

Electric Vehicle Charging Installation Framework

International Facility Manager's Association - Knoxville, TN

Owner/Manager Concerns

Installation/Siting

- *“How much power and data is needed for a bank of chargers? For example the Airport is currently in the design of a new Parking Garage. In the past, while at the airport, I installed 2 chargers in a less than ideal location based on power availability. We never installed data because of cost so we did not charge for charging.”*
- *“Best location within a parking facility”*

Owner/Manager Concerns

Maintenance and Operations

- *“How do you keep non electric cars just parking in those empty spaces? Is there a politically correct way to deter this?”*
- *“Signage”*
- *“Possible long term maintenance issues”*

Vocabulary

Electric Vehicles

- Battery Electric Vehicle (BEV): Fully electric vehicle with no internal combustion engine (ICE). Must plug in.
Examples: Tesla, BMW i-4/5/X/7, Nissan Leaf, Chevy Bolt, MB EQ-series, Ford Mach-E and F-150 Lightning
- Plug-in Hybrid Electric Vehicle (PHEV): Partially electric vehicle that can run on either electric motor or ICE. Can go 10-40 miles before using ICE. Plug in optional.
Examples: BMW i8, Chevy Volt, Audi e-Tron, Toyota Prius, Mercedes C350e, S550e, GLE550e
- Hybrid Electric Vehicle (HEV): Partially electric vehicle that can run on either electric motor or ICE. Cannot plug in, charges only through regenerative braking.

Vocabulary

Charging Equipment and Electricity

- Electric Vehicle Supply Equipment (EVSE) - The equipment to provide power for charging to an EV from the grid.
 - Level 1 - 120V
 - Level 2 - 208-240V
 - DC Fast - up to 350kW (today) or 1MW (future)
- Volts, Amps, Power - The *Power* supplied while charging depends on the *Volts* and *Amps*. $P \text{ (kW)} = V * A$
- Energy - The *Energy (kWh)* used and delivered is the *Power over Time*

Vocabulary

Charging Equipment and Electricity

- Load Sharing - “Smart” EVSEs that are linked (wired or wirelessly) to negotiate the available power of the circuit, allowing more charging points
 - Example: A single 60A circuit can support a single 48A EVSE, OR up to **six** Tesla Wall Connectors in a load group.
- Power Management - “Smart” electrical panels (or existing with the addition of a meter) can communicate with the EVSE and when fewer loads are in use allow more power to be directed to charging
- NACS - North American Charging Standard (SAE J3400)

Energy Usage

How much does an EV use, anyways...

- Less than you may think.
 - A typical EV can drive 3-4 miles with 1 kWh, or 11-12¢ of electricity (TVA/KUB rates)
 - A typical *commute* of 41mi round-trip uses around \$1.20-1.70 in electricity per day
 - A “full charge” is less than \$10 (82kWh battery, 12¢/kWh) but...
 - Most EV owners prefer to plug in every night and recover what they used that day.
- As a business or facility owner, be cognizant of the install costs and maintenance costs vs. operator fees and overhead for “turnkey” installations
- Remember that “turnkey” operators are also in areas with 30-40¢/kWh electric rates and users may be willing to bear a higher cost there vs. here

Costs from an Owner's Perspective

Where should I charge?

- Suburban dweller, single family home: likely can charge every night for less than 12¢/kWh with an EVSE install cost of \$400-1,500 initial.
 - Workplace / Retail charging probably only if free OR if “better” parking
- Urban dweller, condo (in Knoxville): may have free charging options available, but access may be sporadic
 - Workplace / Retail charging more of an incentive, even if paid
 - Unlikely to pay substantially more than 20-30¢/kWh, which approaches DC Fast charging costs

Costs from an Owner's Perspective

Where should I charge?

- Urban/Suburban dweller, apartment: may have paid charging options available, but access may be sporadic
 - Workplace / Retail charging very much of an incentive, even if paid
 - Likely to pay up to their retail rate at their complex, which may be approaching or even exceed DC Fast charging costs (~40¢/kWh)
- Traveler: visitor to area or traveling through, may be staying overnight
 - Any option that they can park overnight is an incentive
 - Charging as an amenity (hotel, free) is likely to be a significant attraction

Locating

Parking ICE-free and Reducing EV-holes

- Consider other needs such as Cellular or Wifi connectivity - May dictate in a garage or similar structure
- Most installs to date have been where the power is available, and cheapest to access, which is usually a “prime” parking location (first level, front row)
- EV owners who have an incentive will be willing to park further to charge
 - “Incentive” could be free charging, or that they don’t have reliable charging access at home
 - ... but it could also be consistent parking location

Locating

Parking ICE-free and Reducing EV-holes

- Non-Prime parking locations reduces ICEing (Internal Combustion Engine blocking) of EV spaces
- Non-Prime parking also reduces “EV-hole” blocking of EV spaces with an EV while not charging
- Site layout - particularly for fast charging - is important when trailers or bike racks are involved



Locating

Parking ICE-free and Reducing EV-holes

- Signage helps! But it has to be *enforceable and clearly posted*
 - Depends on jurisdiction
 - On private property, it's likely up to the owner to enforce
- The best way to reduce friction is to make the parking desirable *only* for EV users



Locating

Parking ICE-free and Reducing EV-holes

- Standard signs are available
 - Provide contact number for violators
 - Only specify a time limit if necessary (e.g., retail)
- Stipulate “while charging”



City Ordinance

Knoxville, TN

Sec. 17-307. - Reserved parking for recharging electric vehicles.

(c) Where signs designating a parking space for the exclusive use of recharging electric vehicles are erected, no person shall park a vehicle upon any street, municipal parking lot, municipal parking garage, or portion of any street, parking lot, or parking garage so signed unless such vehicle is an electric vehicle and is connected to an electric charging station.

(d) Violators of this section may be issued a parking ticket attached to the vehicle or a citation to court and the vehicle may be towed to an impoundment lot at the owner's expense and stored at the owner's expense. Signs designating recharging electric vehicle parking shall indicate that unauthorized or improperly parked vehicles may be towed and the driver fined fifty dollars (\$50.00).

(e) Any merchant or owner of a privately owned parking lot maintained for use by the general public is hereby authorized to designate, by the installation of appropriate signs, parking spaces for the exclusive use of recharging electric. Enforcement shall be responsibility of the owner of the private property.

The real question is...

BIG

Or small...

How Many Plugs is Enough?

Planning for the future

- Don't build for tomorrow - but *plan* for it
 - Select units that can load share
- Know what you're building for - residential, commercial, retail... and tailor your installation accordingly
- *MOST* electricians in this area aren't familiar with multi-unit EVSE charging

Residential Use Case

Apartments / Condos with Non-designated Parking

- Location - What is the most economical?
- Type - Amenity or not? Will you need pay-per-use?
- Size - More likely to charge overnight, may not need high-current
- Number - How many EVs are in your community?

Residential Use Case

Apartments / Condos with Designated Parking

- Location - Fixed, but is access to individual unit feeds reasonable? May need to use house / HOA electricity and may need to consider burden on spaces further from electrical feeds
- Type - If an individual feed is available, anything. If not, require reimbursement? If an HOA, how exact do you need to be?
- Size - Most likely to charge every night, most likely to not need high-current
- Number - More likely to need to adapt most spaces to EV charging

Commercial Use Case

Businesses / Employee Parking

- Location - What is most economical? What is less likely to be ICE'd? Would customers or the public have access?
- Type - Amenity or Consideration // Free or Paid
- Size - Charging during workday - less likely to need high current
- Number - How many EVs would utilize? Best case is enough that employees don't need to move cars to be fair, just leave it there all day

Commercial Use Case

Businesses / Customer & Public Parking

- Location - What is most economical? What is less likely to be ICE'd?
- Type - Amenity or Consideration // Free or Paid
- Size - Charging while patronizing - more likely to want high current
- Number - How many EVs do you see during the day in your parking lot? What brands are they (Tesla, Nissan, Ford, Chevy, VW, etc)? May only need a few.

Vendors

2024 is *vastly* different than just a few years ago...

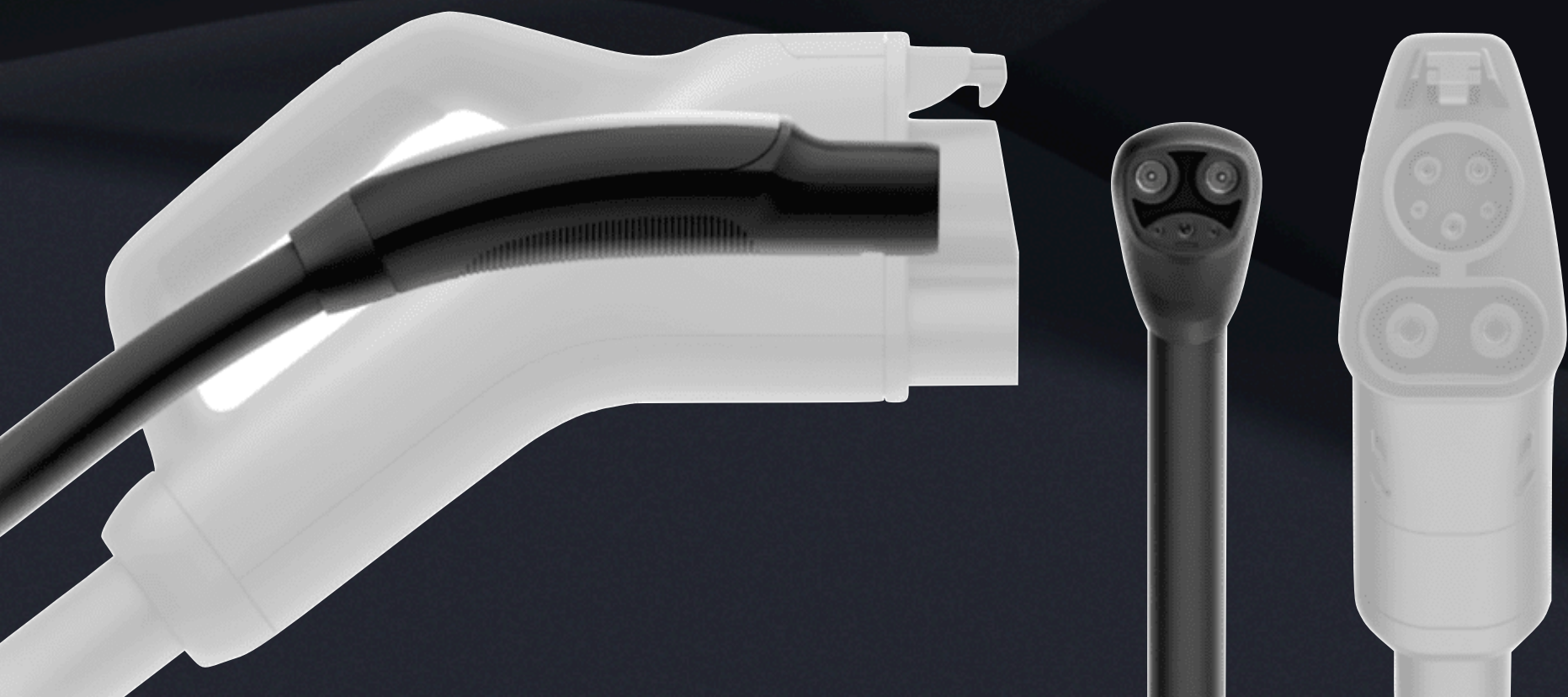
- Commercial Turnkey Vendors
 - Blink - "On the Blink"
 - ChargePoint - Better...
 - PowerFlex - LARGE installs, fleet management, Time of Use, Solar (EVA San Diego Video)



Vendors

2024 is *vastly* different than just a few years ago...

- Connector types
 - J1772 - SAE standard since 2009 (current design), Level 1/2
 - NACS - “Tesla connector” became J3400 standard after industry pressure in 2023, Level 1/2/DC Fast
 - CCS1 / CHAdeMO - Other DC Fast charging, CCS1 based on J1772
 - Adapters available for Level 1 & 2 NACS-J1772 and J1772-NACS; Tesla Universal Wall Connector has adapter built-in
 - Adapters available for CCS1-NACS, NACS-CCS1 coming 2024



Non-Turnkey

A little more homework, but a lot less middleman

- Tesla
 - Wall Connector (6A-48A, \$475) and Universal Wall Connector (\$595)
- Enphase (formerly ClipperCreek)
 - HCS Line (32A-60A, \$732-1176)
 - HCS Dual (\$1704-2382)
- EnelX
 - JuiceBox and Juicebox Pro
- Others
 - Siemens, Emporia, EvoCharge

Turnkey Providers

Typical Models

	Host Owned	Hybrid	Vendor Owned
Equipment Cost	Host	Vendor	Vendor
Installation	Host	Host	Vendor
Electricity	Host	Host	Vendor
Maintenance	Host	Vendor	Vendor
Revenue	Contract-Dependent; Host-owned has more control, vendor-owned least control		

Turnkey Providers

Electrical and Other Needs

- Typically only need adequate power
- Units use cellular network
 - May be problematic in garages/underground
 - May be able to use wifi to lower network fees or if cellular service isn't reliable
 - If cellular, connectivity issues may cause user frustration (failure to activate)

Typical Install

... there are no typical installs.

- Provide some number of “dumb” EVSEs or shared (similar to City of Knoxville)
- Provide some number of “dumb” EVSEs with access control
- Provide some number of “smart” EVSEs with load sharing
- Provide some number of “smart” EVSEs with load sharing AND pay-per-use
- Provide Vendor-operated EVSEs
- (Owner/condo) Allow installation of individual EVSE

Connectivity

Getting the smarts to the “smart” EVSE

- Vendor operated (Blink, Chargepoint) units typically have a built-in cellular modem, but may also be able to use wifi if preferred or no cell service
- Owner-operated (Tesla Wall Connector, JuiceBox) pay-per-use units will need wifi somehow, but it doesn't take much data
 - Use case: Condo install with 2 Tesla Wall Connectors on pay-per-use with a realtime meter at the panel uses 5-10GB/mo
 - Depending on situation, low-cost options may exist; currently using a “500MB” plan hotspot on T-Mobile for \$5/mo, after cap is hit data slows but has not been an issue for our setup

Maintenance

Long-Term Costs and Risks

- EVSEs are *durable*, and surprisingly so. The City's ClipperCreek (now Enphase) units have had no damage/cord replacements necessary in the ~3 years they have been installed at Market Square that I am aware of.
- However, people are the problem. The most common failure point is the cord or the J1772/NACS charge head because of vandalism or negligence (not re-racking and getting run over by the next user). Limiting by design is best.
- EVSE hardware is generally robust - bigger names and fewer features tend to have fewer issues. Tesla's Wall Connector is solid for durability, reliability and cost, and Enphase units are built like a tank.