On-Road NEC 2014 Proposals

Greg Nieminski
NEC Task Force
December 7, 2010

2011 NEC Change Proposal Results

- **11 Proposals Submitted**
- **5 Proposals Accepted**
  - 625.2 – Added Electric Motorcycles
  - 625.2 – Changed charging to power transfer for Connector
  - 625.2 – Changed charging to power transfer for Inlet
  - 625.2 – Changed EVSE to transferring energy between the premise wiring and the EV
  - 625.2 – Added Rechargeable Energy Storage System

2014 NEC Change Proposals

625.13 Electric Vehicle Supply Equipment

- **Clarify when cord-and-plug connection is permitted**
  - Define Fixed EVSE (Equipment fastened in place) similar to 250.110
  - Fixed EVSE could meet requirements of 625.18, 19, and 29 with either cord-and-plug or hard wiring.

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2014 NEC Change Proposals

PEV Load Diversity

- **Demand Factors**
  - Develop demand factors for multiple EVSE locations to account for load diversity.
  - Will require actual data to support recommendations.
- **Automated Load Control**
  - Add new clause on automated load control for multiple EVSE locations.

2014 NEC Change Proposals

Vehicle to Grid Issues

- **Male Plug Blades Energized**
  - Review 702 and 705 to see if changes are needed to 625.26.
- **Establish Neutral**
  - Add isolation transformer requirement to establish neutral for vehicle to house when islanded from grid.

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2014 NEC Change Proposals

DC Input to EVSE

- **Add option for EVSE to be powered from DC source**
  - Eliminate extra conversion stage for premises with Photovoltaic System / Battery Storage

2014 NEC Change Proposals

625.25 Personnel Protection System

- **Add option to allow 1.5 meters between PPS and plug**
  - PPS would have to be rated for drive over
  - Current requirement of 12 inches causes PPS to hang down which can result in damaged receptacles.

2014 NEC Change Proposals

625.29 (D) 4 Supply Circuits

- **Clarify outlet labeling requirements for ventilation**
  - Shouldn’t be 625.15 (C) “Ventilation Required”

2014 NEC Change Proposals

Tables 625.29 (D1) and (D2)

- **Combined Tables 625.29 (D1) and (D2) into a single table with both m^3/min and cfm data**

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2014 NEC Change Proposals

PEV Load Information

- Add clause on PEV loads in Article 625 and reference in Table 220.3

  OR

- Add 220.14 (M) on PEV loads

- Consider adding to PEV loads to examples in Annex D

Georgia Tech

2014 NEC Change Proposals

625.17 Cable

- Investigate removing EVSE cable requirements from 625 as they are covered in end product standard (UL)

IEC Project Stages and Timetable for Standards Development.

Project Stage	Associated Document Name	Abbreviation	Minimum Timeline (for comment and/or voting)
Proposal stage	New Work Item Proposal	NP	3 months for voting
Preparatory stage	Working draft	WD	12 months recommended
Committee stage	Committee draft	CD	2-4 months for comment
Enquiry stage	Enquiry draft	IEC/CDV	5 months for comment and voting
Approval stage	Final Draft International Standard	FDIS	2 months for voting
Publication stage	International Standard	IEC or ISO/IEC	1.5 months

IEC – High Voltage Shore Power Equipment

International Electrotechnical Commission (IEC) Technical Committee No. 18

IEC TC18 MT26 - IEC/ISO/IEEE 60092-*510 Electrical installations in ships - Special Features - High Voltage Shore Connection Systems (HVSC-Systems)*

Last meeting November 2010 – Berlin, Germany

Brian Sisco to report.

60092-510 Status

After final editing of the draft CDV by the three (3) joint committee convenors in December, document will be forwarded to the IEC for review and circulation as a CDV for 5 months. If no negative votes are received the document will be circulated as a FDIS for two months followed by a published standard with a target date of the 3^{rd} or 4^{th} quarter of 2011

The combined committee of experts are from:

- IEC Project Team PT 60092-510: High Voltage Shore Connection Systems (HVSC Systems)
- International Organization for Standardization (ISO) Technical Committee ISO/TC 8, Ships and Marine Technology, Subcommittee SC 3, Piping and Machinery, Working group WG11: Cold Ironing
- IEEE, PCIC Marine Industry Subcommittee, P1713 Electrical Shore-to-Ship Connections WG

International Electrotechnical Commission (IEC) Sub-Committee SC23H

IEC 62613, *Plugs, Socket-Outlets, Ship Connectors And Ship Inlets For High-Voltage Shore Connection Systems, (HVSC-Systems)*

IEC 62613 has been divided into two parts:

- Part 1: *General requirements*. Contains constructional and test requirements for both 7.2kV and 12 kV plugs, socket-outlets (receptacles), connectors and ship inlets. Special requirements were developed to include:
  - **non-rewireable accessory** - accessory so constructed that the cable or wiring cannot be separated from the accessory without making it permanently useless
  - **field-rewireable accessory** - accessory so constructed that it can be rewired by skilled personnel as qualified by the manufacturer
  - **non-field-rewireable accessory** -accessory so constructed that it shall only be rewired by the manufacturer's authorized personnel

Preliminary CDVs were completed in August but are still waiting for final engineering drawings from the manufacturers before the CDVs can be issued for comment and vote.

Pending a positive vote to both the CDV and following FDIS, the Standard is expected to be published late in 2011.

NREL National Renewable Energy Laboratory
Innovation for Our Energy Future

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National EV Permitting Project Update

National Renewable Energy Laboratory

Carl Rivkin, P.E.

Date December 7, 2010

The EV Charging Station Project Background

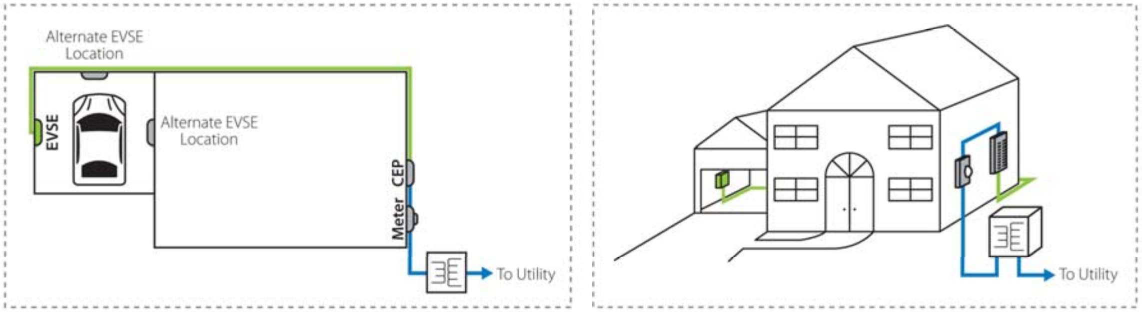
- Started with a request to the Vehicle Technologies program manager from the Grid Interaction Technical Team (GITT)
- GITT requested that the DOE assist in developing streamlined permitting procedures
- The request was quite extensive and included data base development to assist jurisdictions as well as outreach to distribute information on EVs and EV charging
- The permit template portion of the request was funded
- The permit template is a set of requirements that would likely apply in most jurisdictions and could be used as the basis for a generic permit
- Would apply to residential charging installations and would potentially eliminate the need for an inspection prior to operation

Draft Permit Contents

Permit is divided into 4 Sections:

1. Jurisdiction info
2. Code requirements
3. Certification statement
4. Checklist

Typical Electric Vehicle Charging Station Installation



Permit Template

Jurisdiction of ________________, ___________(state)

Permit For Charging station

Compliance with the following permit will allow the construction and operation of electric vehicle charging station at a residence in the ________________ jurisdiction. This permit addresses the following situations:

1. Only a branch circuit and meter would be constructed at the residence

   or

2. A hard-wired charging station would be constructed at the residence. The requirements for the charging station are taken directly out of the 2008 edition of the National Electrical Code® (NEC) NFPA 70, Article 625 Electric Vehicle Charging Stations.

This permit contains a general reference to the NEC or electrical code used in the jurisdiction. All work and installed equipment will comply with the requirements of the NEC or the electrical code used in the jurisdiction. The jurisdiction maintains the authority/responsibility to conduct any inspections deemed necessary to protect public safety, however due to the projected PEV volume it is suggested for consideration that a qualified electrician be approved to self-inspect the system enabling system operation in advance of jurisdiction inspection. . The charging station installer shall also be responsible for notifying or coordinating any work with the utility company where needed.

Section 1 of the permit application requires basic identifying information be submitted. Note that there is a separate portion of the form requesting information on the property owner who may not be the individual requesting the installation.

Section 2 of the permit application identifies which code needs to be complied with depending on whether a branch circuit and meter or a hard-wired charging station is being installed.

The technical installation requirements address the following specific elements of electric vehicle charging station safety:

A. Listing and labeling requirements
B. Wiring methods
C. Breakaway requirements
D. Overcurrent protection
E. Indoor siting
F. Outdoor siting

This permit package also includes a schematic drawing depicting a typical indoor installation. In this installation the wiring path follows the exterior of the structure and the charging station is located indoors. The NEC® allows for interior wiring and outdoor installations. The purpose of the schematic is only to show how the charging station equipment could be arranged and is not intended to convey any permit requirements.

APPLICATION FOR INSTALLATION OF ELECTRIC VEHICLE CHARGING STATION

INSTRUCTIONS: The system must be installed in compliance with NFPA 70, National Electric Code, Article 625 or applicable Electrical Code currently adopted and enforced within the jurisdiction of installation. All associated work with circuits, electrical service and meters shall be completed in compliance with NFPA 70, National Electric Code, or applicable Electrical Code currently adopted and enforced within the jurisdiction of installation.

Section 1: Permit Applicant Information

NAME			
INSTALLATION STREET ADDRESS (PO BOX NOT ACCEPTABLE)	CONTACT PERSON		AREA CODE & TELEPHONE NUMBER ( ) --
CITY	COUNTY	STATE	ZIP CODE
OWNER NAME	OWNER ADDRESS		AREA CODE & TELEPHONE NUMBER ( ) --
CITY	STATE		ZIP CODE
SUBMITTER'S NAME/COMPANY	STREET ADDRESS		AREA CODE & TELEPHONE NUMBER ( ) --
CITY	STATE		ZIP CODE
GENERAL DESCRIPTION OF EQUIPMENT TO BE INSTALLED:			

Section 2: Permit Code Information

NEC® ITEM Chapter or Artcle	DESCRIPTION
Chapter2 and 3	**Branch Circuit** **A new electrical box added on a branch circuit shall comply with NFPA 70 National Electrical Code® Chapter 2 Wiring and Protection and Chapter 3 Wiring Methods and Materials and all administrative requirements of the NEC or the electrical code in effect in the jurisdiction**
625.4	**VOLTAGES** Unless other Voltages are specified, the nominal ac system voltages of 120, 120/240, 208Y/120, 240, 480Y/277, 480, 600Y/347, and 600 Volts shall be used to supply equipment
625.5	**LISTED OR LABELED** All electrical materials, devices, fittings, and associated equipment shall be listed or labeled.
625.9	**WIRING METHODS** The electric vehicle coupler shall comply with 625.9(A) through (F). (A) Polarization. The electric vehicle coupler shall be polarized unless part of a system identified and listed as suitable for the purpose. (B) Noninterchangeability. The electric vehicle coupler shall have a configuration that is noninterchangeable with wiring devices in other electrical systems. Nongrounding-type electric vehicle couplers shall not be interchangeable with grounding-type electric vehicle couplers. (C) Construction and Installation. The electric vehicle coupler shall be constructed and installed so as to guard against inadvertent contact by persons with parts made live from the electric vehicle supply equipment or the electric vehicle battery. (D) Unintentional Disconnection. The electric vehicle coupler shall be provided with a positive means to prevent unintentional disconnection. (E) Grounding Pole. The electric vehicle coupler shall be provided with a grounding pole, unless part of a system identified and listed as suitable for the purpose in accordance with Article 250. (F) Grounding Pole Requirements. If a grounding pole is provided, the electric vehicle coupler shall be so designed that the grounding pole connection is the first to make and the last to break contact.
625.13	**ELECTRIC VEHICLE SUPPLY EQUIPMENT** Electric vehicle supply equipment rated at 125 volts, single phase, 15 or 20 amperes or part of a system identified and listed as suitable for the purpose and meeting the requirements of 625.18, 625.19, and 625.29 shall be permitted to be cord-and-plug-connected. All other electric vehicle supply equipment shall be permanently connected and fastened in place. This equipment shall have no exposed live parts.
625.14	**Rating** Electric vehicle supply equipment shall have sufficient rating to supply the load served. For the purposes of this article, electric vehicle charging loads shall be considered to be continuous loads.
625.15	**Markings** The electric vehicle supply equipment shall comply with 625.15(A) through (C). (A) General. All electric vehicle supply equipment shall be marked by the manufacturer as follows: FOR USE WITH ELECTRIC VEHICLES (B) Ventilation Not Required. Where marking is required by 625.29(C), the electric vehicle supply equipment shall be clearly marked by the manufacturer as follows: VENTILATION NOT REQUIRED The marking shall be located so as to be clearly visible after installation. (C) Ventilation Required. Where marking is required by 625.29(D), the electric vehicle supply equipment shall be clearly marked by the manufacturer, "Ventilation Required." The marking shall be located so as to be clearly visible after installation.
625.16	**Means of Coupling** The means of coupling to the electric vehicle shall be either conductive or inductive. Attachment plugs, electric vehicle connectors, and electric vehicle inlets shall be listed or labeled for the purpose.

Permit Template

625.17	**Cable** The electric vehicle supply equipment cable shall be Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable as specified in Article 400 and Table 400.4. Ampacities shall be as specified in Table 400.5(A) for 10 AWG and smaller, and in Table 400.5(B) for 8 AWG and larger. The overall length of the cable shall not exceed 7.5 m (25 ft) unless equipped with a cable management system that is listed as suitable for the purpose. Other cable types and assemblies listed as being suitable for the purpose, including optional hybrid communications, signal, and optical fiber cables, shall be permitted.
625.18	**Interlock** Electric vehicle supply equipment shall be provided with an interlock that de-energizes the electric vehicle connector and its cable whenever the electrical connector is uncoupled from the electric vehicle. An interlock shall not be required for portable cord-and-plug-connected electric vehicle supply equipment intended for connection to receptacle outlets rated at 125 volts, single phase, 15 and 20 amperes.
625.19	**Automatic De-Energization of Cable** The electric vehicle supply equipment or the cable-connector combination of the equipment shall be provided with an automatic means to de-energize the cable conductors and electric vehicle connector upon exposure to strain that could result in either cable rupture or separation of the cable from the electric connector and exposure of live parts. Automatic means to de-energize the cable conductors and electric vehicle connector shall not be required for portable cord-and-plug-connected electric vehicle supply equipment intended for connection to receptacle outlets rated at 125 volts, single phase, 15 and 20 amperes.
625.21	**Overcurrent Protection** Overcurrent protection for feeders and branch circuits supplying electric vehicle supply equipment shall be sized for continuous duty and shall have a rating of not less than 125 percent of the maximum load of the electric vehicle supply equipment. Where noncontinuous loads are supplied from the same feeder or branch circuit, the overcurrent device shall have a rating of not less than the sum of the noncontinuous loads plus 125 percent of the continuous loads.
625.22	**Personnel Protection System** The electric vehicle supply equipment shall have a listed system of protection against electric shock of personnel. The personnel protection system shall be composed of listed personnel protection devices and constructional features. Where cord-and-plug-connected electric vehicle supply equipment is used, the interrupting device of a listed personnel protection system shall be provided and shall be an integral part of the attachment plug or shall be located in the power supply cable not more than 300 mm (12 in.) from the attachment plug.
625.23	**Disconnecting Means** For electric vehicle supply equipment rated more than 60 amperes or more than 150 volts to ground, the disconnecting means shall be provided and installed in a readily accessible location. The disconnecting means shall be capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.
625.25	**Loss of Primary Source** Means shall be provided such that, upon loss of voltage from the utility or other electrical system(s), energy cannot be back fed through the electric vehicle and the supply equipment to the premises wiring system unless permitted by 625.26.
625.26	**Interactive Systems** Electric vehicle supply equipment and other parts of a system, either on-board or off-board the vehicle, that are identified for and intended to be interconnected to a vehicle and also serve as an optional standby system or an electric power production source or provide for bi-directional power feed shall be listed as suitable for that purpose. When used as an optional standby system, the requirements of Article 702 shall apply, and when used as an electric power production source, the requirements of Article 705 shall apply.
625.28	**Hazardous (Classified) Locations** Where electric vehicle supply equipment or wiring is installed in a hazardous (classified) location, the requirements of Articles 500 through 516 shall apply.
625.29	**Indoor Sites** Indoor sites shall include, but not be limited to, integral, attached, and detached residential garages; enclosed and underground parking structures; repair and nonrepair commercial garages; and agricultural buildings. (A) Location. The electric vehicle supply equipment shall be located to permit direct connection to the electric vehicle. (B) Height. Unless specifically listed for the purpose and location, the coupling means of the electric vehicle supply equipment shall be stored or located at a height of not less than 450 mm (18 in.) and not more than 1.2 m (4 ft) above the floor level. (C) Ventilation Not Required. Where electric vehicle nonventilated storage batteries are used or where the electric vehicle supply equipment is listed or labeled as suitable for charging electric vehicles indoors without ventilation and marked in accordance with 625.15(B), mechanical ventilation shall not be required. (D) Ventilation Required. Where the electric vehicle supply equipment is listed or labeled as suitable for charging electric vehicles that require ventilation for indoor charging, and is marked in accordance with 625.15(C), mechanical ventilation such as a fan shall be provided. The ventilation shall include both supply and exhaust equipment and shall be permanently installed and located to intake from, and vent directly to, the outdoors. Positive pressure ventilation systems shall be permitted only in buildings or areas that have been specifically designed and approved for that application. Mechanical ventilation requirements shall be determined by one of the methods specified in 625.29(D)(1) through (D)(4). (1) Table Values. For supply voltages and currents specified in Table 625.29(D)(1) or Table 625.29(D)(2), the minimum ventilation requirements shall be as specified in Table 625.29(D)(1) or Table 625.29(D)(2) for each of the total number of electric vehicles that can be charged at one time. (2) Other Values. For supply voltages and currents other than specified in Table 625.29(D)(1) or Table 625.29(D)(2), the minimum ventilation requirements shall be calculated by means of general formulas stated in article 625.39(D)(2). (3) Engineered Systems. For an electric vehicle supply equipment ventilation system designed by a person qualified to perform such calculations as an integral part of a building's total ventilation system, the minimum ventilation requirements shall be permitted to be determined per calculations specified in the engineering study. (4) Supply Circuits. The supply circuit to the mechanical ventilation equipment shall be electrically interlocked with the electric vehicle supply equipment and shall remain energized during the entire electric vehicle charging cycle. Electric vehicle supply equipment shall be marked in accordance with 625.15. Electric vehicle supply equipment receptacles rated at 125 volts, single phase, 15 and 20 amperes shall be marked in accordance with 625.15(C) and shall be switched, and the mechanical ventilation system shall be electrically interlocked through the switch supply power to the receptacle.
625.30	**Outdoor Sites** Outdoor sites shall include but not be limited to residential carports and driveways, curbside, open parking structures, parking lots, and commercial charging facilities. (A) Location. The electric vehicle supply equipment shall be located to permit direct connection to the electric vehicle. (B) Height. Unless specifically listed for the purpose and location, the coupling means of electric vehicle supply equipment shall be stored or located at a height of not less than 600 mm (24 in.) and not more than 1.2 m (4 ft) above the parking surface.

Section 3: Certification Statement

I hereby certify that the electrical work described on this permit application shall be/has been installed in compliance with the conditions in this permit, NFPA 70, National Electric Code, Article 625 or applicable Electrical Code currently adopted and enforced within the jurisdiction of installation. Furthermore, all associated work with circuits, electrical service and meters shall be/has been completed in compliance with NFPA 70, National Electric Code, or applicable Electrical Code currently adopted and enforced within the jurisdiction of installation. By agreeing to the above requirements, the licensee or owner shall be permitted to construct and operate the charging station.

Signature of Licensee	Date
Signature of Owner	Date

Section 4: Jurisdiction Checklist

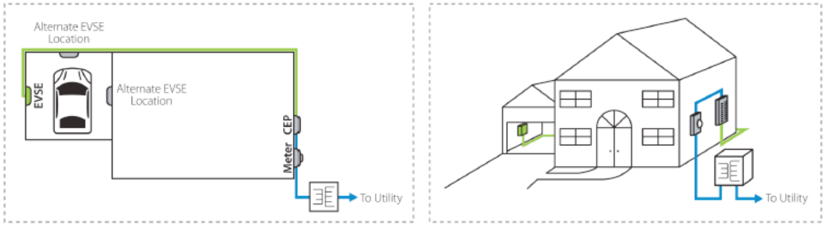
Information each Jurisdiction would add to permit such as:

1. Date utility notified of work completed
2. Info sent to tax accessor?
3. Other?

Draft

Permit Template

Figure 1. TYPICAL ELECTRIC VEHICLE Service Equipment INSTALLATION



· Meter and Circuit Breaker Panel on Exterior of home and on opposite side of Parking Location
· Charging Station to be located inside of garage
· Exterior cable run from Charging Station to CBP

Draft

EV Permitting Project Update

Draft Permit template complete in FY10

Feedback from multiple jurisdictions indicates that they see value in the permit template but are waiting to see the rate of permit applications submitted before taking action

In October NREL published a Request for Information (RIF) soliciting interested parties to work with NREL in implementing a streamlined permitting process for EV charging stations

Several jurisdictions and organizations responded including the following:

- Bay Area Air Quality Management District (BAAQMD)
- Monterrey Bay Electric Vehicle Alliance
- Utah Department of Environmental Quality
- Mecklenburg, NC Building Code Department
- Bay Area Climate Collaborative
- Duke Energy

NREL met with these interested parties and reviewed the permit template

They expressed an interest in NREL developing information that would put the permit template into context by providing information on EV charging and associated safety issues

NREL will work to develop this information and work these or other jurisdictions can to streamline their EV charging station permitting process

Database

As project has progressed more interest in potential data base component has been expressed by interested parties, such a Boulder County, CO

Data base would coordinate the activities of at least the following entities:

•Car dealer

•EV charging station installer

•Jurisdiction issuing permit for EV charging station

•Utility supplying charging station

Contextual Information

Several jurisdictions and organizations expressed an interest in providing information to put the permit template in context

This information would include:

- Explanations of what a PHEV is and how it is charged
- Basic safety information on vehicles and charging

The DOE AFDC web site contains information that may be useful

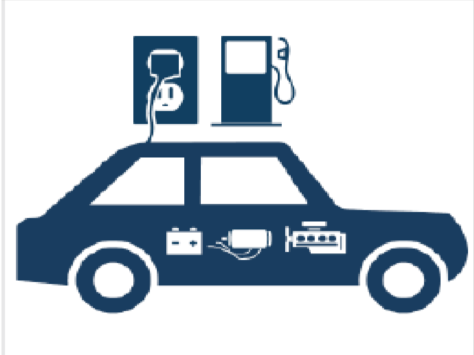
EV Permitting Project Update/AFDC web Site

U.S. Department of Energy - Energy Efficiency and Renewable Energy
Alternative Fuels and Advanced Vehicles Data Center

Plug-in Hybrid Electric Vehicle Basics

Plug-in hybrid electric vehicles (PHEVs) are powered by conventional or alternative fuels as well as electric power stored in a battery. Using electricity from the grid to run the vehicle some of the time costs less and reduces petroleum consumption compared with conventional vehicles. PHEVs might also reduce emissions, depending on the electricity source.

Light-duty PHEVs are nearing commercial availability, and heavy-duty vehicles can be converted to PHEVs. Although PHEVs will likely be more expensive than similar conventional and hybrid vehicles, some cost can be recovered through fuel savings, a federal tax credit, or state incentives.



Plug It in or Fill It Up
Plug-in hybrid electric vehicles have an internal combustion engine and electric motor. These vehicles are powered by an alternative fuel or a conventional fuel, such as gasoline, and a battery, which you can plug in to charge.

Powered by Electric Motor and Engine

Plug-in hybrid electric vehicles have an internal combustion engine and an electric motor, which uses energy stored in batteries. PHEVs have a larger battery pack than hybrid electric vehicles. This makes it possible to drive using only electricity for some distance (about 10 to 40 miles), commonly referred to as the "all-electric range" of the vehicle.

During urban driving, most of a PHEV's power comes from stored electricity. For example, a light-duty PHEV driver might drive to and from work on all-electric power, plug in the vehicle to charge it at night, and be ready for another all-electric commute the next day. For longer trips or periods of higher acceleration, the internal combustion engine is used. Heavy-duty PHEVs sometimes work just the opposite, using the internal combustion engine while a worker drives to and from a job site and using electricity to power the vehicle's equipment or to keep the vehicle's cab at a comfortable temperature at the job site.

Fueling and Driving Options

Plug-in hybrid electric vehicle batteries can be charged by an outside electric power source, by the internal combustion engine, or through regenerative braking. During braking, the electric motor acts as a generator, using the energy to charge the battery. Learn more about charging PHEVs.

PHEV fuel consumption depends on the distance driven between battery charges. For example, if the vehicle is never plugged in to charge, fuel economy will be about the same as a similarly sized hybrid electric vehicle. If the vehicle is driven less than its all-electric range and plugged in, it is possible to use only electric power.

Fuel-Efficient System Design

Beyond battery storage and motor power, there are different designs for combining the power from the electric motor and the engine. The two main designs are parallel and series.

- **Parallel** plug-in hybrids connect the engine and the electric motor to the wheels through mechanical coupling. Both the electric motor and the engine can drive the wheels directly.
- **Series** plug-in hybrids use only the electric motor to drive the wheels. The internal combustion engine is used to generate electricity for the motor. General Motors refers to this design as an extended range electric vehicle (EREV). This design is used in the Chevy Volt.

EV Permitting Project Update/AFDC Web Site

U.S. Department of Energy - Energy Efficiency and Renewable Energy
Alternative Fuels and Advanced Vehicles Data Center

Charging Equipment for Plug-in Hybrid and All-Electric Vehicles

Charging plug-in hybrid electric vehicles (PHEVs) and all-electric vehicles (EVs) requires plugging into electric vehicle supply equipment (EVSE). Hybrid electric vehicles (HEVs) are charged using regenerative braking and the internal combustion engine and are not plugged into charging equipment.

Charging equipment for plug-in hybrid electric and all-electric vehicles is classified by the maximum amount of power in kilowatts (kW) provided to the battery. Charging times vary based on how empty the battery is, how much energy it holds, and the type of battery. The charging time can range from 30 minutes to 20 hours or more, depending on the type of charging equipment used.

How fast a vehicle charges depends on the battery type and the type of charging equipment used.

Level 1 = 8 to 20 hours
Level 2 = 3 to 8 hours
DC Fast Charging = < 30 minutes

Level 1

Level 1 equipment provides charging through a 120 volt (V), alternating-current (AC) plug (up to 15 amperes and 1.8 kW) and requires a dedicated circuit. Level 1 EVSE is portable and does not require installation of charging equipment. On one end of the cord is a standard, three-prong household plug. On the other end is a connector, which plugs into the vehicle.

Level 1 works well for charging at home, work, or when there is only a 120 V outlet, or "trickle charge," available. Based on the battery type, Level 1 charging can take 8 to 20 hours to reach a full charge, adding about 5 to 6 miles of range per hour of charging time, depending on the vehicle.

Level 2

Level 2 equipment offers charging through a 240 V, AC plug and requires installation of home charging or public charging equipment. This charging option can operate at up to 80 amperes and 19.2 kW. However, most residential level 2 EVSE will operate at lower power. Many such units operate at 30 amperes, delivering 7.2 kW of power. These units require a dedicated 40 amp circuit.

Most homes have 240 V service available, and because Level 2 EVSE can easily charge a typical EV battery overnight, this will be a common installation for homes. Level 2 equipment also uses the same connector on the vehicle as Level 1 equipment. Based on the battery type and circuit capacity, level 2 charging can take 3 to 8 hours to reach a full charge, adding about 25 miles of range per hour of charging time, depending on the vehicle.

Level 3

Level 3 charging will enable a faster AC charging option. Level 3 equipment is still in development. This charging option will operate at a higher voltage and current than Level 2, and it would be installed at public charging stations. Level 3 charging could take less than 30 minutes to reach a full charge.

DC Fast Charging

Direct-current (DC) fast charging equipment (480 V) provides 50 kW to the battery. This option enables charging along heavy traffic corridors and at public stations. A DC fast charge can take less than 30 minutes to fully charge a battery.

Inductive Charging

Inductive charging equipment installed for all-electric vehicles in the early 1990s, such as the Toyota RAV4 EV and the Chevy S10 EV, is still being used in certain areas. Some companies are working on inductive charging options for future electric drive vehicles.

Connectors and Plugs

Modern charging equipment and vehicles have a standard connector and plug receptacle. This connector is based on the Society of Automotive Engineers (SAE) J1772 standard. Any vehicle with this plug receptacle can use any Level 1 or Level 2 EVSE. All major vehicle and charging system manufacturers support this standard, which should eliminate drivers' concerns about whether their vehicle is compatible with the infrastructure. The DC fast charging connector has not been standardized yet. To receive DC fast charging, most EVs and PHEVs are using the Tokyo Electric Power Company (TEPCO) connector and receptacle, which have not become standard yet. Manufacturers may offer the TEPCO DC fast charge receptacle as an option on vehicles until a standard is in place.

The standard J1772 receptacle (right) can receive charge from Level 1 or Level 2 equipment. The DC fast charge receptacle (left) uses a different type of connector.

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EV Permitting Project Update/AFDC Web site

U.S. Department of Energy - Energy Efficiency and Renewable Energy
Alternative Fuels and Advanced Vehicles Data Center

Charging Plug-in Hybrid and All-Electric Vehicles at Home

For consumers to widely accept using all-electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs), they need affordable, convenient, and compatible options to charge their electric drive vehicles at home.

The Electric Power Research Institute anticipates most EV and PHEV owners will charge their vehicles overnight at home. For this reason, Level 1 (120 volts) and Level 2 (240 volts) charging equipment will be the primary options for homeowners. Charging at home is convenient and allows drivers to estimate and plan transportation costs better because residential electricity rates are more stable and predictable than rates for petroleum-based fuels.

PHEV and EV owners may want to install Level 2 (240 V) charging equipment in their homes for a faster charge.

Installing Charging Equipment in Your Home

Currently available Level 2 charging equipment costs approximately $1,500 to $2,500 (installed) before a 50% federal tax credit (up to $2,000) and potential state incentives. Nissan and Tesla have information on Level 2 equipment for their vehicles.

Installation contractors can inform homeowners if their home has adequate electrical capacity for vehicle charging. Most people will prefer Level 2 equipment for faster charging, but older homes might have insufficient electric capacity. Homeowners can add circuits to accommodate the capacity needed for Level 2 charging.

Learn more about installing equipment from Pacific Gas and Electric Company's guide: EV Charging in Single Family Residences.

Complying With Regulations

Electric vehicle supply equipment (EVSE) installations must comply with local, state, and national codes and regulations, and installation requires permitting and licensed contractors. Contractors should check with the local planning department before installing equipment. Homeowners should consult EV and PHEV manufacturer guidance for information about the required charging equipment and find out the specifications before purchasing equipment and electric services. Project Get Ready has more information about codes and standards for charging infrastructure.

Electricity Costs for Charging

The fuel efficiency of an all-electric vehicle is usually measured in cost per mile rather than miles per gallon. To calculate the cost per mile of an all-electric vehicle, the cost of electricity (in dollars per kilowatt-hour) and the efficiency of the vehicle (how much electricity is used to travel 1 mile) must be known. If electricity costs $0.12 per kilowatt-hour (kWh) and the vehicle consumes 200 watt-hours to travel 1 mile, the cost per mile is about $0.02.

If electricity costs $0.12 per kilowatt-hour, charging an all-electric vehicle with a 100-mile range (assuming a 20 kWh battery) will cost about $2.40 to reach a full charge. This cost is about the same as operating an average central air conditioner for 5 hours. General Motors estimates the annual energy use of the Chevy Volt will be 2,520 kilowatt-hours, which is less than that required for a typical water heater or central air conditioning.

For EV and PHEV charging, the stability and planning benefits of household electricity rates offer an attractive alternative compared to traditional petroleum-based transportation. Learn more from Idaho National Laboratory's report: Comparing Energy Costs per Mile for Electric and Gasoline-Fueled Vehicles.

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U.S. Department of Energy - Energy Efficiency and Renewable Energy
Alternative Fuels and Advanced Vehicles Data Center

Charging Hybrid, Plug-in Hybrid, and All-Electric Vehicles

Charging plug-in hybrid electric vehicles (PHEVs) and all-electric vehicles (EVs) requires plugging into electric vehicle supply equipment (EVSE). Hybrid electric vehicles (HEVs) are charged using regenerative braking and the internal combustion engine and are not plugged into charging equipment.

Choose from the buttons below to learn about charging equipment, charging at home, and charging in public.

Charging Equipment ›

Charging at Home ›

Charging in Public ›

Find electric charging stations near you and learn more about charging infrastructure in the following documents.

- Plug-in Electric Vehicle Infrastructure: A Foundation for Electrified Transportation—National Renewable Energy Laboratory
- Plug-in Hybrid Electric Vehicle Charging Infrastructure Review—Idaho National Laboratory

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Charging Plug-in Hybrid and All-Electric Vehicles in Public

For fleet drivers and consumers to charge their all-electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) in public, charging stations must be deployed and integrated with consideration of daily commutes and typical driving habits.

The average person takes 3.5 to 4 trips per day (source: ECOtality from the Charging Infrastructure Micro Climate Process and Data Collection Webinar). Understanding more about the destination of these trips and how long vehicles remain at the destinations will facilitate the development of public charging stations and infrastructure locations.

A standardized plug means vehicle owners do not need to worry about compatibility issues at stations.

Find electric charging stations near you.

Charging Stations

Public charging stations make all-electric vehicles and plug-in hybrid electric vehicles more convenient. They increase the useful range of EVs and reduce the amount of gasoline consumed by PHEVs. The majority of EV and PHEV owners will charge at single-family homes, but public charging stations are also needed. Because housing density in large cities requires street or public garage parking, public chargers must be accessible to consumers who purchase EVs or PHEVs but do not live in single-family dwellings.

General public charging will use Level 2 or DC fast charging to enable faster charging. The public charging infrastructure should consist of charging locations where vehicle owners are highly concentrated, such as shopping centers, city parking lots and garages, airports, hotels, government offices, and other businesses. Widespread public charging infrastructure will help facilitate the penetration of all-electric vehicles and plug-in hybrid electric vehicles and help address consumer "range anxiety" for those vehicles with limited range.

Read more from Project Get Ready about infrastructure costs and charging infrastructure development: Plugging In: A Stakeholder Investment Guide for Public Electric-Vehicle Charging Infrastructure.

Learn about the U.S. Department of Energy's Clean Cities infrastructure projects funded by the American Recovery and Reinvestment Act and other infrastructure deployment projects.

Workplace Charging

The ability to charge at work nearly doubles the daily feasible commuting distance for an EV or a PHEV driver and allows fleets to charge their vehicles overnight.

- **Commuters:** Many organizations are analyzing the trade-offs of installing charging equipment for their employees. With proper implementation, building managers can provide significant value to their occupants at relatively little cost. Premium parking, such as "employee of the month" spots or VIP spots, may come with access to a charging station in the near future. However, charging at work during peak demand for electricity may be discouraged by utilities.
- **Fleets:** City planners and utilities will work with automobile manufacturers and installers to determine the best location for public fleet charging stations. After they determine where the fleet vehicles will be located, all stakeholders will be able to propose charging stations in locations they believe will be the most efficient and useful. The process of establishing moderate- to large-scale charging equipment at places of work and fleet locations is more complicated than private residences, but many of the underlying issues are the same.

Impact on the Power Grid

While ample unused electric generation capacity exists to charge electric drive vehicles overnight during periods of low electric demand, a large number of vehicles using public charging stations during times of peak load could strain the electric grid. This issue can be addressed partially through time-of-use pricing, which would charge more for electricity during periods of peak demand, providing an incentive to charge off-peak.

Learn more in Pacific Northwest National Laboratory's report: Impacts Assessment of Plug-in Hybrid Vehicles on Electric Utilities and Regional U.S. Power Grids—Part 1: Technical Analysis.

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Maintenance and Safety of Hybrid, Plug-in Hybrid, and All-Electric Vehicles

Maintenance needs and safety requirements for hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and all-electric vehicles (EVs) are similar compared with conventional vehicles. Manufacturers are designing these vehicles and publishing guides with maintenance and safety in mind.

HEVs and PHEVs require the same general maintenance as conventional vehicles. EVs have fewer maintenance costs than HEVs and PHEVs.

Maintenance Comparison

Because hybrid electric vehicles and plug-in hybrid electric vehicles have internal combustion engines, maintenance requirements are similar compared with conventional vehicles. The electrical system (battery, motor, and associated electronics) does not require scheduled maintenance. Due to the effects of regenerative braking, brake systems on these vehicles typically last longer than on conventional vehicles.

All-electric vehicles typically require less maintenance than conventional vehicles because:

- The battery, motor, and associated electronics require no regular maintenance
- There are no fluids to change aside from brake fluid
- Brake wear is significantly reduced due to regenerative braking
- There are far fewer moving parts compared to a conventional gasoline engine.

Battery Maintenance

The advanced batteries used in these vehicles have a limited number of charging cycles (the number of times the battery can be charged and discharged). Check with the dealer about battery life and warranties and consider the manufacturer's battery recycling policy.

The batteries in electric drive vehicles are designed to last for the expected lifetime of the vehicle. The Toyota Prius HEV, which has been sold in the United States since 2001, has had less than 0.003% battery failures (source: HybridCars.com). Nissan (source: Autoblog) and General Motors (source: Autoblog Green) have both announced 8-year/100,000 mile warranties for the batteries in the LEAF and the Volt.

Although manufacturers have not published pricing for replacement batteries, if the battery does need to be replaced outside the warranty, it is expected to be a significant expense.

Safety Requirements

Electric drive vehicles must meet the same safety standards required for conventional vehicles sold in the United States. The exception is neighborhood electric vehicles, which are subject to less-stringent standards because they are typically limited to roadways specified by state and local regulations. All other electric drive vehicles undergo the same rigorous safety testing as conventional vehicles and must meet all the same standards for safety, including crash testing and airbags.

HEVs, PHEVs, and EVs have a high-voltage electric system that ranges from 36 to 300 volts. Manufacturers have been careful to design these vehicles with safety features that deactivate the electric system in the event of an accident. In addition, EVs tend to have a lower center of gravity than conventional vehicles, making them less likely to roll over.

Emergency Response and Training

Emergency response for electric drive vehicles is not significantly different from conventional vehicles. Electric drive vehicles are designed with cutoff switches to isolate the battery and disable the electric system, and all high-voltage power lines are colored orange.

Manufacturers publish emergency response guides for their hybrid vehicles and offer training for emergency responders. HybridCars.com has more information about emergency first responders (source: National Alternative Fuels Training Consortium). Find a list of education and training programs with contact information in Electric Vehicle Workforce Education & First-Responder Training Programs.

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Conclusion

There is interest in using permit template

There is also interest in producing information that puts the permit template in a larger context

There is interest in a coordinating data base

NREL has as their FY11 task implementing the permit template or some other change that would streamline the EV charging station permitting process in three jurisdictions

IEC 62196-3 DC CHARGE COUPLER UPDATE FOR IWC

December 7, 2010

Tim Rose
IEC 62196-3 Convenor

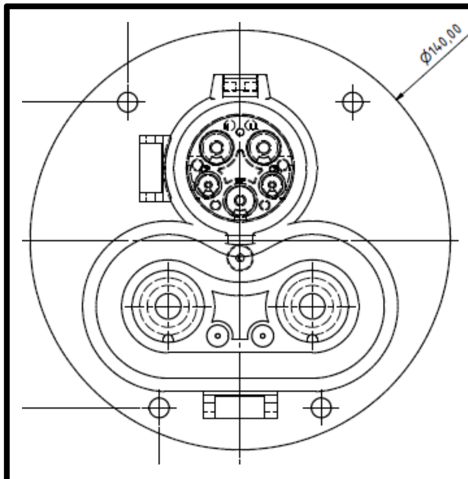
BACKGROUND

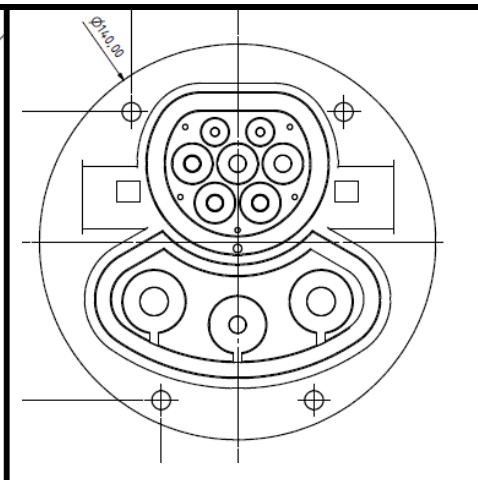
- March, 2010 a new work proposal was presented by Japan for DC Charging
  - Plugs, Socket-Outlets, and Vehicle Couplers
  - Operating Voltages up to 1,000 V DC
  - Rated Currents up to 400A DC
- Proposal was affirmed by vote in June, 2010
- First Project Team/Working Group meeting held September 28-29, 2010 in Osaka, Japan

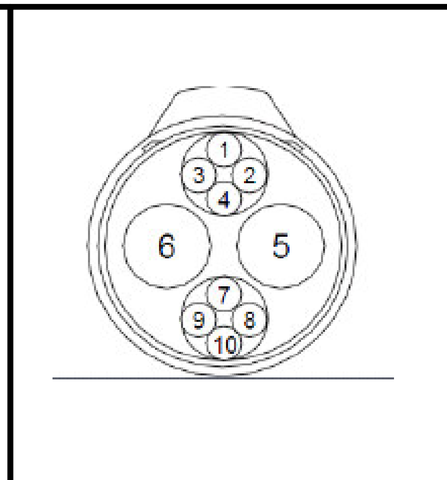
PT 62196-3 MEETING SUMMARY

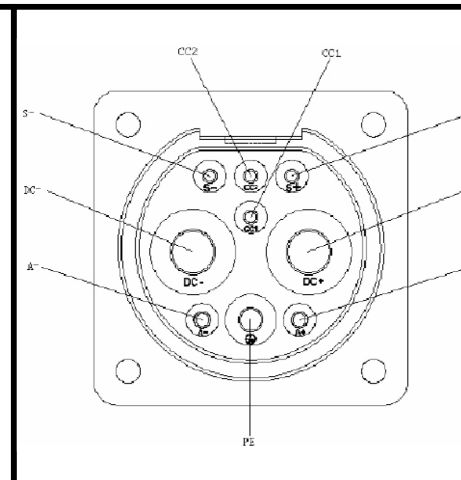
- Working Draft proposed by Japan and comments submitted by the National Committees were reviewed
- Proposals from China, USA and Germany were also presented and discussed
- Consensus was reached to consider these three additional proposal as well as any other proposal submitted by January 14, 2011
- Relevant documents that are also being considered are IEC 62196-1, 61851-1 and 61851-23

PT 62196-3 CONSENSUS CATEGORIES









USA Proposal	Germany Proposal	Japan Proposal	China Proposal
AC / DC Universal Type 1	AC / DC Universal Type 2	DC Type 1	DC Type 2
Corresponding to IEC 62196-2, Type 1	Corresponding to IEC 62196-2, Type 2		

PT 62196-3 TENTATIVE SCHEDULE

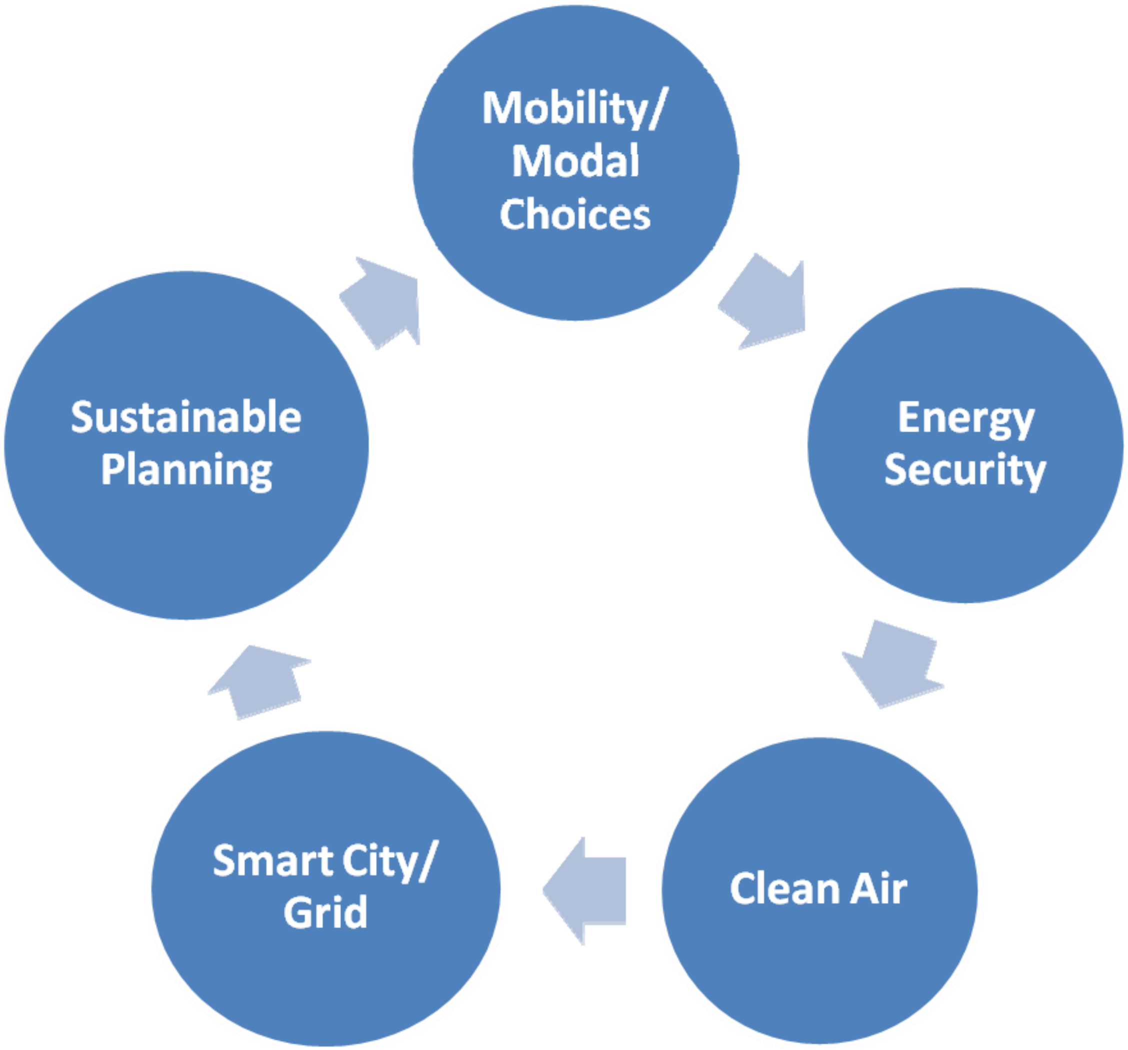
Working Draft	January 14, 2011	National Committee Proposals due
	January 31, 2011	Circulation of WP for comments
	February 28, 2011	NC comments on WD due
	April 6-7, 2011	PT 62196-3 Meeting in USA
CD	June, 2011	3-month period for comments
	October, 2011	PT 62196-3 Meeting
CDV	January, 2012	5-month period for voting and comments
	June, 2012	PT 62196-3 Meeting
FDIS	August, 2012	2-month period for voting
IS	December, 2012	Publication of IS

Using Electric Vehicles To Connect The Dots

How Sustainable Planning Can Enable The Successful Deployment of Electric Vehicle Networks

James Aloisi

AECOM


Mobility/
Modal
Choices
Energy
Security
Clean Air
Smart City/
Grid
Sustainable
Planning

The 21st Century will, out of necessity, introduce fundamental, transformative changes to vehicular travel

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Challenge #1

Current Transportation Systems Cannot Scale To A World of 9 Billion People

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Challenge #2

Traffic Congestion and Air Pollution Increasingly Threaten Economic Growth and Prosperity By Diminishing Quality of Life

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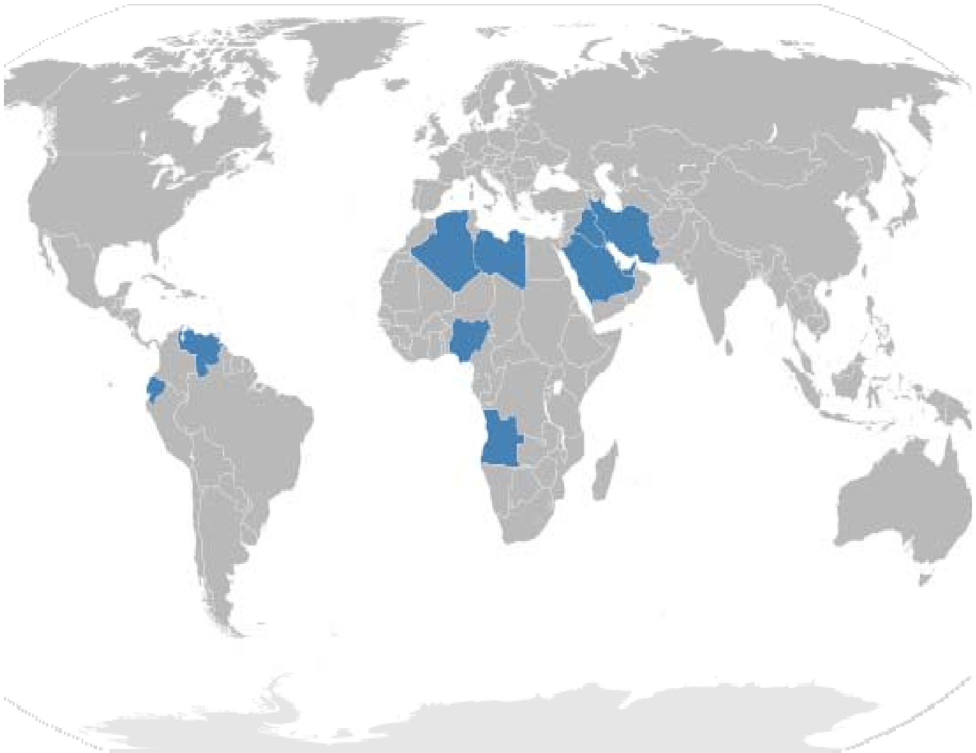

Challenge #3

Energy Dependence Threatens National Security and Prosperity

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Electric Vehicles Can Help Solve The Growing Mobility, Clean Air and Energy Security Challenges

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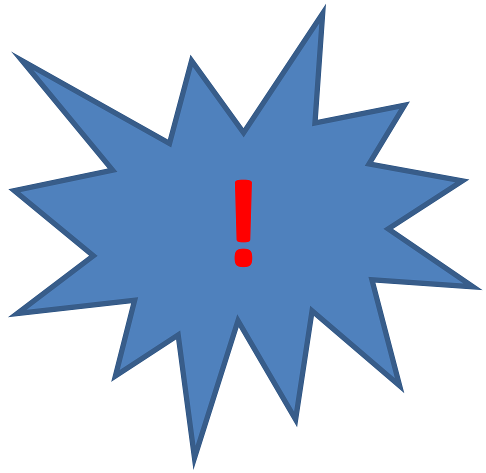

Edison's great *invention:* the practical incandescent bulb.

Edison's great *insight:* building a power plant so people had the electricity needed to use the bulb.

(With apologies to George Westinghouse)

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Will We Get It Right ?

Planning Now Will Result In Better Outcomes Later

- Or -

Chaos Is Multiplicity Without Rhythm

M.C. Escher

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"Those Who Cannot Remember The Past Are Condemned To Repeat It."

George Santayana

Build Without a Plan

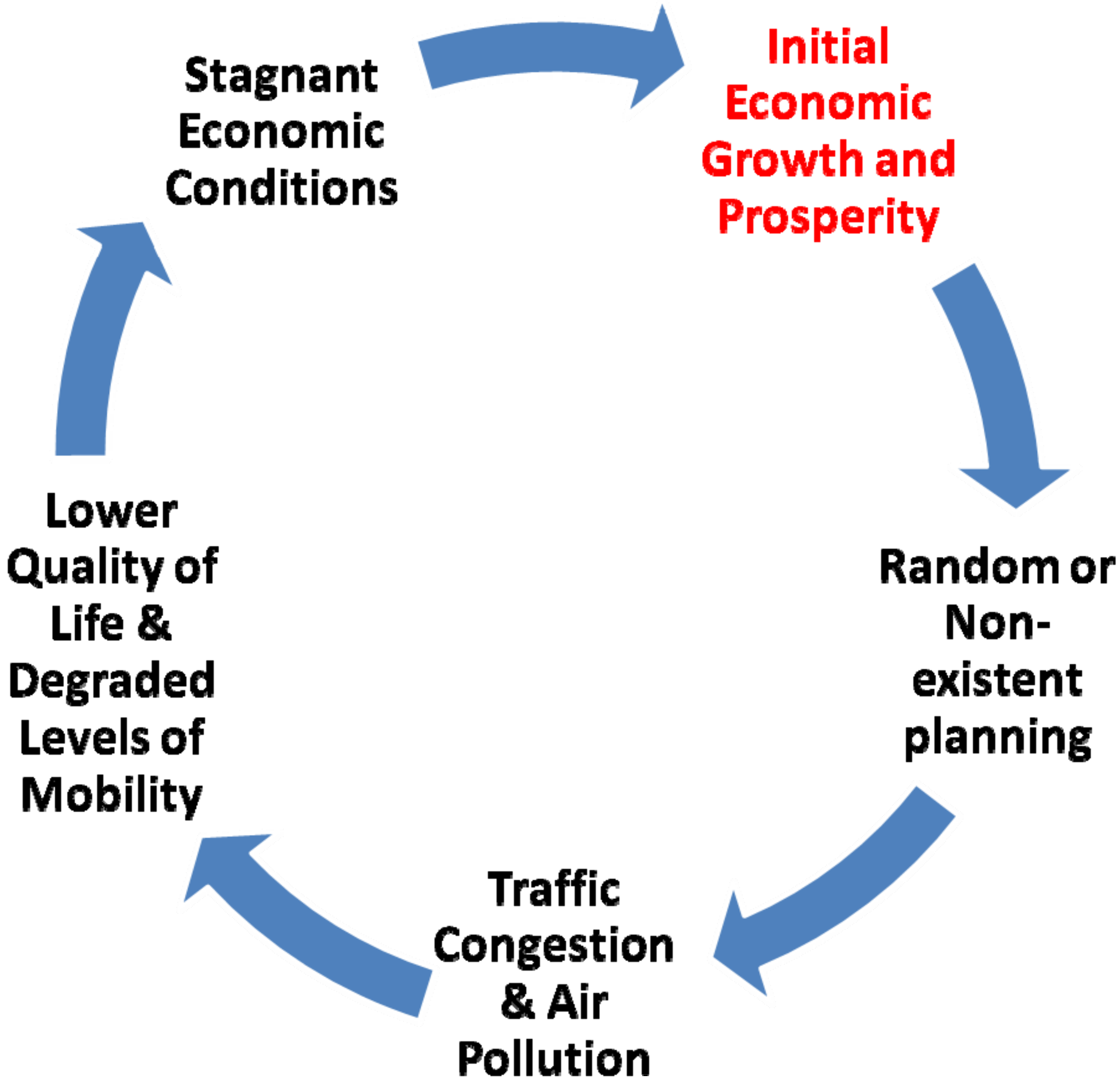
- In the early days of aviation, Boston's airfield was located on marshland bracketed by an established city neighborhood on one side, and the Atlantic Ocean on the other.

Grow Without A Plan

- As Boston's airfield grew to become Logan International Airport, it pushed expansion to encroach upon both neighborhoods and the ocean.

Stagnation

- Today, Logan is confined to a tight footprint, plagued by limited access, poor weather conditions and unhappy neighbors. Future growth will come from regional airports outside of Massachusetts.


Initial Economic Growth and Prosperity
Random or Non-existent planning
Traffic Congestion & Air Pollution
Lower Quality of Life & Degraded Levels of Mobility
Stagnant Economic Conditions

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Sustainable Planning: Leveraging Electric Vehicles to Spark Economic Growth and Prosperity

Planning Along A Time Line

- **Promotion Period – next 1 to 2 years**
- **Near Term – next 5 years**
- **Long Term – next 10 -15 years**
- **Full Development – when the EV infrastructure is fully in place, what does the EV Network look like?**

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Three Principles To Guide EV Planning:

Access, Connectivity & Integration

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1. **Establishing Access to EV Charging infrastructure through deployment of an *ample, equitable and strategic* EV Charging Network.**

2. **Connecting EVs and the EV Charging Network into Smart Grid *and* Smarter Mobility Networks.**

3. **Integrating the EV Charging Network into a coherent transportation management plan and energy infrastructure plan, designed to enhance mobility, improve air quality and establish a more sustainable energy supply system.**

Access

Charging Access Must Be Ample, Equitable and Strategic

- ***Ample*** means an EV Charging Infrastructure that satisfies demand and eases range anxiety.
- ***Equitable*** means that EV Charging Infrastructure is reasonably available (**by location and cost**) to any citizen who wishes to own an electric vehicle.
- ***Strategic*** means deploying an EV Network to encourage economic growth through improved mobility and co-ordinated land use.

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London's Approach To Access

In the UK, *less than 40%* of urban households have off-street parking availability.

The London EV Network aims to ensure that *no Londoner is more than one mile from a public charging point by 2015.*

Any Londoner wishing to buy an EV should have reasonable access to charging facilities.

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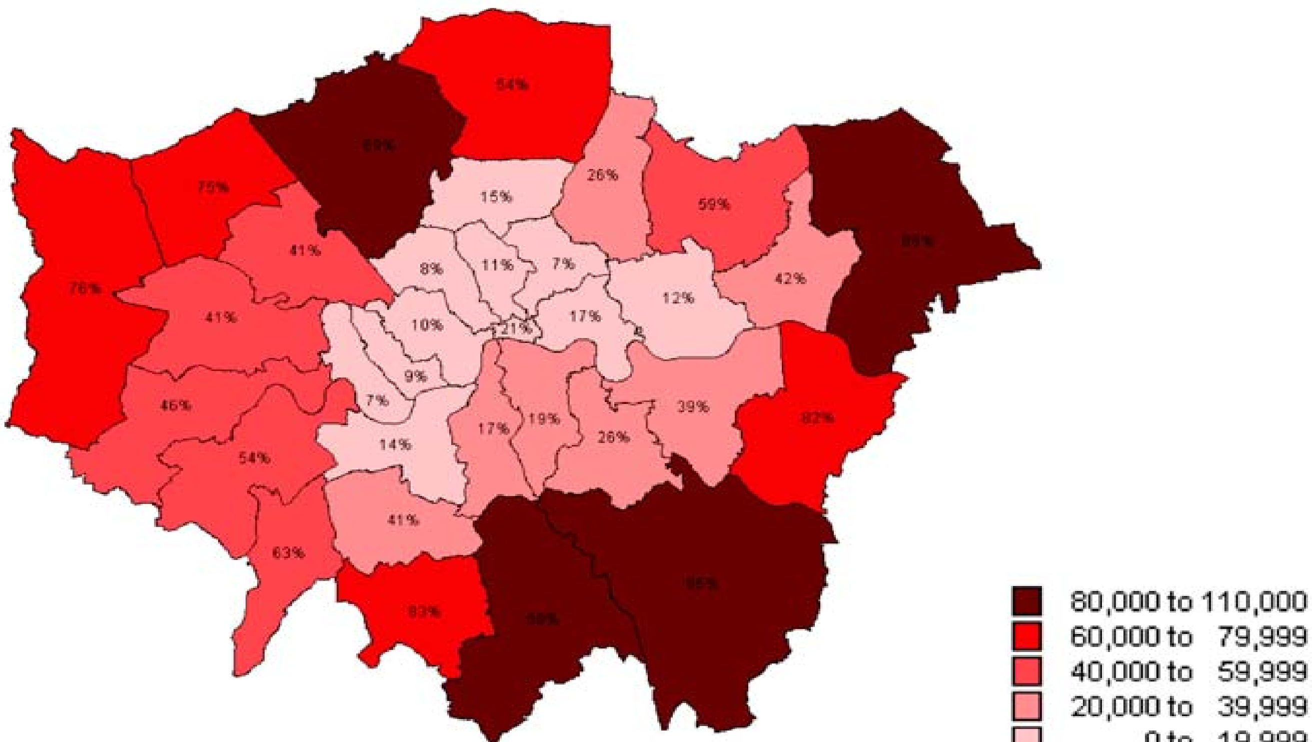
Planning Helps Identify Households With Off-Street Parking



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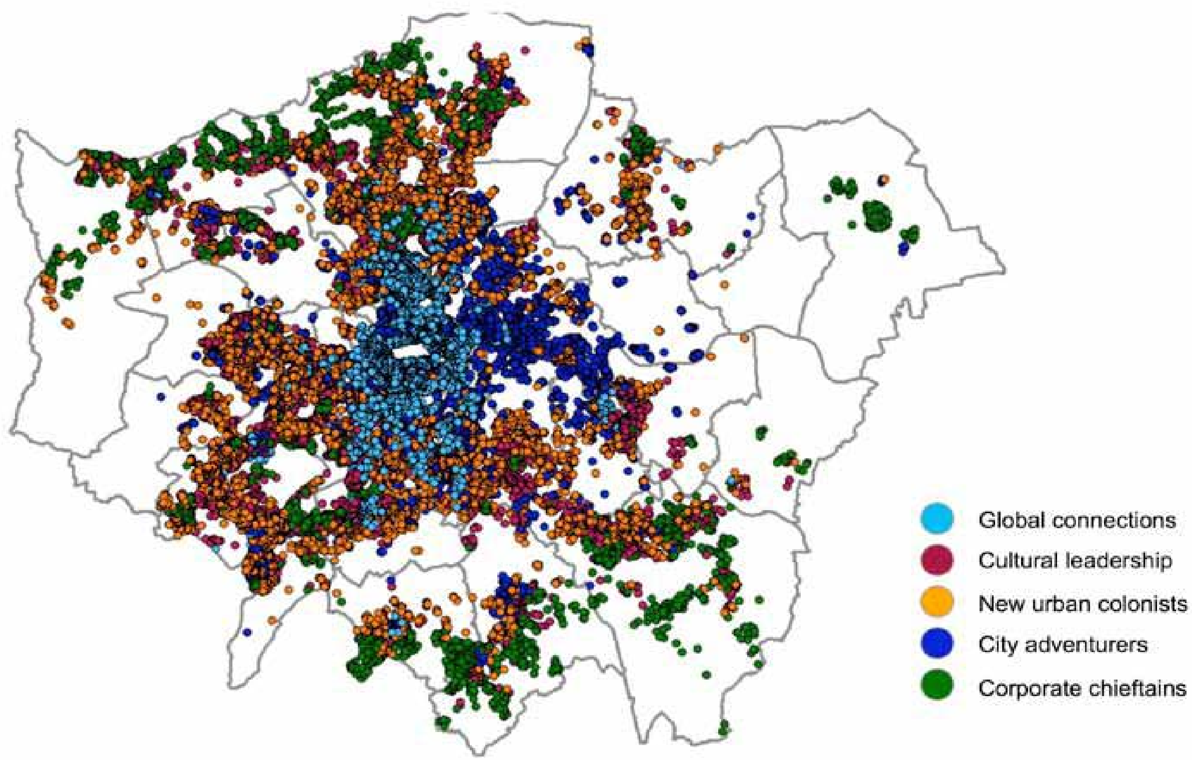
Planning Helps Identify Where Potential Adopters of EVs Live.



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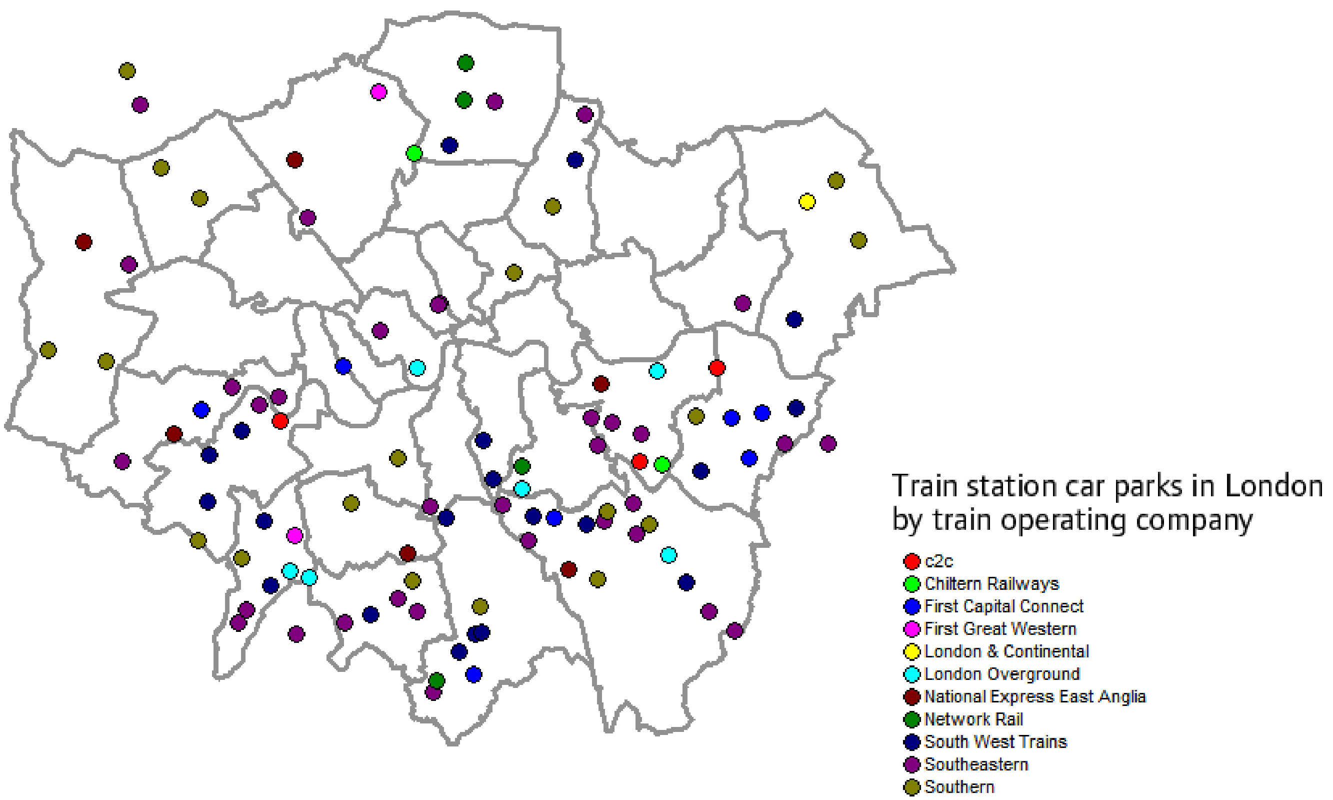
Planning Enables Strategic Approaches To Locating EV Charging Stations



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In Contrast . . .

The Sacramento California regional light rail system is a 37.5-mile line, which links both the eastern and northeastern suburbs with Downtown and South Sacramento. It carries 55,000 passengers on a typical weekday. But . . .

In Sacramento California, you can find a charging station at Herb's Car Wash, but you won't find one at any of the 18 parking lots that provide nearly 8 thousand parking spaces for daily commuters.

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Connectivity

The City of the Future is a Smart City

- **Using technology to perform asset management throughout life cycle of assets**
- **Using Traffic Management Centers as an effective mobility, revenue collection, incident management and safety tool.**
- **Offering citizens unprecedented information enabling real-time choices.**

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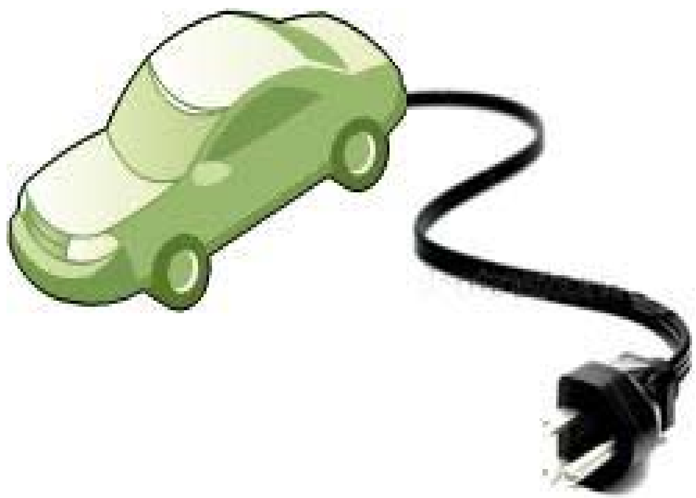
Planning Enables A Functional Smart Grid That Enhances The Value Proposition For Consumers and Utilities



- **Point of sale for EV Charging Stations**
- **Customer Convenience: Location and Type**
- **Data Recovery & Analytics**
- **Managing Impacts to Grid**
- **V2G; a new interactive paradigm**

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Integration

The Transition To Electric Vehicles Is About More Than Just Switching Out Technology

Electric Vehicles Deployed Without Proper Planning:

(It isn't pretty)

Traffic Congestion

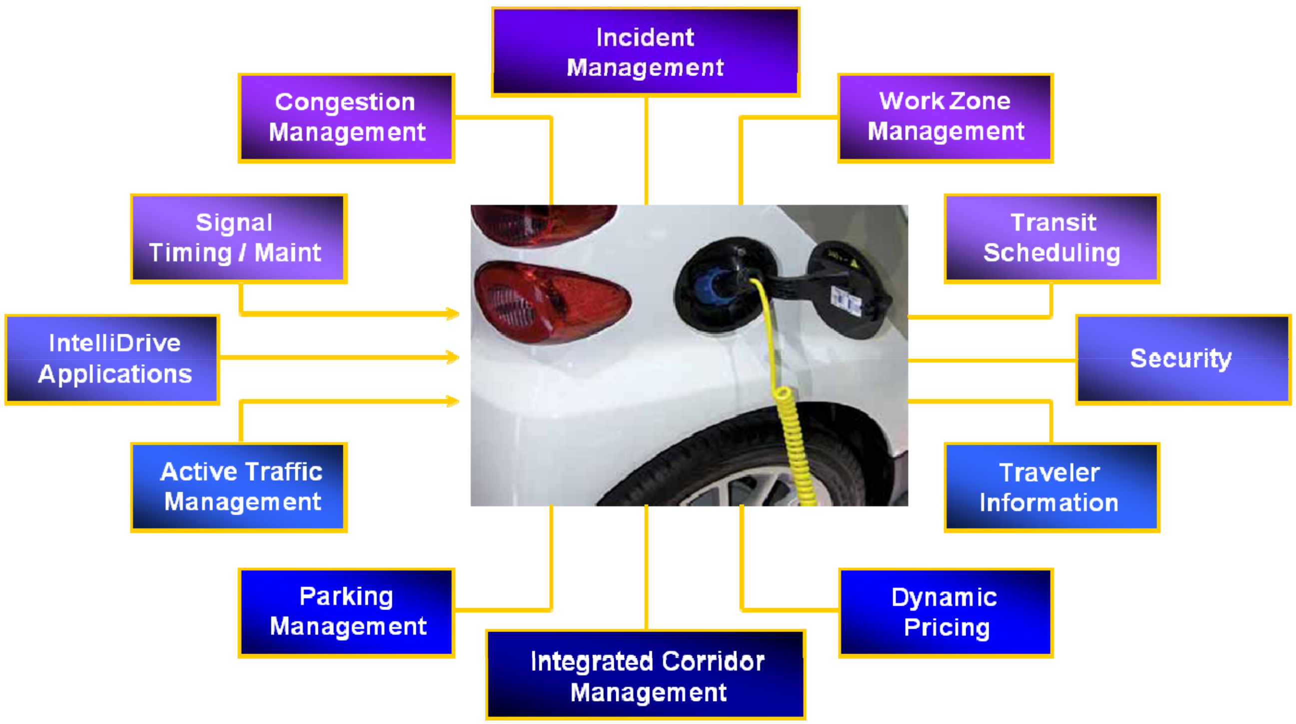
Before EVs

Traffic Congestion

After EVs

AECOM

Electric Vehicle Deployment Needs To Be Planned As Part of an Interactive System



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Planning Facilitates Insights By Asking and Answering Important Questions

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How can we use predictions of future traffic and growth patterns to roll out the EV charging infrastructure?

Will Battery Swapping Stations Be Used Primarily for Fleet and Public Vehicles?

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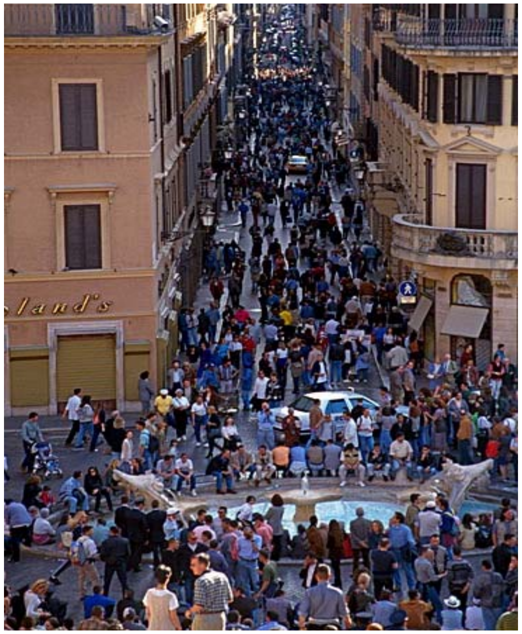
How do EV charge and swap locations serve existing economic development patterns, and impact planned or predicted future patterns?

How do we ensure that EV charging locations will be located and managed in such a way as to improve mobility, enable locally-driven land use choices, and enhance the public realm?



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Electric Vehicles Can Be The Catalyst For:

- **Modal Shift**
- **Creation of Mobility Hubs**
- **Encouraging Smart Location Decisions**
- **Improving Land Use & Public Realm**
- **Facilitating a more sustainable energy supply system**

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A Comprehensive Planning Process Can Help Us:

Transform

Our relationship to the Grid

Rethink

How we approach vehicular mobility

Deliver

A Successful 21st Century paradigm

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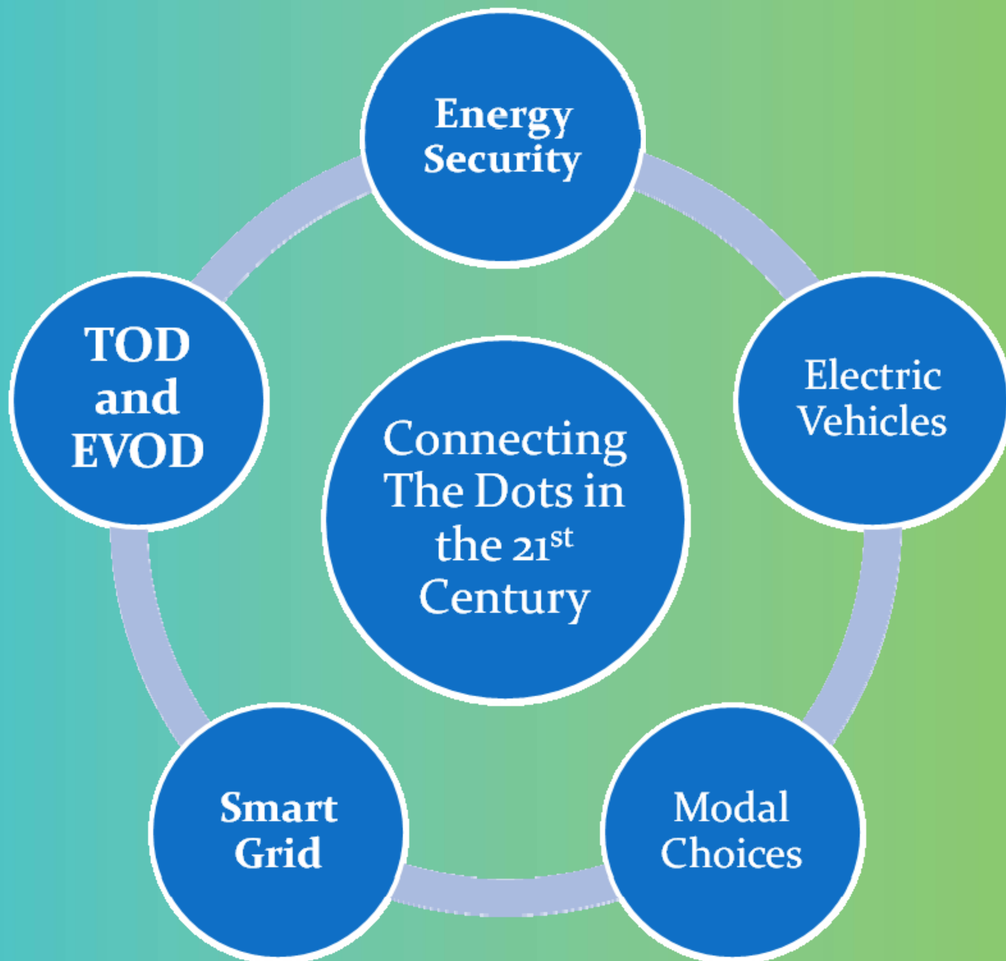
The Future Is In Our Control *If* We Can Connect The Dots



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SAE J1772™ Update for IWC PHEV WG

Gery Kissel
SAE J1772™ Task Force Lead
December 7, 2010

Contents

- Charging Configurations and Ratings
- Document Status
  - Coupler Compatibility Testing
  - Revision Plan
- Charge Coupler Strategy
- DC Fast Charge Standardization
  - DC Fast Charge Coupler Summary
  - Hybrid Coupler Design Status
- China Standards

SAE J1772™ Update for IWC PHEV WG

- Charging Configurations and Ratings

Proposed SAE Charging Configurations and Ratings Terminology

- AC L1: 120V AC single phase
  - Configuration current 12, 16 amp
  - Configuration power 1.44, 1.92kw
- AC L2: 240V AC single phase
  - Rated Current ≤ 80 amp
  - Rated Power ≤ 19.2kw
- AC L3:TBD
  - AC single or 3ϕ ?
- DC L1: 200 – 450V DC
  - Rated Current ≤ 80 amp
  - Rated Power ≤ 19.2kw
- DC L2: 200 – 450V DC
  - Rated Current ≤ 200 amp
  - Rated Power ≤ 90kw
- DC L3: TBD
  - 200 – 600V DC ?
  - Rated Current ≤ 400 amp?
  - Rated Power ≤ 240kw?

Voltages are nominal configuration operating voltages, not coupler rating.
Rated power is at nominal configuration operating voltage and coupler rated current.

SAE J1772™ Update for IWC PHEV WG

- Document Status

Coupler Compatibility Testing Background

- Testing to be conducted by the manufacturers
- Coupler samples will be exchanged
- Participating manufacturers will provide inlets
- Inlets to be equipped with thermocouples for temperature measurements during electrical tests
- Test criteria developed and agreed to
- Results to be consolidate and summary presented to SAE Task Force

Original Coupler Compatibility Testing Plan

SAE J1772™ Inter-Compatibility Evaluation

EVALUATION TIME LINE					
Description	**August**	**September**	**October**	**November**	**December**
Test Procedure Development	**Posted on SAE Website**				
Fit-Up "Round Table"					
Exchange Components					
Level 1 - Mechanical					
Level 2 - Temp Rise					
Level 3 - Cycle Test					
Final Report to Task Force					

* Test procedure is posted on SAE Website, please review and submit comments/questions to T. Rose

* Participating manufacturers:
- Amphenol
- Delphi (ODU)
- ITT
- REMA
- Yazaki

* Fit-Up "Round Table" held 8/24/2010 -- all connector and inlet combinations verified for mechanical fit and electrical continuity

Presented by: T. Rose, REMA USA, LLC

August 24, 2010

Coupler Compatibility "Fit-Up" Results

SAE J1772™ Inter-Compatibility Fit-Up "Round Table" Results

INLET MANUFACTURER		CONNECTOR MANUFACTURER				
		Amphenol	Delphi(ODU)	ITT	REMA	Yazaki
	Amphenol	n/a	M	M / C	M / C	M / C
	Delphi (ODU)	M	n/a	M	M	M
	ITT	M / C	M	n/a	M / C	M / C
	REMA	M / C	M	M / C	n/a	M / C
	Yazaki	M / C	M	M / C	M / C	n/a

Notes: M = Mechanical compatibility confirmed with acceptable mating and un-mating force (subjective)
C = Electrical continuity confirmed for each conductor -- L1, L2, GND and Control Pilot
n/a = not evaluated

Prepared by: T. Rose, REMA USA, LLC

August 25, 2010

Coupler Compatibility Testing Status

- After “Fit-up” testing all suppliers except REMA and Yazaki backed out of remaining tests
- Testing estimated to be complete end of January 2011

J1772™ Revision Plan

- Since January release, implementation of the standard and development of EVSE compatibility test plan has identified areas needing correction / clarification
- Sub-workgroup will be organized and meet via WebEx
- Workgroup will edit/revise document and present results to Task Force
- Draft document will be surveyed for a minimum of 2 weeks
- Targeted publication, 1Q11

J1772™ Revision Plan

- Revision to include:
  - Editorial corrections
  - Technical corrections
  - Charging configurations and ratings definitions
  - EVSE compatibility test (new Appendix)
  - DC L1 charging
    - Requires concurrent approval of SAE J2847/2 and successful demonstration of system

Proposed J1772
evisions 10_11_3

SAE J1772™ Update for IWC PHEV WG

- Charge Coupler Strategy

Coupler Usage Summary

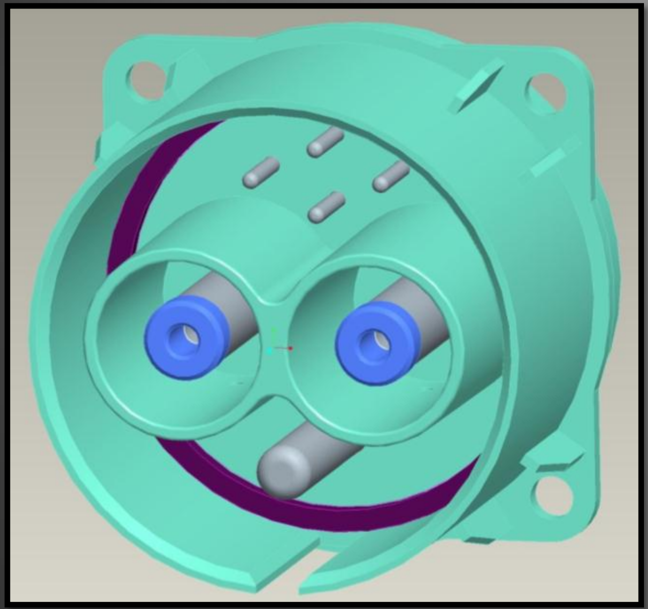
- PHEV / EREV –C1 coupler as standard
  - AC L1 & L2, DC L1
  - Largest vehicle volume (90%?), smallest inlet
  - Coupler C2 as option
- BEVs – C2 "Hybrid" coupler as standard
  - Single vehicle charge inlet for AC L1 & L2, DC L1 & L2
  - Coupler C3 as option
- Commercial / Fleet Vehicles –C3 coupler as standard
  - AC L3, DC L3
  - Optional for BEVs

Charge Inlets

C1: AC L1 & L2, DC L1

C2 "Hybrid Inlet":
AC L1 & L2, DC L1 & L2

Charge Inlets



C3 TBD: AC L3 & DC L3

SAE J1772™ Update for IWC PHEV WG

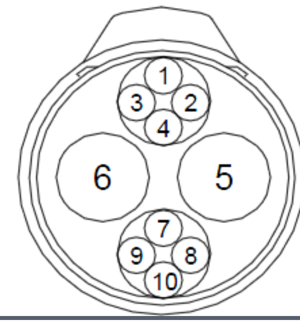
- DC Fast Charge Standardization

DC Fast Charge Coupler Summary

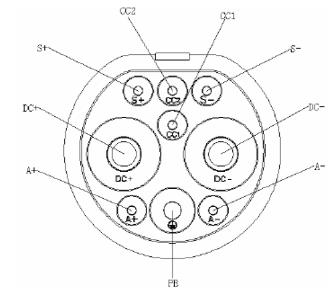
DC Connector:
IEC 62196-3
EU

DC Connector:
SAE J1772™
NA

DC Connector:
CHADEMO
Japan



DC Connector:
China



Working to harmonize:

- Type 1 or Type 2 “core”, adding DC contacts
- DC contact location and other physical features are common
- Common control signals

DC Fast Charge Coupler Summary

- IEC 62196-3 and SAE J1772™ Have Common Control Signals and Overall Physical Shape
- Japan CHADEMO Has Unique Control Signals and Unique Overall Physical Shape
- China Standard Has Unique Control Signals and Unique Overall Physical Shape

DC L2 Charge

"Hybrid" Coupler Design

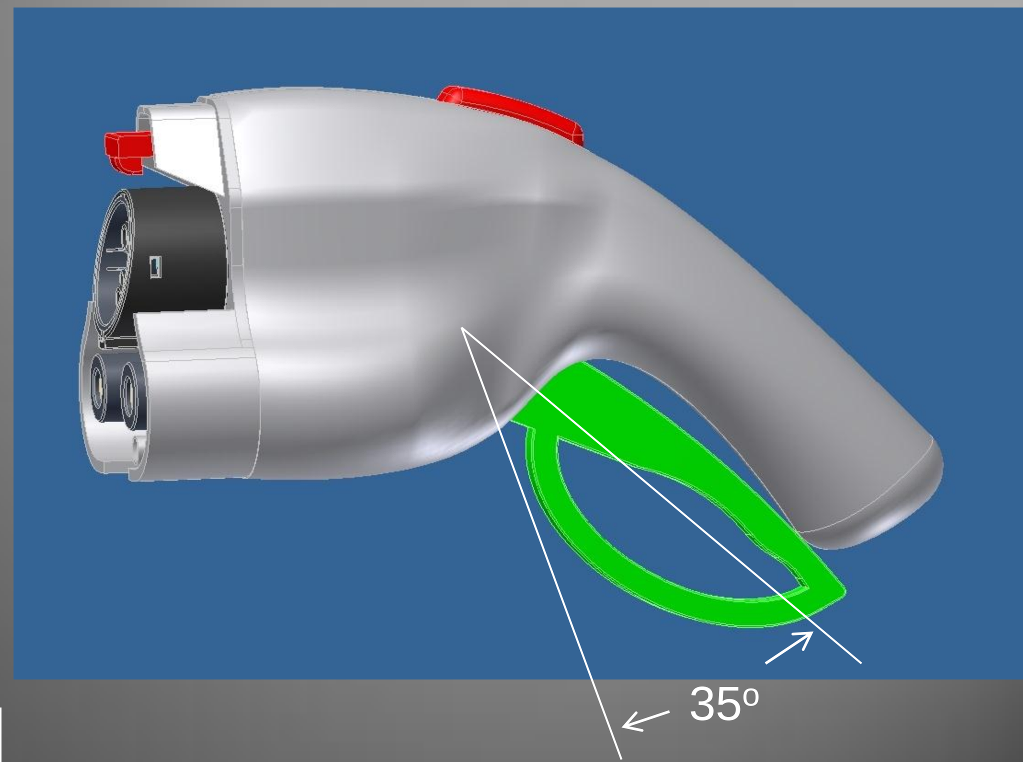
- Working with CARMEQ (Audi, BMW, Daimler, Porsche, Volkswagen) to provide Working Draft (WD) of IEC 62196-3 and related documents by January 15, 2011
- Combine AC L1, L2 and DC L1, L2 in one coupler.
- Add DC pins, 200 amp capacity
- Provide provision for 2 optional data pins (plan to remove once communications strategy is resolved)
- Reuse ground, control pilot and proximity circuit pins from AC L1, L2

DC L2 Charge

- Working Draft (WD) will include use of either IEC Type 1 (SAE J1772™) or Type 2 (Mennekes) "core"
- DC and communication pins as well as other necessary feature locations will be harmonized
- Strategy maximizes commonality between SAE and IEC DC L2 hybrid couplers

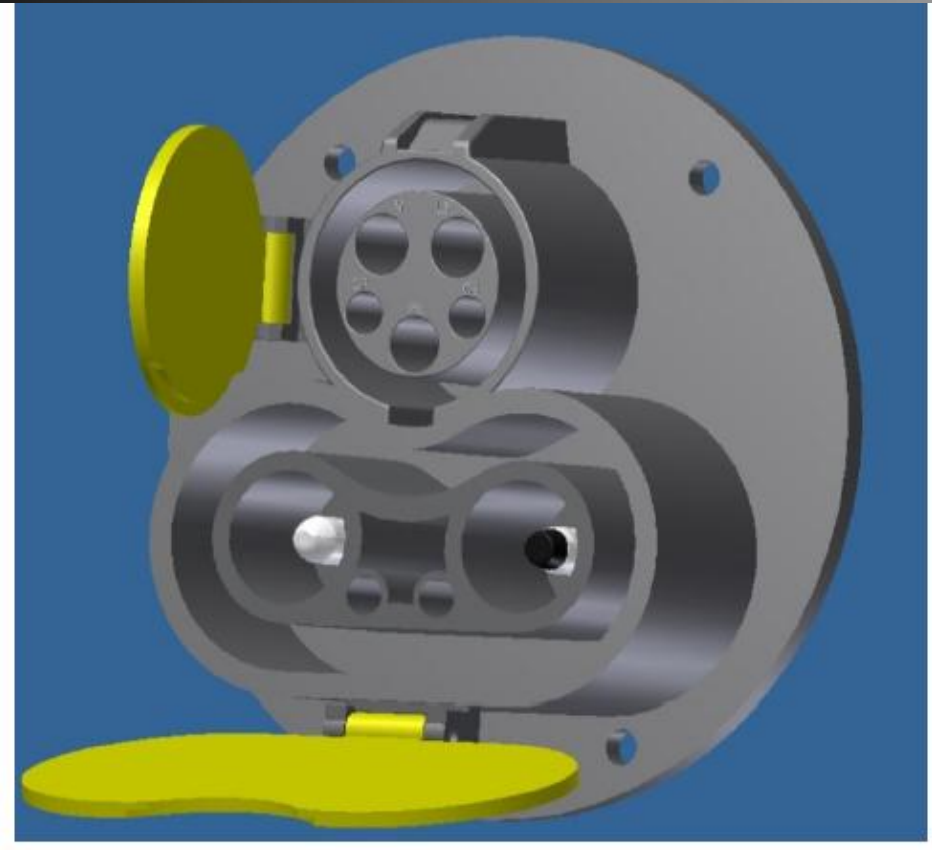
DC L2 Charge

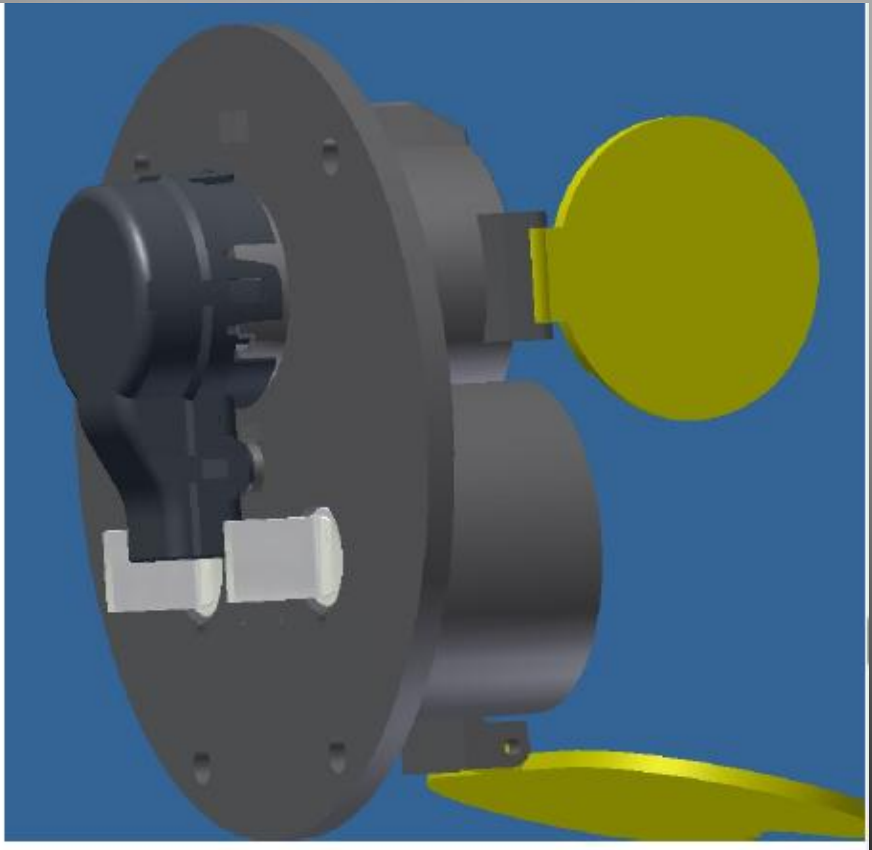
DC L2 Charge



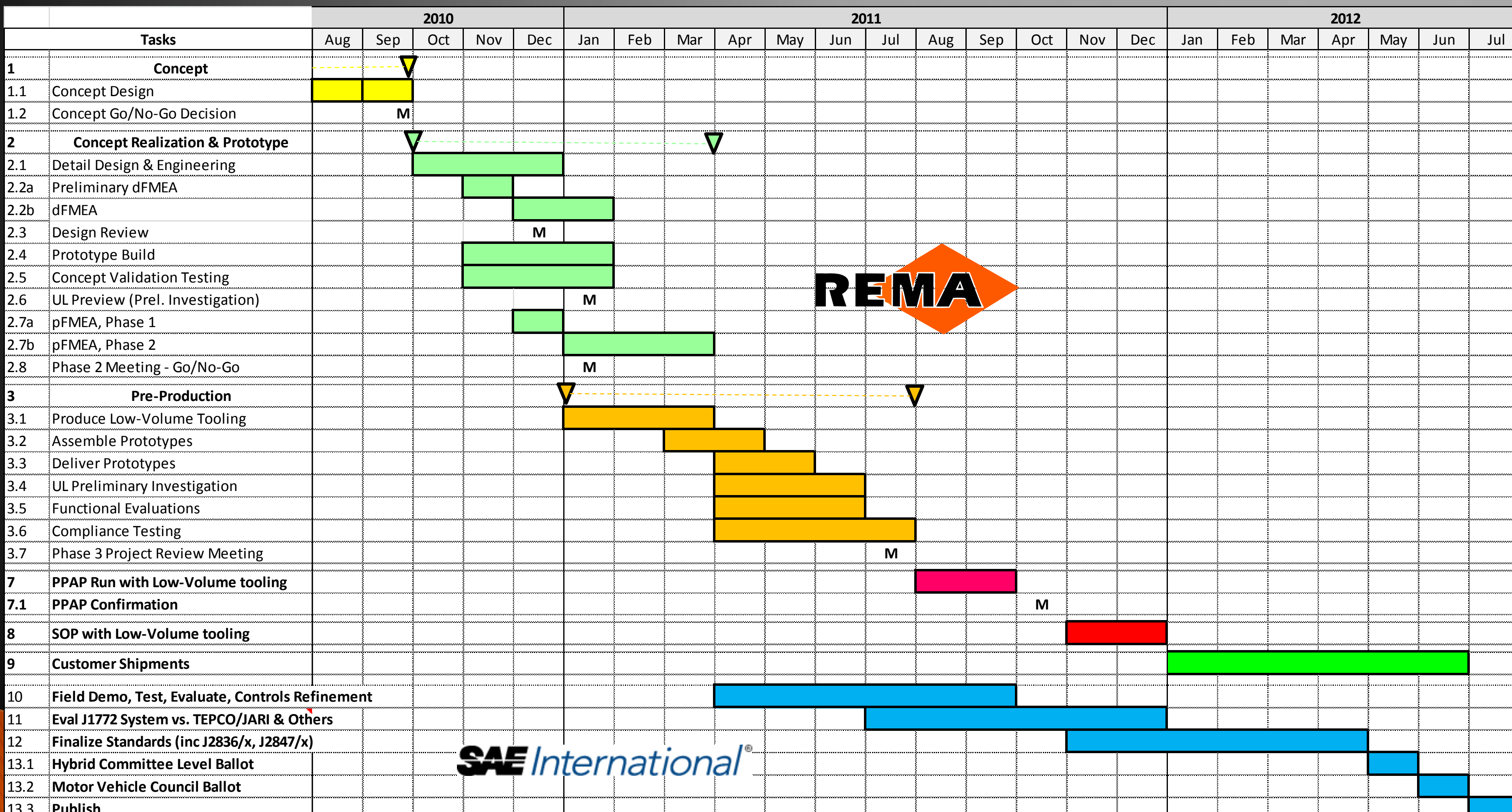
User applied force mating and un-mating is approximately 55N, including sealing of DC pins

DC L2 Charge





Hybrid Coupler Timing



SAE J1772™ Update for IWC PHEV WG

- China Standards

China Standards Issued

类型/type		已发布的标准Number of standards issued		
		全部 all	国标National standards	行标Industry standards
Electric road vehicles	BEV	11	11	0
	HEV	6	6	0
	FCV	4	3	1
	E motorcycles & mopeds	6	4	2
components	Energy storage system	8	4	4
	E motor	3	3	0
	Charging	4	4	0
总 计/ **total**		42	35	7

China Standards – New / Revised

列入计划正在制定28项、修订4项，共32项，其中12项已通过审查。

28 being drafted, 4 under revision, 12 approved.

标准类型 type		制定 new items	修订 revision	合计 add up
Electric vehicle	BEV	4	0	4
	HEV	3	2	5
	FCEV	6	0	6
components	RESS (battery)	4	0	4
	Motor and controller	3	2	5
	Charger and interface	8	0	8
total		28	4	32

China Standards

- China draft AC charging standards charge coupler and electrical interfaces do not harmonize with SAE or IEC
- China issued a request for comment on 3 of their EV charging standards in November
  - Part 1 – General Requirements
  - Part 2 – AC Coupler Requirements
  - Part 3 – DC Coupler Requirements
- Comments were due November 26, 2010
- OEMs submitted their own technical comments
- To prevent redundant comments, SAE submitted high level comments requesting China harmonize AC single phase charging with SAE J1772™ and IEC 6296-2 Type 2

U.S. Emergency Responder Safety Training for Advanced Electric Drive Vehicles

ELECTRIC VEHICLE
SAFETY TRAINING
A PROJECT OF THE NATIONAL FIRE PROTECTION ASSOCIATION

For more information, visit:

www.EVSafetyTraining.org

NFPA Mission:

Reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating …

- Consensus codes & standards
- Research
- Training and
- Education

Private, Not-for-Profit Organization

Founded in 1896

Voluntary codes and standards organization

ANSI accredited standards developer

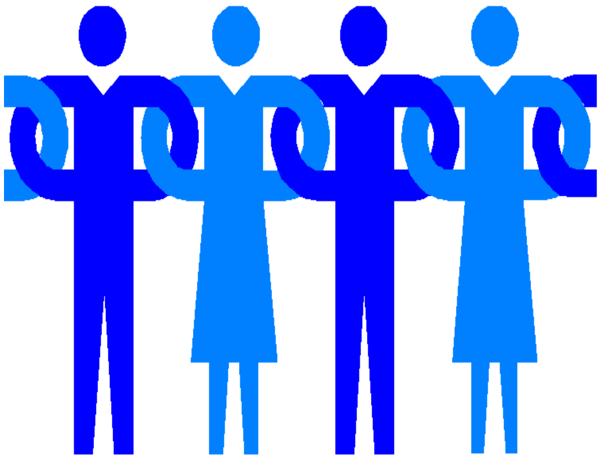
73,000 members in 120 countries

300 staff

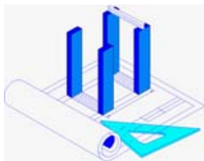
Headquarters in Quincy, MA

10 Regional offices U.S. and Canada

3 International offices

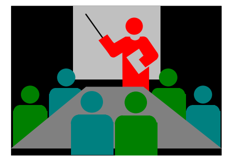


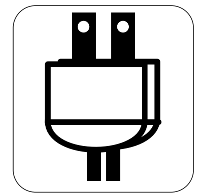
Diversity of NFPA Membership: 16 Membership Sections


AEBO

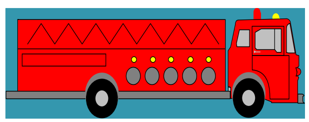

Aviation


BFSSystems

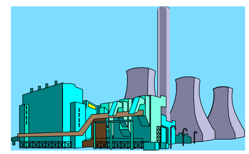

Education

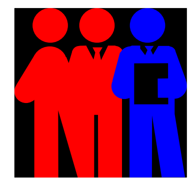

Electrical


FS&Tech Ed

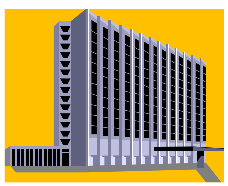

Fire Service


Health Care

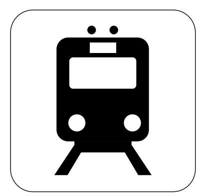

Industrial


IFMA


Latin Am


Lodging


Metro Chiefs


Rail


Research


Wildland

The NFPA Codes & Standards Process

275 codes and standards

Developed by approximately 200 technical committees

Populated by ~7000 TC volunteers

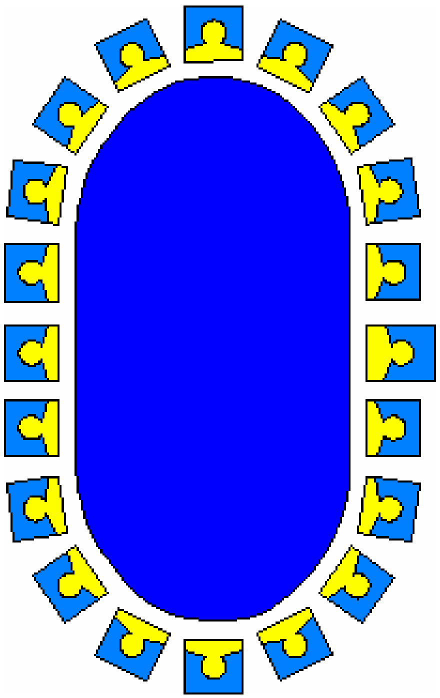
NFPA documents often used in regulations

Essentials of the NFPA system

- Due process – rules, oversight
- Openness & transparency - accessible
- Lack of dominance – balance, consensus

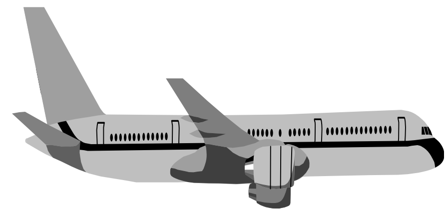
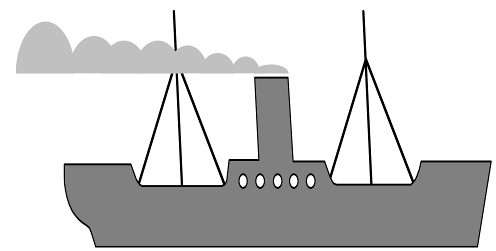
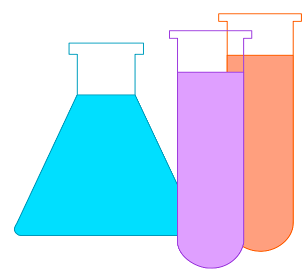
Seek balance between:

- Acceptable risk
- Commitment of resources



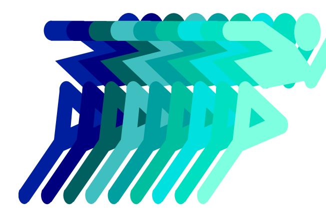
Federal Participation on NFPA Technical Committees

- HHS, GSA, OSHA - Life Safety Code®
- EPA, DOT - Hazardous Materials
- FAA - Aviation Facilities
- MSHA - Mining
- DOE - Nuclear Facilities
- Coast Guard, OSHA - Marine
- OSHA, CPSC - National Electrical Code®
- FEMA – Emergency Management
- DOD – Various

NFPA Activity Areas

- Codes & Standards – fire safety, life safety, electrical safety, building safety, hazardous materials, emergency response, and premises security
- Research – data collection and analysis, incident investigations, human behavior, research foundation
- Professional Development – training , videos, personnel, certification
- Public Education – injury prevention
- Advocacy – public safety beyond standards



NFPA Resources

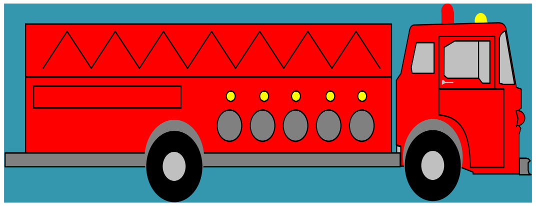
- Publications
- NFPA Conference and Exposition
- Seminars and workshops
- Public education and safety information
- Fire Protection Research Foundation
- One-Stop Data Shop
- Morgan Technical Library
- Advisory services
- Website: www.nfpa.org

Standards for Emergency Responders

- <u>NFPA 470 Series:</u>

  Competence of Responders to Haz Mat/WMD Incidents
- <u>NFPA 921:</u>

  Fire Investigations



- <u>NFPA 1000 Series:</u>

  Emergency Responder Professional Qualifications
- <u>NFPA 1500 Series:</u>

  Occupational Safety and Health Standards for Fire Fighters
- <u>NFPA 1600 Series:</u>

  Emergency Planning and Response including NFPA 1670, Standard for Technical Rescue Incidents

Codes & Standards for Electric Vehicles

NFPA 70®, NATIONAL ELECTRICAL CODE® (NEC®)

Article 625: Electric Vehicle Charging Stations

Article 626: Electrified Truck Parking Spaces

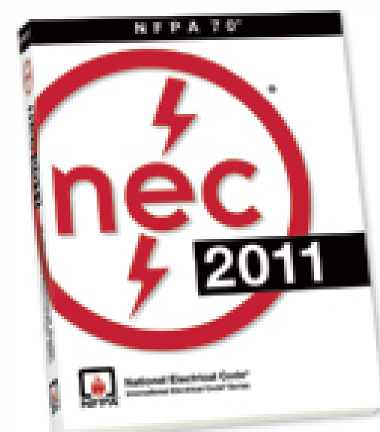
Article 220: Residential power consumption calculations

Related Activities:

Solar Photovoltaic Systems

Fuel Cell Technology

Smart Grid Technology



Projects Related to EVs
Fire Grant Project

Fire Fighter Safety & Emergency Response for EVs & HEVs

Project Goal: To assemble and widely disseminate best practice tactical information for fire fighters and fire ground incident commanders to assist in their decision making process when responding to emergency events involving alt-energy applications.

Project Vehicle Scope: EVs, BEVs, HEVs, PHEVs, NEVs – focus on 4 wheel passenger vehicle events on roadways or at structures.

Report posted on www.nfpa.org/foundation

Hybrid & EVs on the Road

NFPA Advanced EV First Responder Training

Objective

Implement a comprehensive Emergency Responder Training Program for Advanced Electric Drive Vehicles to keep our first responders prepared and the public safe.

- Reach 1.1 million fire service members & D.O.D.
- Offer courses to EMS and Law Enforcement.
- Develop NFPA Emergency Responder Web Portal for all EV safety training and info.
- Develop awareness for Public on EV Safety.

Project Partnerships

International Association of Fire Fighters (IAFF)
International Association of Fire Chiefs (IAFC)
National Volunteer Fire Council (NVFC)
International Fire Marshals Association (IFMA)
National Association of State Fire Marshals (NASFM)
Metropolitan Fire Chiefs
U.S. Fire Administration (USFA)
North American Fire Training Directors (NAFTD)

Fire Service Technical Committee: assisting with needs assessment & direction for training development

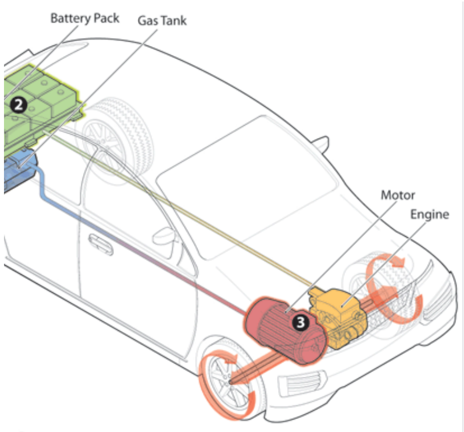
Alliance of Automobile Manufactures (AAM)
Association of International Automobile Manufactures (AIAM)
Auto Manufacturers

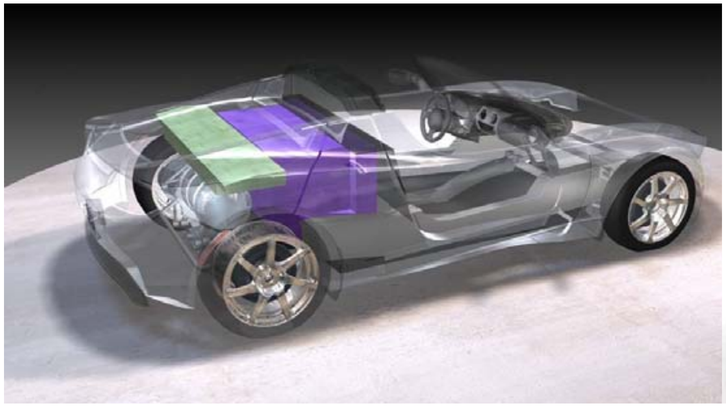
EV ERGs, No-Cut Graphics, Power Down Sequences

National Renewable Energy Lab (NREL) – Tech Questions & Trends
State Farm Insurance – Safety Issues, Crash Test Results
National Highway Traffic and Safety Association (NHTSA) – Stats, Tests

Project Scope
Model Years 2008-2011

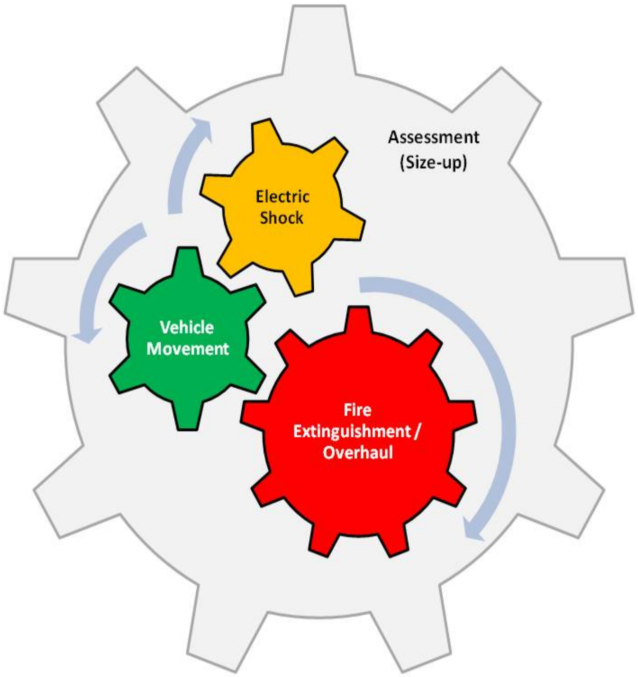
Plug in Hybrids | Electric | Hybrids

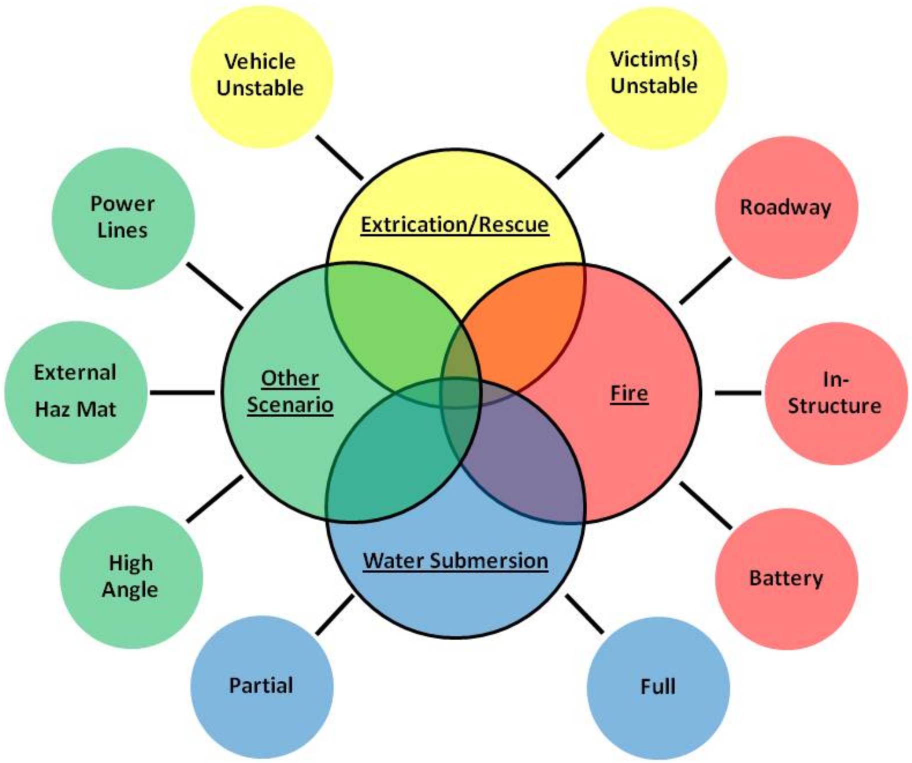




Charging Stations (NEC)

NFPA SMEs Identifying EV Risks, Procedures & Emergency Scenarios





Fire Services & Electrical Codes Standards Training Alignment

Standards for Fire Service

- NFPA 1500: Occupational Safety & Health Standards for Fire Fighters
- NFPA 1001: Fire Fighter Professional Qualifications Series
- NFPA 1600: Disaster Planning and Emergency Preparedness
- NFPA 472: Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents
- NFPA 1670: Standards for Technical Rescue Incidents
- NFPA 921: Fire Investigation

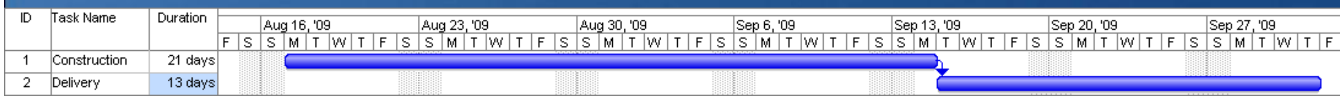
National Electric Code

- Article 625: Electric Vehicle Charging Stations
- Article 626: Electrified Truck Parking Spaces
- Article 220: Residential power consumption and how EV charging infrastructure will effect power consumption and emergency responders

- Related Activities: Photovoltaic Cells; Fuel Cell Tech; Smart Grid Tech

Project Milestones

Approach



2010

- ✓ Hire Communications Firm (FH)
- ✓ Communication Branding
- ✓ Begin Communications Campaign
- ❖ Hire SME Advisory & Review Panel
- ❖ U.S. EV Safety Web Portal Development
- ❖ Emergency Field Guide Development

- ✓ Exec Fire Service Tech Panel Meetings
- ✓ Develop E-Learning Course
- ✓ Fire Service Focus Groups
- ✓ Media Development (Accident Scenarios)
- ❖ Develop Flagship Training Program
- ❖ Develop Content & Curriculum (ATEC)
- ❖ Develop E-Learning (ATEC)

Q2

Q3

Q4

Project Milestones

Approach

2010 Q4

- ✓ Web Portal Completed
- Hire Webinar Provider
- ❖ Flagship Training Courses Completed
- Develop Webinars: ‘Ask the Experts’
- GM First Responder Content on Portal

2011 Q1

- Develop Distribution Plan
- Develop Train-the-Trainer Toolkit
- Final Walkthrough of Training w/SMEs
- EV Emergency Field Guide Complete
- Communications Campaign - High Gear

Q2

- Training/Train the Trainer Product Release
- Distribution Plan Execution

Meetings, Agreements & Focus Groups
Fire Service, Auto, Battery OEMs & Utilities

U.S. National **Electric Vehicle Safety Standards** Summit

October 21-22, 2010 • Cobo Center, Detroit, Michigan

NFPA

www.sae.org/nevss

SAE International

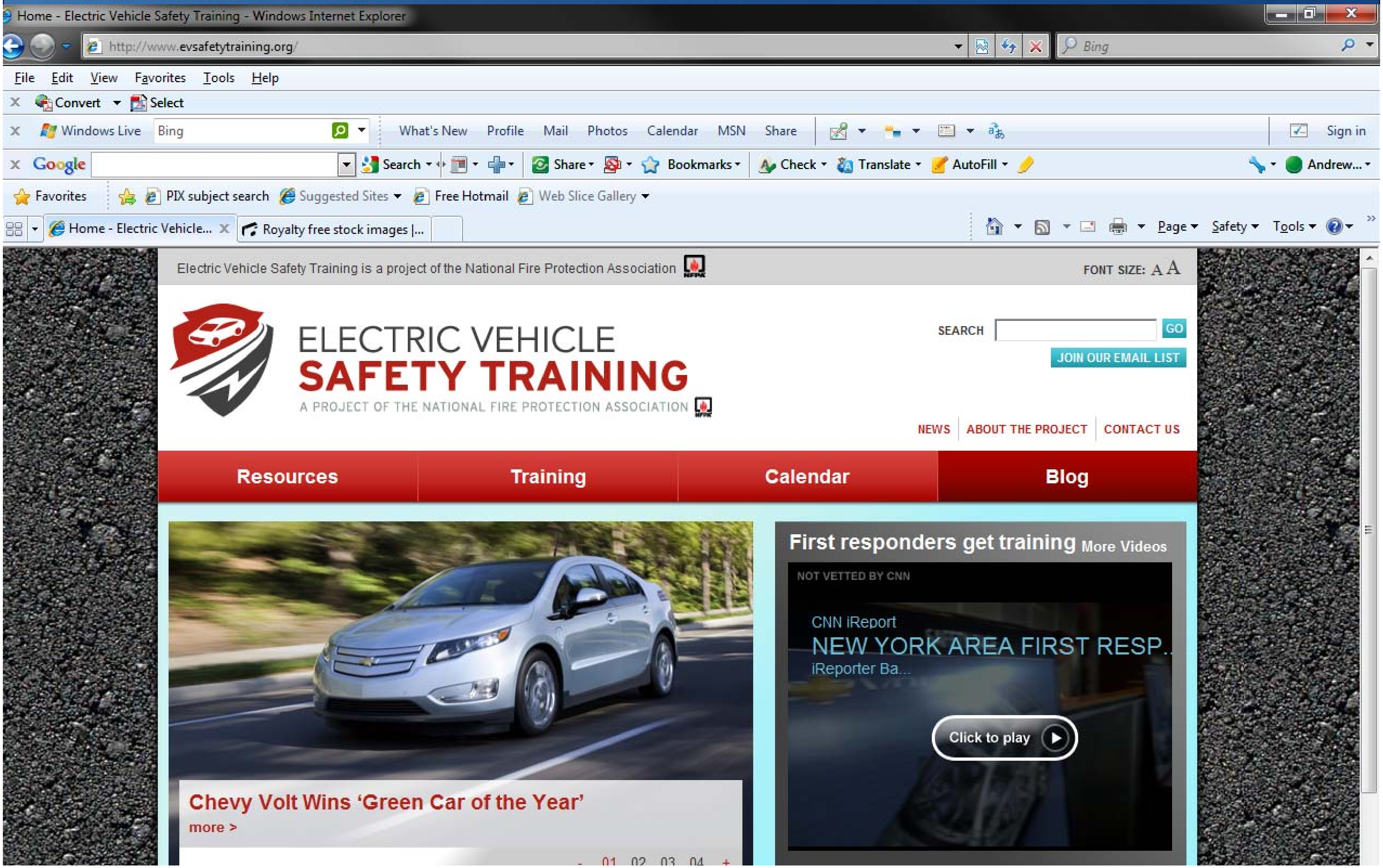
Crash Scene Re-creation (NH)

Crash Scene Re-creation

Crash Scene Re-creation

Crash Scene Re-creation

EVSafetyTraining.org
First Responder EV Safety Central Repository



GM/NFPA Alliance on Chevy Volt
Chevrolet Volt Training Tour

- Boron Infused Steel Safety Cage
- 400 lb Lithium Ion T cell battery / 360 volts / 111 Kw
- Knee & Roof Rail Airbags

GM

ELECTRIC VEHICLE SAFETY TRAINING

VOLT

MY PROFILE

Responder Actions

DATA ACCESS

- Course Overview
- Identification
- EV construction
- Vehicle Safety Systems
- Responder Safety
- Responder Procedures
- DATA Review

- Scene safety (ABC's of extrication) - mention that they apply, then get into Volt-specific

- Size up
  - Scene survey (inner/outer circle)
  - Identification
    - > Emergency Field Guides

(Examples of crumpled vehicle; incidents where vehicle identification is difficult or unreliable)

  - Consideration of biometric info from OnStar
  - Evaluate need for extrication
  - Number of victims
  - Additional Secure vehicle

- Immobilize Vehicle

  - Approach vehicle from the sides
  - Stabilization of vehicle
    - Turn vehicle off
    - Chock wheels
    - Set parking/emergency brake
    - Place vehicle into park
    - Consideration of electrical system deactivation

- Disable Vehicle (Vehicle Shutdown

SAMPLE VIDEO / ANIMATION

0:24/0:30

samples

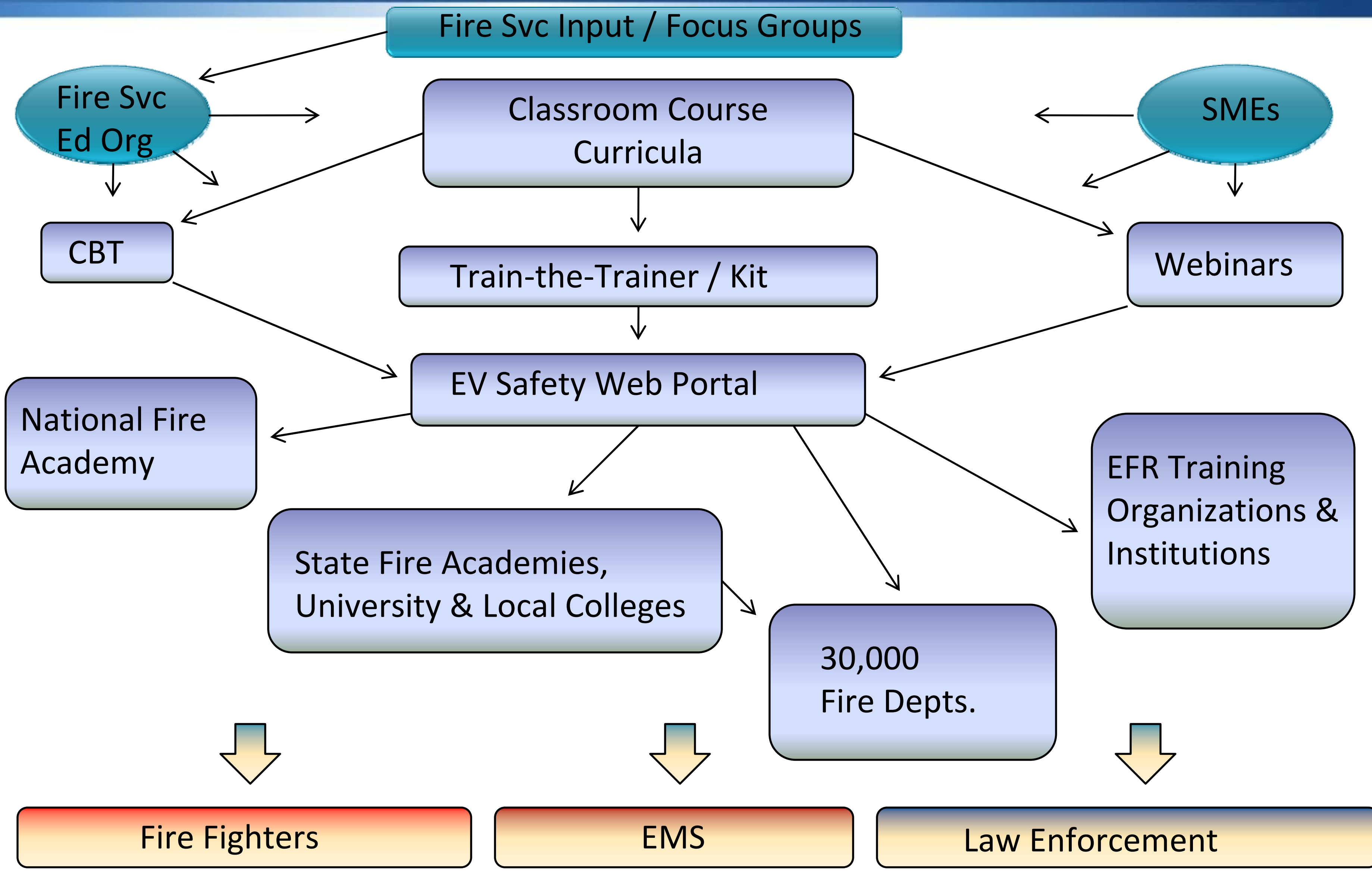
NFPA

NFPA TRAINING SYSTEMS

Emergency Field Guide Database

Training Development & Distribution Plan

Next Steps



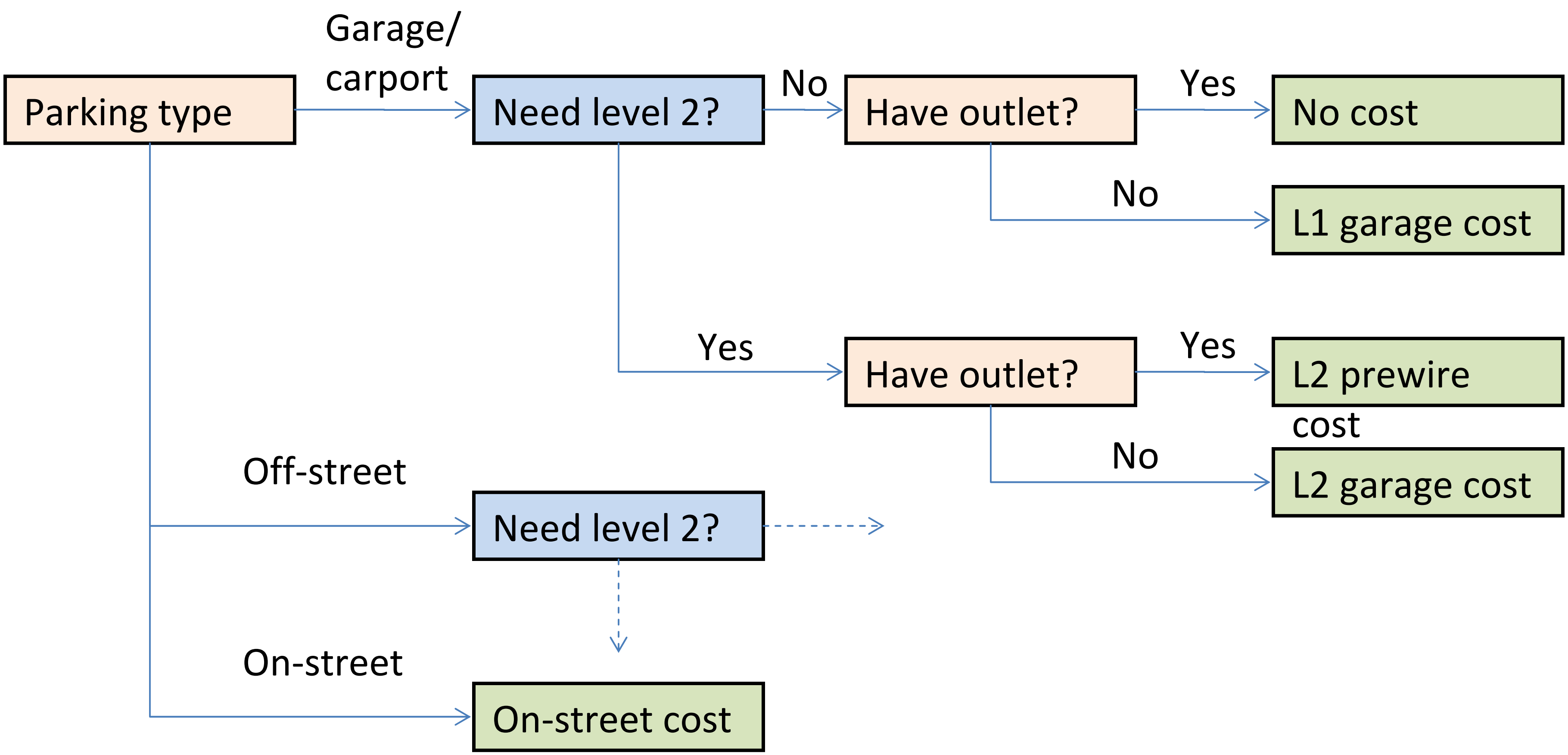
Infrastructure Discussion

What should be the cost of EVSE install for different infrastructure types

Overview

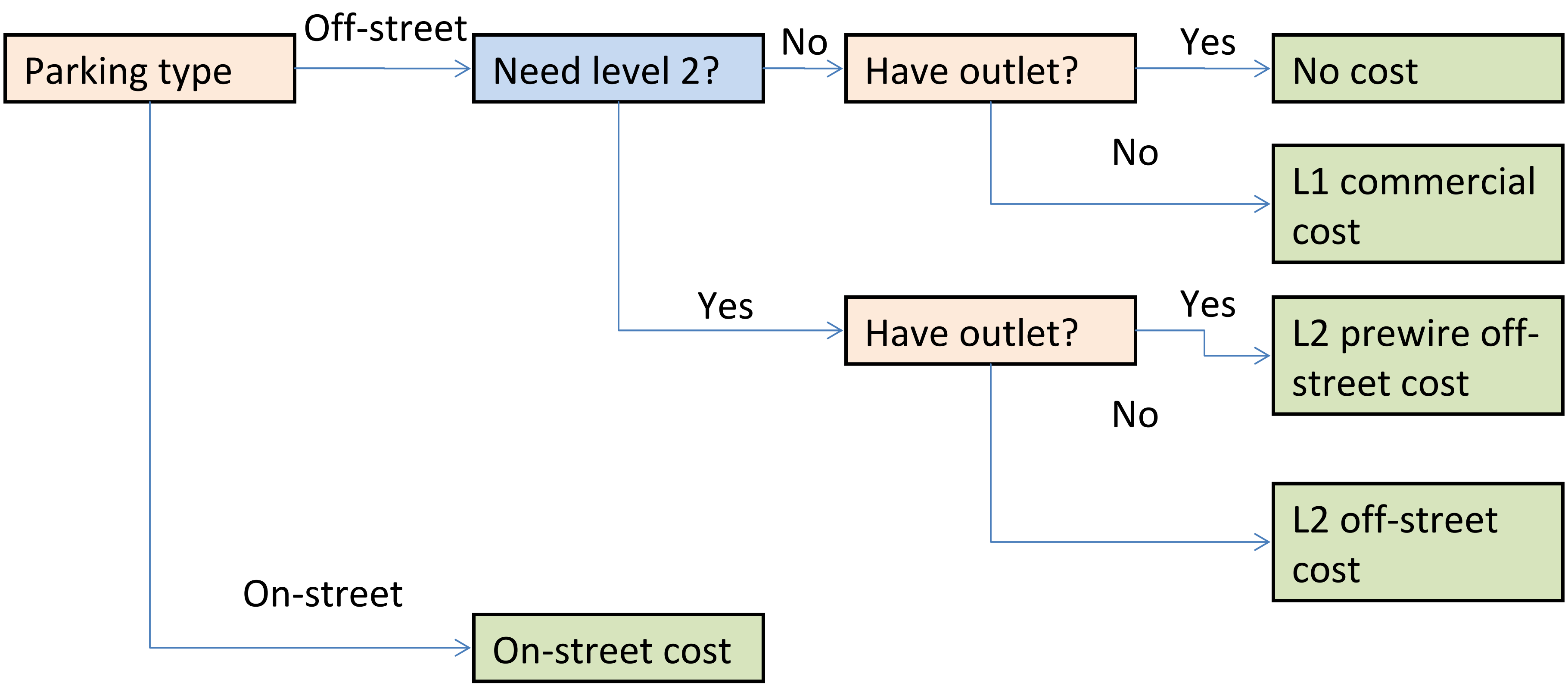
- Residential
  - Garage/carport
  - Off-street
  - On-street
- Workplace
  - Off-street
  - On-street
- Commercial
  - Off-street
  - On-street
- Critical charging

Residential charging tree



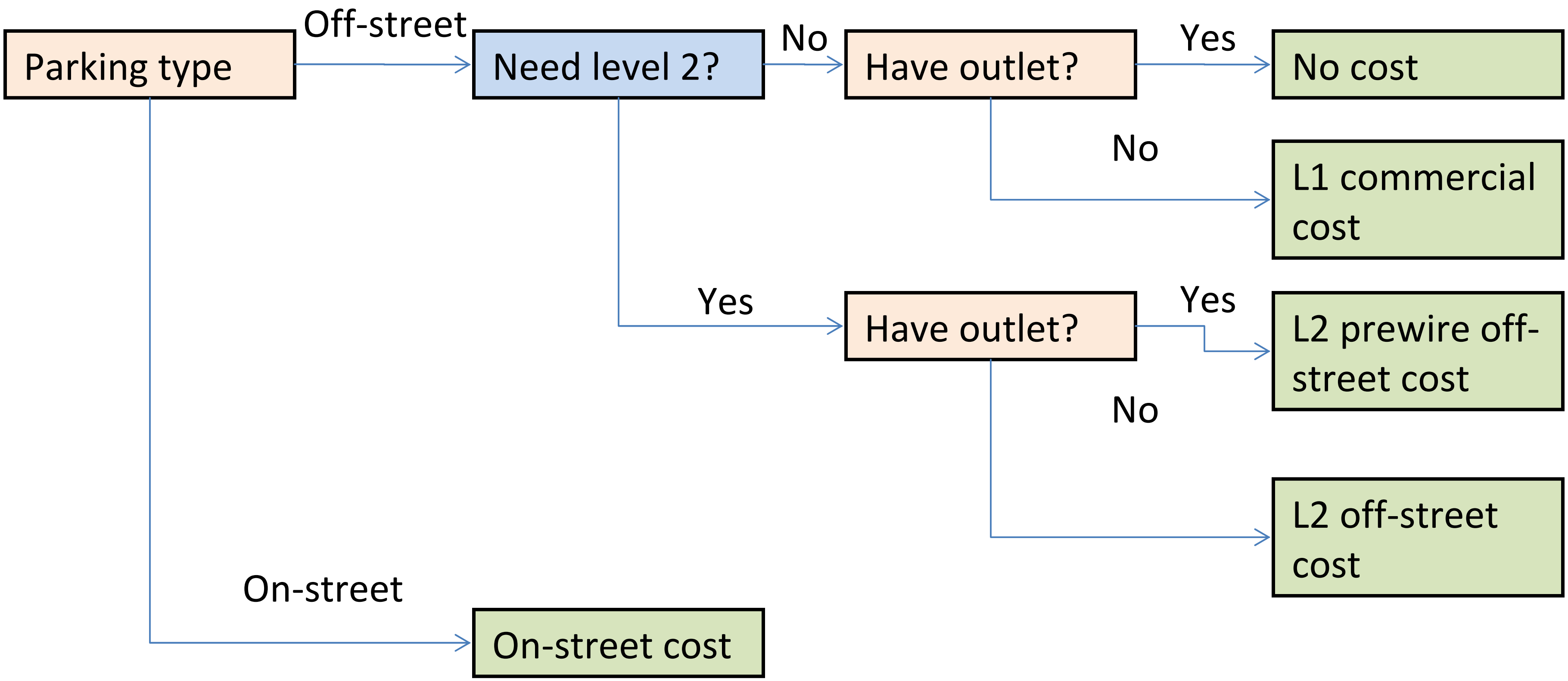
- There is one of these for PHEV10, PHEV40, and EV100
- The blue boxes change depending on vehicle type
- The tan boxes are characteristics of the built environment
- Off-street is the same as garage/carport

Workplace charging tree



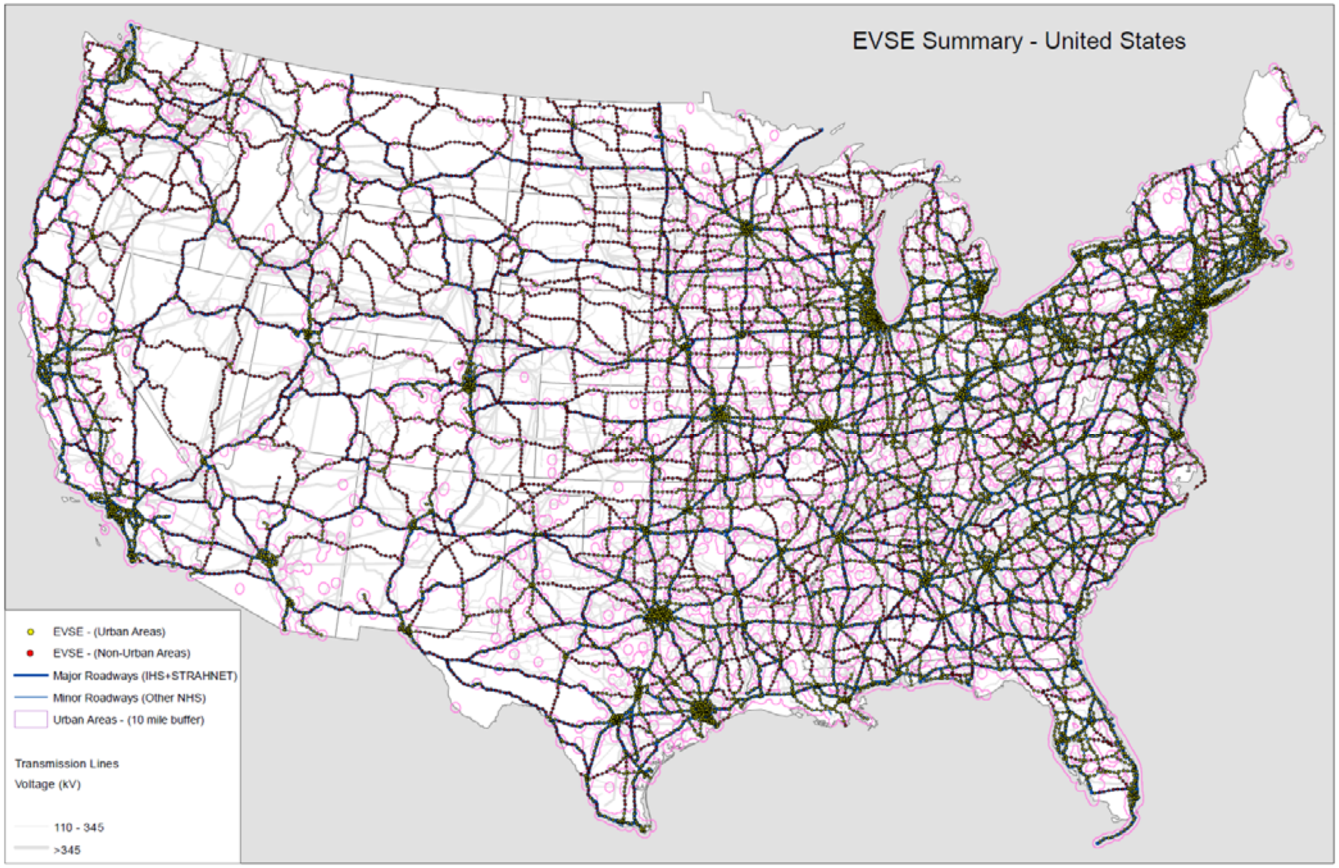
- Workplace only has two parking types; off-street and on-street
- Only some vehicles need workplace charging

Commercial charging tree



- Commercial is the same as workplace
- The costs (green) are the same in both cases
- The need for charging, the need for Level 2, and the mix of parking and outlet types are different

Critical charging



- Major highways are covered, with an EVSE spaced every 10 miles
- Costs are independent of the number of vehicles

Need Input of Infrastructure Cost

- Looking for average costs
- Interested in both numbers and qualitative assessments
- '2010' is the near future, not necessarily the next month

Level 1 garage/carport installation

	2010	2015	beyond
Labor	$300	$300	$300
EVSE	$0	$0	$0
Non-EVSE materials	$131	$131	$131
Permits	$85	$85	$85
Administrative costs	$77	$77	$77
Total	$593	$593	$593

- This is a standard wall plug

Level 2 garage/carport installation

	2010	2015	beyond
Labor	$455	$455	$455
EVSE	$490	$350	$300
Non-EVSE materials	$470	$470	$470
Permits	$155	$155	$155
Administrative costs	$236	$215	$207
Total	$1,806	$1,645	$1,587

- This is a ‘typical’ EVSE installation

Level 2 garage/carport installation with prewiring

	2010	2015	beyond
Labor	$0	$0	$0
EVSE	$490	$350	$300
Non-EVSE materials	$0	$0	$0
Permits	$0	$0	$0
Administrative costs	$74	$53	$45
Total	$564	$403	$345

- Are there other costs we're not considering?
- Will customers just take the unit home and plug it in?

Level 1 residential parking lot installation (5 charger group)

	2010	2015	beyond
Labor	$1,200	$1,200	$1,200
EVSE	$0	$0	$0
Non-EVSE materials	$516	$516	$516
Permits	$155	$155	$155
Signage	$350	$350	$350
Administrative costs	$333	$333	$333
Total	$2,554	$2,554	$2,554
Per charger cost	$511	$511	$511

- Will parking lot installations happen without an EVSE?
- If an EVSE is needed, is Level 1 even relevant?

Level 2 residential parking lot installation (5 charger group)

	2010	2015	beyond
Labor	$1,400	$1,400	$1,400
EVSEs (per charger)	$600	$500	$400
Non-EVSE materials	$696	$696	$696
Permits	$165	$165	$165
Signage	$350	$350	$350
Administrative costs	$842	$767	$692
Total	$6,453	$5,878	$5,303
Per charger cost	$1,291	$1,176	$1,061

- Is the EVSE too cheap?
- Is 5 chargers the 'right' size install size?

Level 2 commercial parking lot installation (10 charger group)

	2010	2015	beyond
Labor	$3,400	$3,400	$3,400
EVSEs (per charger)	$850	$700	$600
Non-EVSE materials	$3,899	$3,899	$3,899
Permits	$700	$700	$700
Signage	$350	$350	$350
Administrative costs	$2,527	$2,302	$2,152
Total	$19,376	$17,651	$16,501
Per charger cost	$1,938	$1,765	$1,650

- Is 10 chargers the ‘right’ size install size?

Level 2 on-street parking installation (10 charger group)

	2010	2015	beyond
Labor	$7,000	$7,000	$7,000
EVSEs (per charger)	$1,500	$1,500	$1,500
Non-EVSE materials	$3,000	$3,000	$3,000
Permits	$500	$500	$500
Signage	$350	$350	$350
Administrative costs	$3,878	$3,878	$3,878
Total	$29,728	$29,728	$29,728
Per charger cost	$2,973	$2,973	$2,973

- Are there cost reductions for on-street parking?

Fast charger

	2010	2015	beyond
Fast charger unit cost	$25,000	$15,000	$10,000
Fast charger installation cost	$15,000	$15,000	$10,000
Total	$40,000	$30,000	$20,000

- The current charger cost is an average of some quotes (~$35k) and Nissan's stated price (+17k)
- Installation cost is based on an actual installation
- Does not include upstream upgrades ($10k in transformer + installation)