
- Repair
  - Little information is available on EVSE lifespan, maintenance costs, and repair costs.
  - DCFC may require ongoing maintenance due to cooling systems, filters, and other components not on L1 or L2 EVSE.

	Single Port EVSE Scenarios	Electricity Consumption and Cost
Level 1	**Workplace charging** 1 light-duty vehicle; Charging 6hrs/day; 5 days/wk	2,184 kWh/yr **$218/yr**
	Fleet charging 1 light-duty vehicle; Charging 14hrs/night; 5 days/wk	5,096 kWh/yr **$510/yr**
Level 2	**Workplace charging** 2 light-duty vehicles; Each charging 3hrs/day; 5 days/wk	10,296 kWh/yr **$1,030/yr**
	Public charging 1 light-duty vehicle; Charging 5hrs/day; 4 days/wk	6,864 kWh/yr **$686/yr**
	Fleet charging 2 medium-duty vehicles; Each charging 5hrs/night; 5 days/wk	17,160 kWh/yr **$1,716/yr**
DCFC	**Public charging** 2 light-duty vehicles; Each charging 20 min/day; 7 days/wk	11,278 kWh/yr **$1,128/yr**

EVSE Incentives Can Reduce Cost



Map Source: ORNL

New Federal EVSE Tax Credit
Up to $1,000 for residential EVSE or $30,000 for a commercial/public EVSE installed January 2015-Dec 2016

Incentive Example	Incentive Description	Base EVSE Unit Cost	EVSE Unit Cost after Incentive
Income Tax Credit	Income tax credit for 20% of the cost of the EVSE, up to $2,500.	$4,000	$3,200
Level 2 Rebate	$1,000 rebate for the purchase and installation of Level 2 EVSE	$3,000	$2,000
DCFC Rebate	$15,000 rebate for the purchase of DCFC	$30,000	$15,000

For current incentives, visit AFDC Laws and Incentives Database http://www.afdc.energy.gov/laws

Other Tactics for Minimizing EVSE Costs

EVSE Unit Selection

- Minimum level of features needed
- Wall mounted EVSE unit (if possible)
- Dual port EVSE minimizes installation costs per charge port.
- Choose the quantity and level of EVSE units to fit within that available electrical capacity

Location

- Minimize the trenching/boring distance.
- Place the EVSE unit close to the electrical service
- Use signage to direct PEV drivers to the EVSE unit
- Choose a location that already has space on the electrical panel with a dedicated circuit

Long Term Planning

- Discuss electrical service needs and charges with your utility
- Avoid demand charges
- Upgrade your electrical service for your anticipated long term EVSE load and run conduit to your anticipated future EVSE locations.
- Consider the electricity infrastructure for EVSE when building a new facility

EVSE Unit and Installation Cost Summary

Ballpark EVSE Unit and Installation Costs

EVSE Type	EVSE Unit* Cost Range (single port)	Average Installation Cost (per unit)	Installation Cost Range (per unit)
Level 1	$300-$1,500	*not available*	$0-$3,000** *Source: Industry Interviews*
Level 2	$400-$6,500	~$3,000 *EV Project*	$600-$12,700 *EV Project*
DCFC	$10,000-$40,000	~$21,000 *EV Project*	$4,000-$51,000 *EV Project and Orlando Utilities Commission*

**EVSE unit costs are based on units commercially available in 2015.*

***The $0 installation cost assumes the site host is offering an outlet for PEV users to plug in their Level 1 EVSE cordsets and that the outlet already has a dedicated circuit.*

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Additional Resources

1. Costs Associated with Non-Residential EVSE: http://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf

2. Alternative Fuel Data Center EVSE page: http://www.afdc.energy.gov/fuels/electricity_stations.html

3. Clean Cities' Plug-In Electric Vehicle Handbook for:
   - Workplace Charging Hosts: http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf
   - Fleet Managers: http://www.afdc.energy.gov/pdfs/pev_handbook.pdf
   - Public Charging Station Hosts: http://www.afdc.energy.gov/pdfs/51227.pdf
   - Consumers: http://www.afdc.energy.gov/uploads/publication/pev_consumer_handbook.pdf
   - Electrical Contractors: http://www.afdc.energy.gov/pdfs/51228.pdf

4. INL Lessons Learned papers from the EV Project: http://avt.inl.gov/evproject.shtml

5. Electric Vehicle Supply Equipment Installed Cost Analysis study by EPRI: http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002000577

6. DOE Workplace Charging Challenge: http://energy.gov/eere/vehicles/ev-everywhere-workplacecharging-challenge
   - ADA Guidance: http://energy.gov/eere/vehicles/ada-requirements-workplace-charging-installation
   - Signage Guidance: http://energy.gov/eere/vehicles/workplace-charging-challenge-signage-guidance
   - Request for Proposal Guidance: http://energy.gov/eere/vehicles/downloads/request-proposal-guidance

7. Siting and Design Guidelines for EVSE: http://www.transportationandclimate.org/sites/www.transportationandclimate.org/files/EV_Siting_and_Design_Guidelines.pdf

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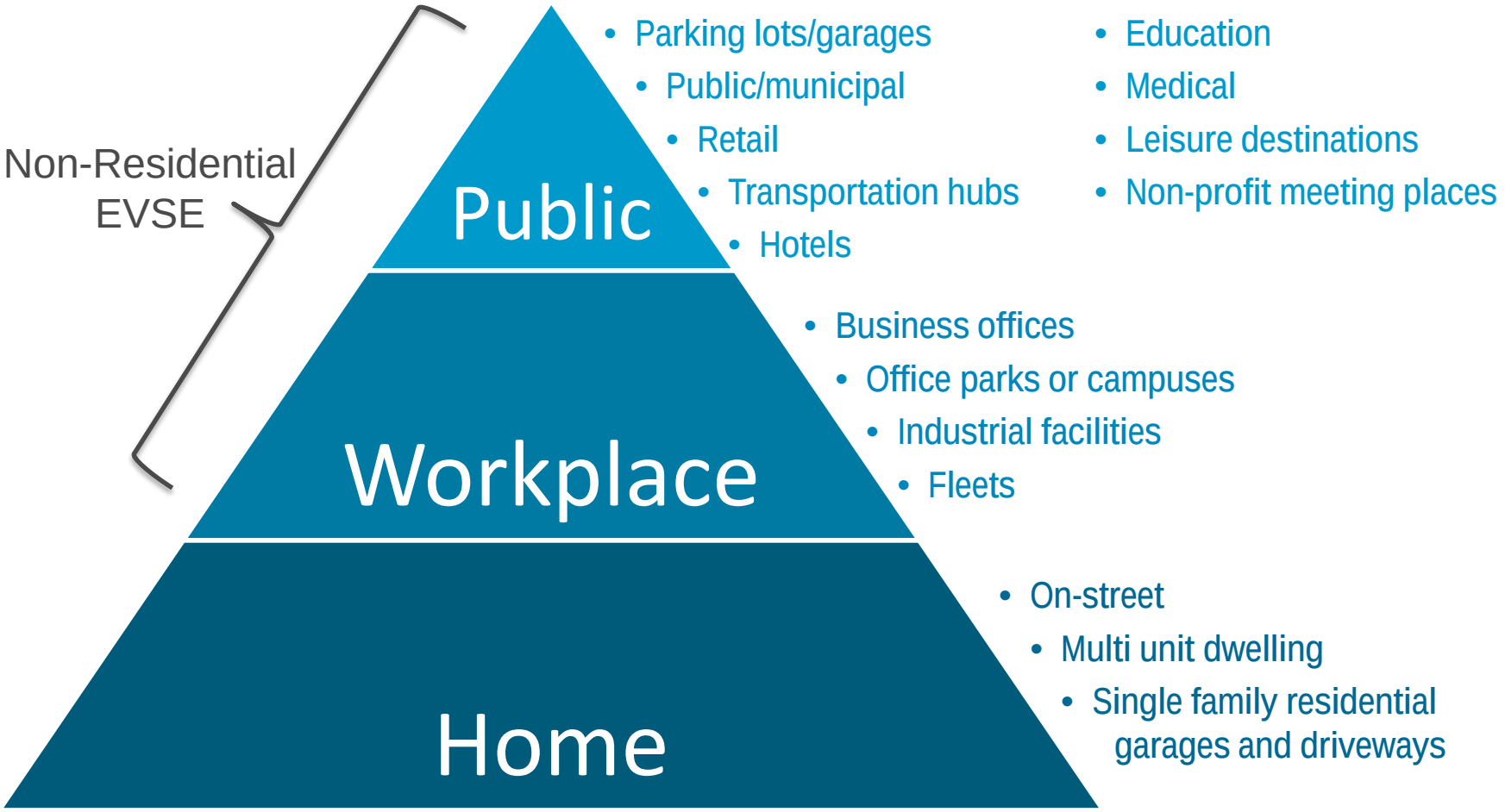
Infrastructure Settings



Non-residential EVSE increases the electric driving range for PEV owners and enables drivers without access to home charging to own PEVs.

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EVSE Unit Costs - Level 1

Level 1 EVSE Unit
(single port)
$300-$1,500

Main L1 EVSE Cost Factors

- Mounting
  - Cordset that can plug into a 120V outlet (low cost)
  - Wall mounted unit
  - Pedestal unit (higher cost)
- Advanced Features

Photo from Telefonix

Photo from ANL

Photo from AeroVironment

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EVSE Unit Costs - Level 2

Level 2 EVSE Unit
(single port)
$400-$6,500

Main L2 EVSE Cost Factors

- Mounting (wall/pedestal)
- Communications capabilities
- Advanced features

Ballpark Cost Ranges for Level 2 EVSE

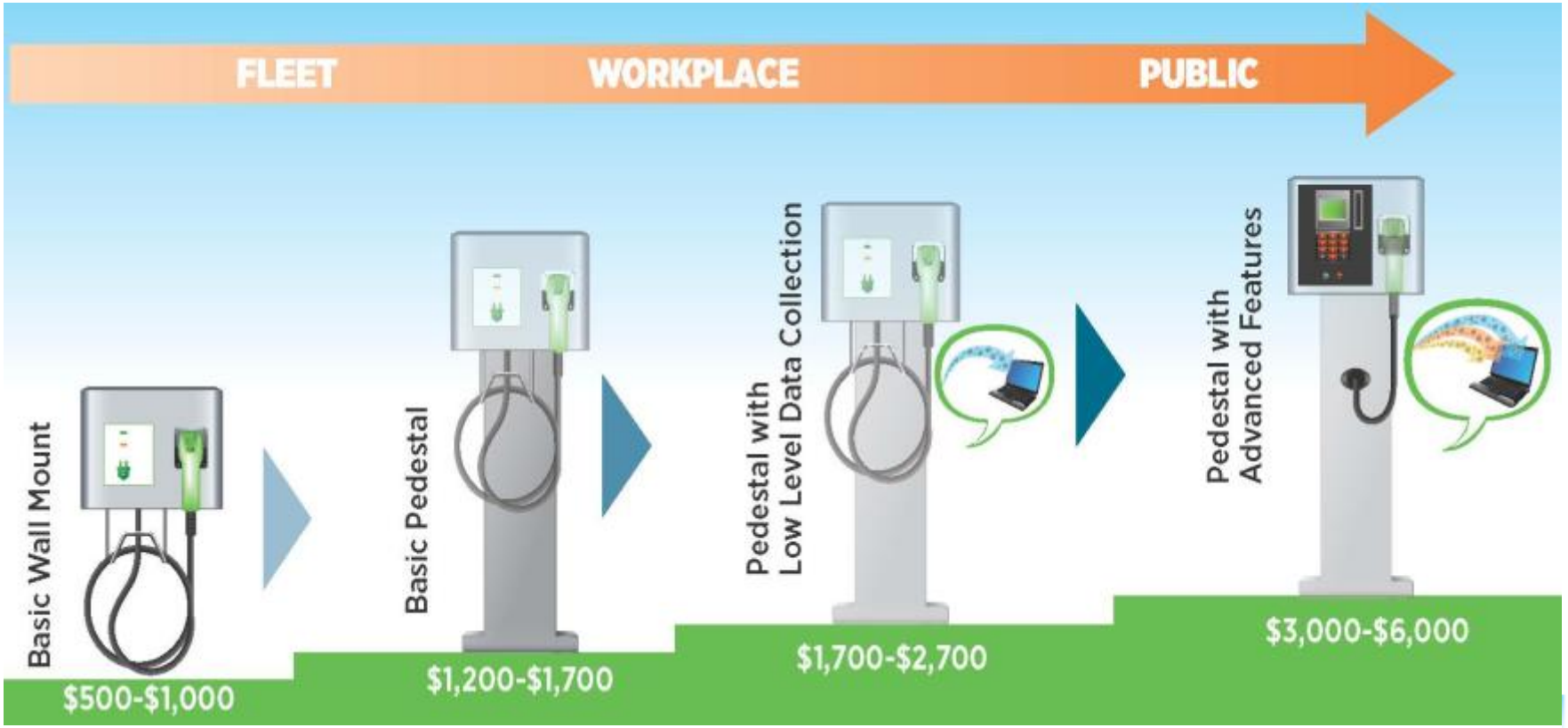

Image from New West Technologies

EVSE Unit Costs - DC Fast Charging

DCFC EVSE Unit

$10K-$40K

Main DCFC EVSE Cost Factors

- Power output ranges from 24-250kW (commonly 50-60kW)
- Number of ports (may have multiple connector standards but only charge one vehicle at a time)
- Advanced features

Photo from Don Karner

Photo from Margaret Smith

DCFC Connectors

SAEJ1772 CCS and CHAdeMO

Photo from Margaret Smith

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Installation Costs – Connecting EVSE to Electrical Service

Simple/lower cost – run conduit along the wall a short distance from the electrical service to the EVSE

Complex/higher cost – trench or bore through concrete to run conduit a long distance from electrical service to EVSE

Trenching cost varies by location but in some areas the cost for digging the trench, laying conduit, then back-filling is:

- $10-$20/ft for soil
- $100-$150/ft for asphalt or concrete

Photo from NYSERDA

Photo from INL

Photo from NYSERDA

Photo from NYSERDA

Concrete cut out and soil removed to access underground electric service

Photo from INL

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Installation Costs – Connecting EVSE to Electrical Service

For some sites, **boring** (drilling a tunnel underneath the ground) is cost effective alternative to trenching.

-less invasive

-does not disrupt traffic flow

-fewer costs for disposing of removed concrete and restoring surface to original appearance

Photo from INL

These EV Project EVSE were installed by boring under existing sidewalk to maintain landscaping.

Installation Costs – New Electrical Service or Upgrades

Photo from Don Karner

Photo from NYSERDA

3 Fundamental EVSE Electrical Needs

1. Sufficient electrical capacity from the utility connection to the electrical panel.
2. Sufficient electrical capacity at the panel.
3. A dedicated circuit for each EVSE unit on the electrical panel (in most cases).

Consult with electrician and utility to determine if electrical work is needed and estimate cost.

- **Service upgrade** – Increasing the electrical capacity from the utility to an existing electrical panel, e.g. new transformer. *$10,000-$25,000 (WCEH).*
- **New electrical service –** Bringing electricity from the utility to a site that did not previously have electricity. *$3,500-$9,500 (EV Project)*
- **Electrical panel work** – Replacing or upgrading the panel, re-working the panel to provide more breaker positions, or adding a sub-panel. Cost is very site specific. *About 72% of Level 2 commercial installations required panel work (EPRI)*

Installation Costs – Additional Cost Factors

- **Permitting and inspection** - *$14-$821 (EV Project)*
- **Engineering review and drawings** -*$1,000-$3,000 (EV Project)*
- **Americans with Disabilities Act (ADA) requirements** can have a minimal or significant effect on costs, depending on the site and authority having jurisdiction (AHJ)
  - Level parking spaces
  - Accessible signage
  - Van accessible parking spaces
  - Curb cutouts
  - Specific connector height
- **Traffic protection**
  - Bollard *$200-$800 (interviews)*
  - Wheel stop *$100-$200 (interviews)*

Photo from ECOtality

Photo from NYSERDA

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Installation Costs – Level 1

Level 1 Installation

$0-$3,000

Photo from Steve Russell

Main L1 Installation Cost Factors

- Offer an existing electrical outlet for drivers to plug in cordset *($0)*
- Install an electrical outlet or a wall mounted Level 1 EVSE *($300-$1,000)*
- Install a pedestal Level 1 EVSE *($1,000-$3,000 assuming no major electrical work needed)*

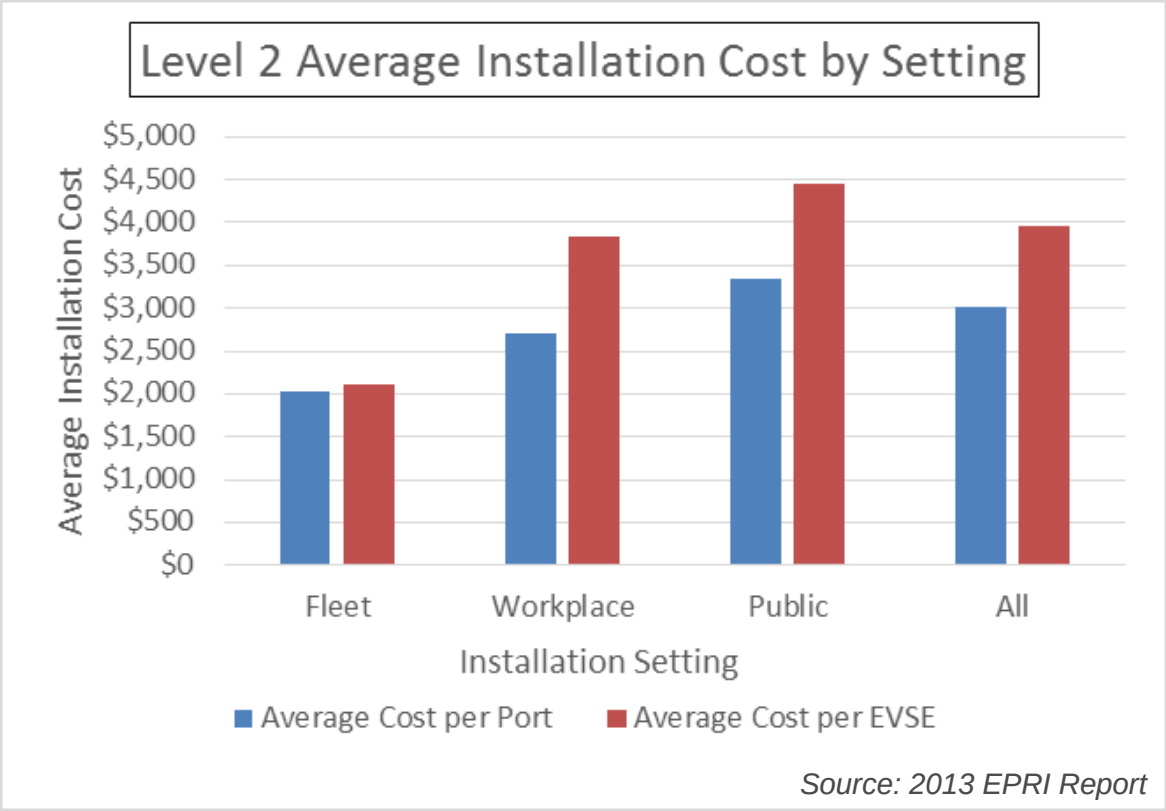
Installation Costs – Level 2

Level 2 Installation

$600-$12,700

Main L2 Installation Cost Factors

- Pedestal/wall mount
- Trenching/boring
- Electrical work (panel, new/upgraded service)
- Geographic location
- Fleet, workplace, or public



Source: 2013 EPRI Report

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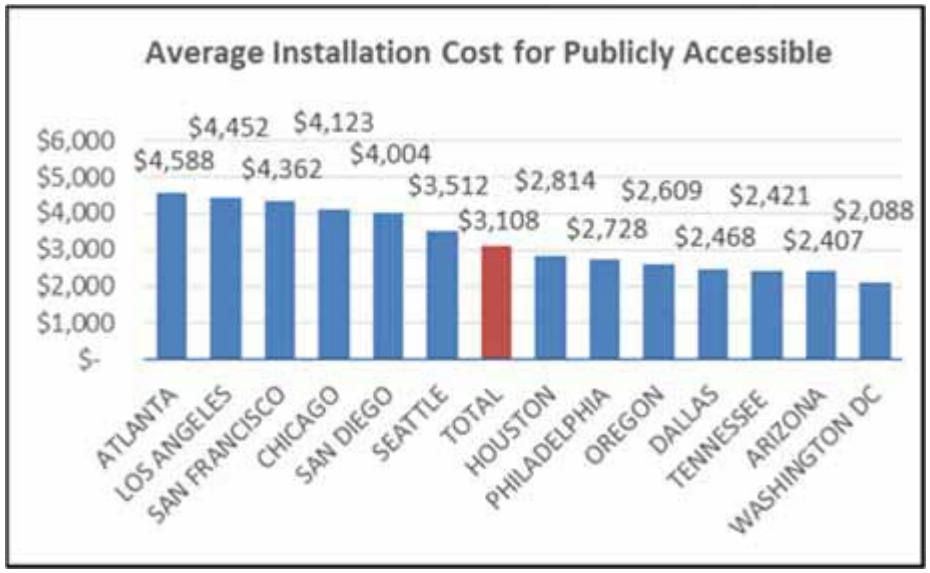
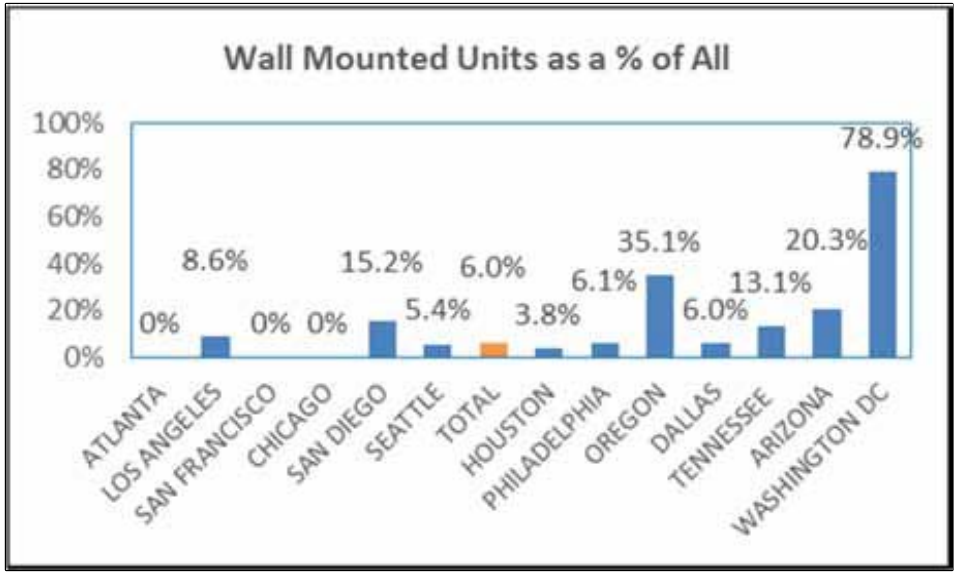
Installation Costs – Level 2 Public by Geographic Region



Source: INL/EV Project



Source: INL/EV Project

Costs vary by geographic region

- Labor rates
- Permitting fees
- ADA requirements
- % of wall mounted units
- Higher costs for high visibility location

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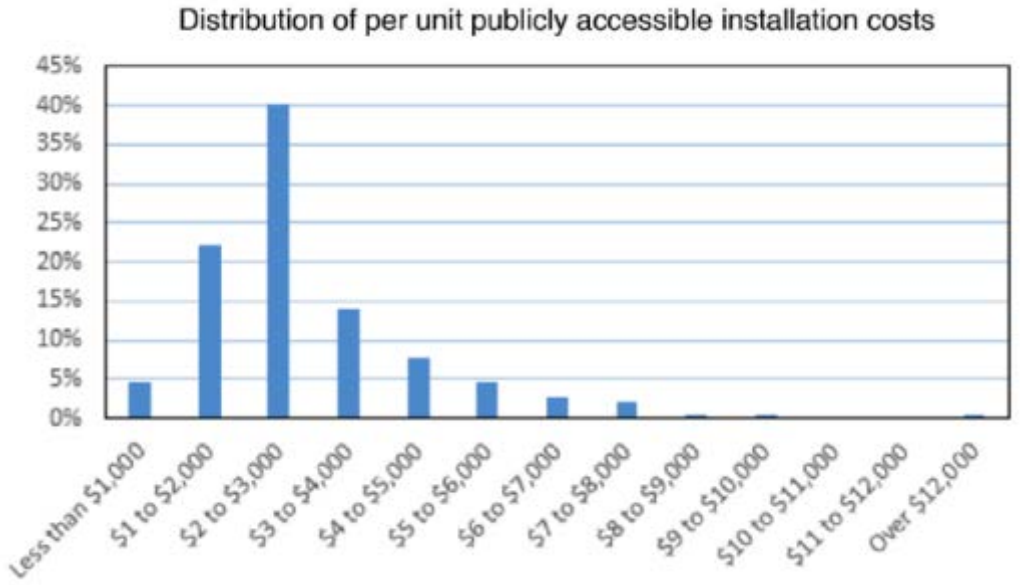
Installation Costs – Level 2 Public and Workplace (EV Project)

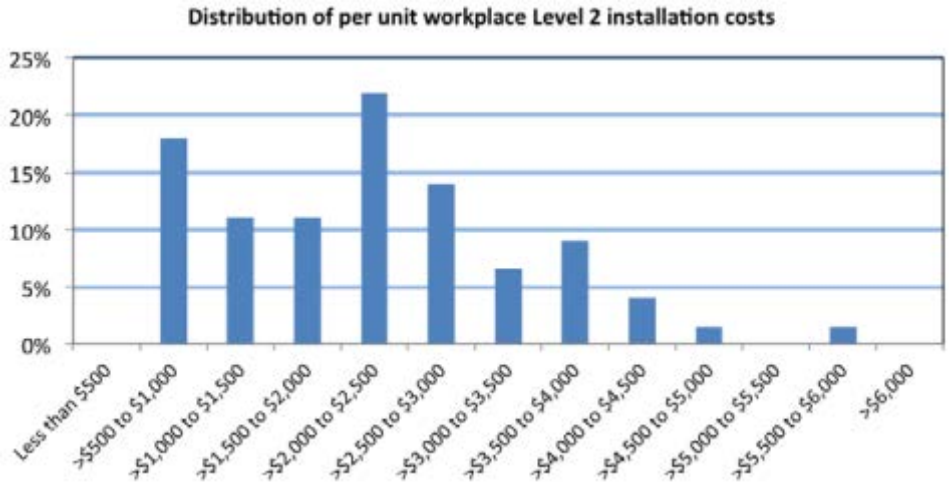
- All non-residential L2 installation cost ~$3,000 avg
- Workplace installation averages are lower than public for all, pedestal, and wall mount installations



Source: INL/EV Project

Avg. Install. Cost EV Project L2 Non-Residential

	All Non-Res.	Publicly Accessible	Workplace
All	**$2,979**	$3,108	$2,223
Pedestal Units	$3,209	$3,308	$2,305
Wall Mount Units	$2,035	$2,042	$2,000

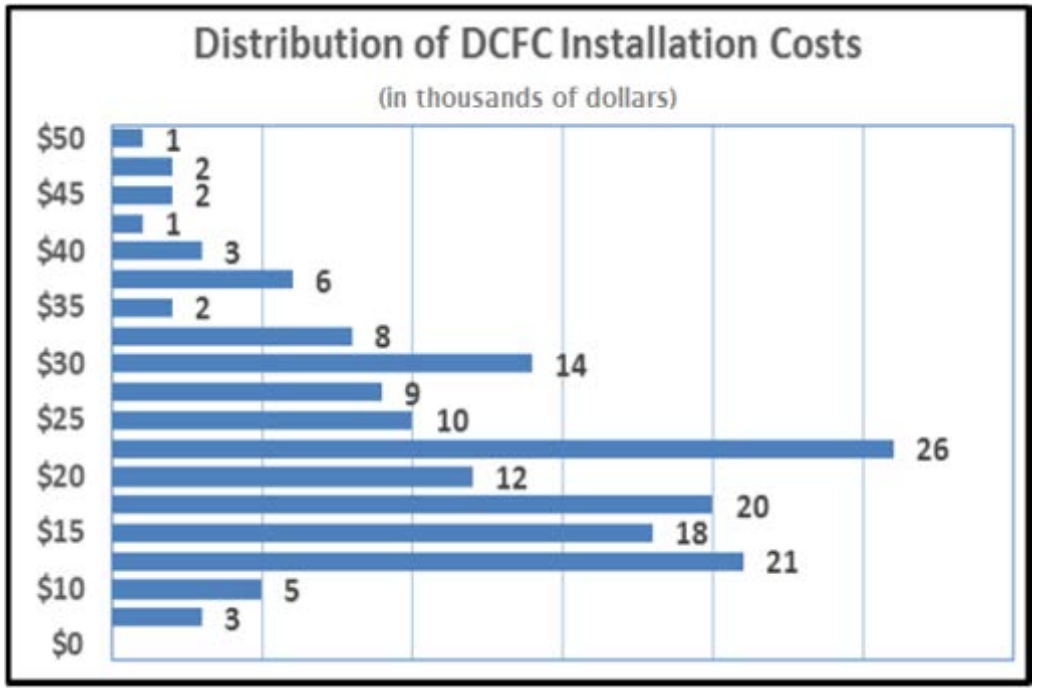


Source: INL/EV Project

Installation Costs – DC Fast Charging

DCFC Installation

$4K-$51K



Source: INL/EV Project

Main DCFC Installation Cost Factors

- New or upgraded electrical service
- Trenching/boring
- Foundation design

Costs from DCFC Projects

- EV Project installation of 100 DCFC *($8.5K-$51K, avg. $21K/each)*
- Orlando Utilities Commission installation of 5 DCFC *($4K-$9K)*
- West Coast Electric Highway installation of 56 DCFC *(avg. $40K/each)*

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Operation and Maintenance (O&M) Costs – Electricity

- **Electricity Consumption**
  - Commercial electricity rates: $0.08-$0.15 per kWh
  - Annual cost varies by power usage
- **Demand Charges**
  - Once site's power usage crosses the utilities threshold (20-50kW), demand charges may apply
  - DCFC or multiple Level 2 EVSE may result in demand charges
  - $0-$2,000+ per month
  - Energy management systems can be used to avoid demand charges

	Single Port EVSE Scenarios	Electricity Consumption and Cost
Level 1	**Workplace charging** 1 light-duty vehicle; Charging 6hrs/day; 5 days/wk	2,184 kWh/yr **$218/yr**
	Fleet charging 1 light-duty vehicle; Charging 14hrs/night; 5 days/wk	5,096 kWh/yr **$510/yr**
Level 2	**Workplace charging** 2 light-duty vehicles; Each charging 3hrs/day; 5 days/wk	10,296 kWh/yr **$1,030/yr**
	Public charging 1 light-duty vehicle; Charging 5hrs/day; 4 days/wk	6,864 kWh/yr **$686/yr**
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DCFC	**Public charging** 2 light-duty vehicles; Each charging 20 min/day; 7 days/wk	11,278 kWh/yr **$1,128/yr**

Talk to your utility!

-Ask your local utility if they offer special PEV charging rates or time-of-use rates

-Find out if EVSE will affect your demand charges and how they can be minimized

O&M Costs – Network Fees

- Networked EVSE
  - EVSE can be networked or non-networked
  - Networked EVSE are connected to the Internet
  - Charging networks provide added value
    - Charging station visibility and availability for drivers
    - Energy monitoring
    - Station usage analysis
    - Access control
    - Payment system
    - Customer support
  - Some of these features may also be available without a charging network such as access control and payment systems. Aftermarket energy monitoring devices can track net power consumption.
- Charging Network Fees
  - $100-$900 annually
  - Cellular/Wi-Fi network communications
  - Back office support

O&M Costs – Maintenance and Repair

- Little information is available on EVSE lifespan, maintenance costs, and repair costs.
- Repair or replacement of EVSE components may be needed due to malfunction or vandalism.
- Basic Level 1 and Level 2 EVSE
  - Regular maintenance is generally not required for basic L1 and L2 EVSE.
  - If the L1 electrical outlet needs to be replaced, the cost of labor and materials may be around *$50-$120*
- Advanced Features/Communications
  - EVSE with advanced features or communications systems have more components that could malfunction.
  - Networked units may have additional costs for technician troubleshooting or manual resets for software malfunctions
- DCFC require ongoing maintenance due to cooling systems, filters, and other components not on L1 or L2 EVSE.

Level 1 Example Scenarios

Level 1: Unit ($300-$1,500) / Installation ($0-$3,000)

Scenario A: Low Cost – Site host installs 5 outlets in parking garage for employees to plug in their own Level 1 cordsets

Scenario A	Cost
EVSE Units	n/a
Installation	$2,500
Total	**$2,500**
Cost/outlet	***$500***

Scenario B: Middle Cost – Site host installs 2 wall mounted Level 1 EVSE.

Scenario B	Cost
EVSE Units ($500 ea.)	$1,000
Installation ($700 ea.)	$1,400
Total	**$2,400**
Cost/EVSE	***$1,200***

Scenario C: High Cost – Site host installs 5 pedestal Level 1 EVSE in parking lot. EVSE is located close to the electrical service and the electrical panel doesn't need significant work.

Scenario C	Cost
EVSE Units ($1,500 ea.)	$7,500
Installation ($3,000 ea.)	$15,000
Total	**$22,500**
Cost/EVSE	***$4,500***

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Level 2 Example Scenarios

Level 2: Unit ($400-$6,500) / Installation ($600-$12,700)

Scenario A: Low Cost – Site host installs 2 wall-mounted L2 EVSE in a location close to the electrical panel. There is sufficient electrical capacity and 2 dedicated circuits already available.

Scenario A	Cost
EVSE Units ($700 ea.)	$1,400
Installation ($1,500 ea.)	$3,000
Total	**$4,400**
Cost/EVSE	***$2,200***

Scenario B: Middle Cost – Site host installs 3 basic pedestal mounted L2 EVSE. Some electrical work is required to create the dedicated breakers. The EVSE is placed close to the electrical service and only needs 10’ of trenching through concrete.

Scenario B	Cost
EVSE Units ($1,500 ea.)	$4,500
Installation ($3,500 ea.)	$10,500
Total	**$15,000**
Cost/EVSE	***$5,000***

Scenario C: High Cost – Site host installs 2 pedestal L2 EVSE with advanced features in a high visibility location far from the electrical service requiring 75’ of trenching.

Scenario C	Cost
EVSE Units ($3,000 ea.)	$6,000
Installation ($6,000 ea.)	$12,000
Total	**$18,000**
Cost/EVSE	***$9,000***

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DCFC Example Scenarios

DCFC: Unit ($10K-$40K) / Installation ($4K-$51K)

Scenario A: Low Cost – Site host installs a low power (25kW) DCFC at a site that has sufficient electrical capacity in a location that requires minimal trenching.

Scenario A	Cost
EVSE Unit	$10,000
Installation	$10,000
Total	**$20,000**

Scenario B: Middle Cost – Site host installs a DCFC (50kW) at a site that required new electrical service. There is a $9,000 cost for extending new electrical service.

Scenario B	Cost
EVSE Unit	$14,000
Installation	$20,000
Total	**$34,000**

Scenario C: High Cost – Site host installs a DCFC (50kW) at a site that does not have sufficient electrical capacity. There is a $20,000 cost to upgrade the electrical service. Significant concrete trenching is also required.

Scenario C	Cost
EVSE Unit	$17,000
Installation	$40,000
Total	**$57,000**

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Questions

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