ELECTRIC VEHICLE CHARGING DESIGNED FOR THE REAL WORLD

A presentation by Philip Skoog & Jeff Finn for the American Institute of Architects – Seattle Committee on the Environment: July 13, 2016
Today’s EV Charging Topics

- EV adoption, usage and capabilities
- EV charging/infrastructure
- EV infrastructure considerations during the Schematic Design, Design Development, Construction Document phases for
  - Single family dwellings
  - Multi-family dwelling units
  - Workplaces (Business properties)
- EV infrastructure incentives/requirements
- Resources for EV infrastructure
EV Adoption, Usage & Capabilities

- Currently ~½ million EVs out of ~190 million light duty vehicles registered in the U.S.
- 80% (~152M) of our automobiles & light duty trucks are driven less than 40 miles/day
  - i.e., all battery only EVs currently on the market have a minimum EPA range which is at least 1½ times the 40 miles/day of documented actual light duty vehicle usage
- 40 miles/day = 10–15kWh of EV energy usage
  - This is true regardless of an EV’s maximum battery only range
  - Typically costs <$1.25 at WA electricity rates
- Charging space usage characteristics will be significantly affected by autonomous driving vehicles
  - Possibly becoming a profit center for EVSE space owners by:
    - Renting existing charging spaces to commercial EV fleet operators
    - Selling excess electricity back to grid
- Still in the early adoption phase of EV technology
  - e.g., current plug–in replaced by inductive park–over charging?
  - We will make mistakes due to unexpected technology changes!
Infrastructure

SUPERCHARGER
The fastest charging station on the planet.
# Electric Vehicle Supply Equipment (EVSE = Charging Stations)

<table>
<thead>
<tr>
<th>Charger Type</th>
<th>Power (typical Configuration)</th>
<th>Typical Rates of Charging</th>
<th>Found At</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC - Level 1</td>
<td>120V 12 amps, standard U.S. outlet</td>
<td>$\approx 3 - 5$ miles of range per hour</td>
<td>EVERYWHERE! Think: same as charging cell phone.</td>
</tr>
<tr>
<td>AC - Level 2</td>
<td>208–240V 30 amps, standard U.S. EV plug (J-1772)</td>
<td>$\approx 12 - 26$ miles of range per hour</td>
<td>Homes, apartment buildings and public charging stations.</td>
</tr>
<tr>
<td>DC - Fast Charge</td>
<td>480V CHAdeMO and SAE Combo EV plugs</td>
<td>$\approx 2 - 5$ miles of range per minute</td>
<td>Public charging stations at shopping malls, fueling stations and travel centers.</td>
</tr>
</tbody>
</table>
Architects’ involvement with EV charging infrastructure
Schematic Design Phase

- Include provisions for EV Charging? (y/n)
  - Also available for guests? (y/n)
  - On–site, sustainable electricity generation? (y/n)

- Single Family Dwellings
  - Think an extra electric clothes dryer or electric range circuit

- Multi–family Dwelling Units (Apartments/Condos)
  - Building Code now requires new construction to be EV Ready based on a % of total parking spaces
  - LED upgrade of existing lighting system creates excess panel capacity which could be available for EV charging

- Workplaces (Business properties)
  - Similar to multi–family with emphasis on employee EV charging opportunities
Automobile Fuel Usage Efficiency *

$1 of **Gas**
- gas tank
- heat & friction
- engine & drive train
- 20¢

$1 of **Electricity**
- batteries
- motor & drive train
- 20¢

* Source:
  Unpublished Study: Idaho National Laboratory

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Jeffrey Finn; Bellevue, WA; 2009
Design Development Phase

- Site suitable for solar electricity generation? (y/n)
- Location(s) of EVSE(s)?
  - Charging port location is **not** standardized on EVs
  - Not too distant from electrical service panel
- Number & Charging Level(s) of EVSE(s)
- Single Family Dwellings
  - L1 or L2 or just conduit w/panel capacity for future L2
  - Long cable for sharing Level 2 w/guests
- Multi-family Dwelling Units
  - L1 for residents?, L2 for guests?
  - Share a single Level 2 between a public charging space and an accessible parking space or among as many as 4 charging spaces
  - L2 w/networking capability for online status, maintenance, fee collection and/or usage restriction purposes?
  - New construction requires *EV Readiness* based on total # of parking spaces
    - Affects number of required EVSEs installed or roughed-in & size of electrical room
- Workplaces (Business properties)
  - Similar to multi-family dwelling units
- General rule of thumb: *Locate EVSEs away from prime parking spots*
Construction Documents Phase

- **Sizing of Electrical Service Panel**
  - Number, Charging Level(s) & Amperage of EVSE(s)
  - Distance from service panel

- **Interior/Exterior grade EVSE(s)?**

- **Single Family Dwellings**
  - EVSE conduit rough-in & service panel capacity specs (90amp EVSE)
  - L2 Recommendation: 240VAC 40a or 50a circuit in garage w/NEMA 6-50r (electric dryer) or NEMA 14-50r (RV hookup) receptacle in garage

- **Multi-family Dwelling Units**
  - EVSE conduit rough-in & service panel capacity specs
  - Optional: wire pull & EVSE specs
  - L1 w/lockbox?, resettable NEMA 15-15r directly to 20a circuit breaker

- **Workplaces (Business properties)**
  - The “Goldilocks” Approach

- **Required signage for EVSEs made available to the public**
  - Applies to those both on public and private property
Incentives/Requirements in WA

- $7,500 EV Federal Income Tax Credit to promote EV adoption
- *Appropriate (Alternative) Fuels’* EV Sales Tax Exemption
  - Exemption also applicable to EVSEs
- PSE’s $500 rebate pilot for residential customers to install L2 EVSEs
- Avista’s $3 million EVSE pilot
  - Install 265 L2 and 7 DC Quick Charge stations at residential, workplace & additional public locations in Avista’s service area
- State’s EV Charging Infrastructure Bank (Public Private Partnership Office)
  - Applications only accepted from governmental units and 501(c )(3) nonprofits
- All State & Local jurisdictions must include EVs in total cost of ownership analyses for fleet vehicle acquisitions
- RCW 43.01.250 No charge for EV charging electricity at state offices
  - “authorizes the purchase of power at state expense to recharge privately and publicly owned plug-in EVs”
  - requires 5% of parking spaces in apartments, condominiums, and some commercial buildings to comply with “EV Readiness” specifications
- Keep current @ DOE’s *Appropriate (Alternative) Fuels* Data Center
EVSEs Available to the Public

- State Law Requires De-ICEing Signage
  - RCW 46.08.185
- Wayfinding signs recommended!
- Electronic Billboard to draw customers
EV Resources

- pskoog4@gmail.com (Philip Skoog)
- jfinn@PlugInAmerica.com (Jeff Finn)
- http://SeattleEVA.org (Seattle EV Association)
- http://pluginamerica.org/ (“Goldilocks”)
- http://ElectricAuto.org (Electric Auto Association)
- http://AFDC.Energy.gov (DOE Alternative Fuels) (should stand for “Appropriate Fuels”)
- http://FuelEconomy.gov (DOE)
As an automobile EVs are fun to drive!