EVS AND EV CHARGING 101

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Electric Vehicle Fleet Initiatives to Support Your Sustainability Program

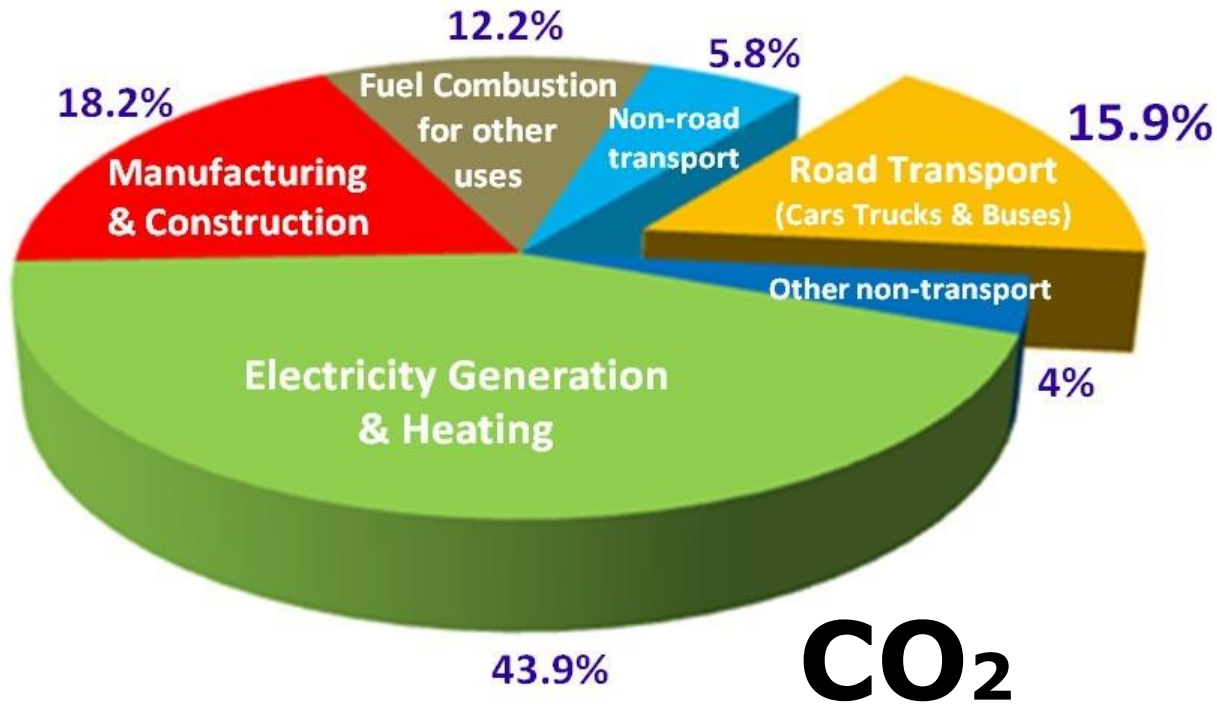
Zero Emission

Sustainable EV Fleet Solutions

Demonstrate YOUR sustainability leadership through:

- From reduced greenhouse gas emissions >>>> Zero emissions
- New model of cost effectiveness – EV fleet case studies
- LEED certification- through EV charging stations at your location

Transport is the easiest Segment to Reduce Greenhouse Gas Emissions



CO_2 Emissions

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Choices in Electric Vehicles (EVs)

HEV = Hybrid Electric Vehicle

PHEV = Plug-In Hybrid Electric Vehicle

BEV = Battery Electric Vehicle

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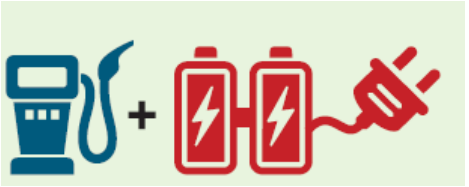
HEVs

HEVs are powered by an internal combustion engine (ICE) and by an electric motor that uses energy stored in a battery.

The battery is charged by the ICE and through regenerative braking, which recaptures some of the energy that is normally lost when braking.

The vehicle cannot be plugged in to charge.

PHEVs



PHEVs are powered by an ICE and by an electric motor that uses energy stored in a battery (larger than the battery in an HEV).

The battery can be charged by plugging in to an electric power source, through regenerative braking, and by the ICE.

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EVs

EVs run on electricity alone.

They are powered by an electric motor that uses energy stored in a battery (larger than the batteries in an HEV or PHEV).

EV batteries are charged by plugging the vehicle in to an electric power source and (to a lesser degree) through regenerative braking.

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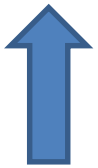
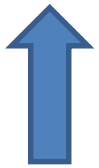
Electric Drive Transportation Association

There were 17,550 plug-in vehicles, including hybrids and plug-in hybrids, sold in March 2017.



40 percent increase over the same month last year.

There have been 40,728 plug-in vehicles sold in the United States January through March 2017.



48 percent increase over the same period last year.

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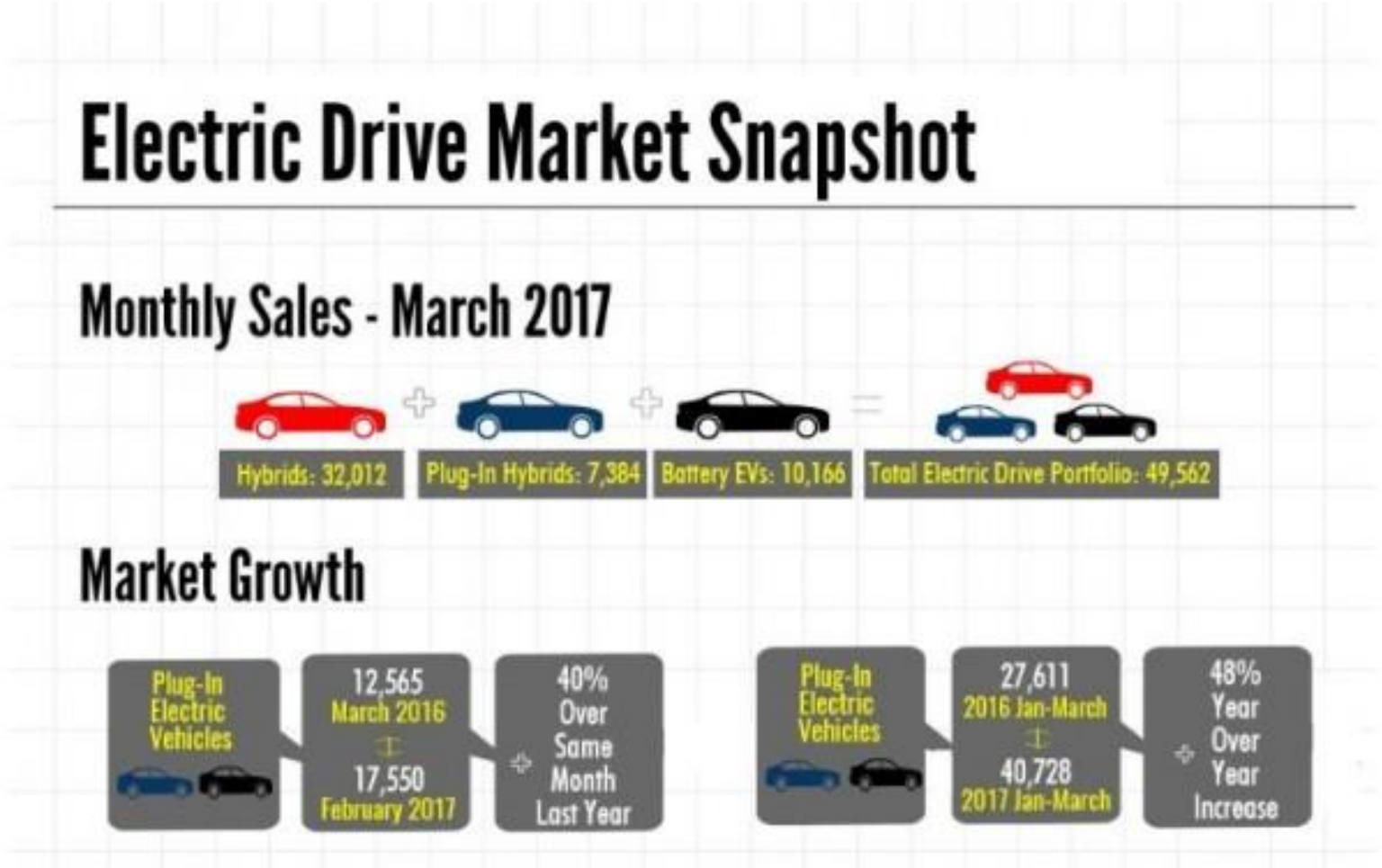
Electric Drive Sales Dashboard



Sales figures sourced from HybridCars.com and direct reports submitted by EDTA member companies.

2017				
Month	Hybrids (HEVs)	Plug-In Hybrids (PHEVs)	Battery (BEVs)	Total Electric Drive (Hybrids+All Plug-Ins)
January	22,584	5,687	5,398	33,669
February	28,355	6,247	5,846	40,448
March	32,012	7,384	10,166	49,562
April				
May				
June				
July				
August				
September				
October				
November				
December				
	Total Hybrid Sales YTD: 82,951		**Total Plug-In Vehicle Sales YTD:** 40,728	**Total Electric Drive Vehicle Sales YTD:** 123,679
			All Vehicle Segment Sales YTD 2017	4,072,257
			Total Electric Drive Market Share	3.04%

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On the Road

598,119

Total Plug-In Vehicles Sold in US Since 2010 Market Introduction

Infrastructure

18,392

Charging Stations, with

47,884

Outlets

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EV Fleets: WHEN they make sense

- Cargo room for local deliveries
- Inter-city/county travel
- Predictable routes with infrastructure availability
- **Usage examples**:

Campus deliveries, meter checking, security routes, parking enforcement, shared pool vehicles and more…

New Model for Cost Effectiveness

Case Studies: EV Fleets in Practice

1

Plug In British Columbia: Modelling vehicles for 9 fleet operators

- BEVs suited 94% of fleet routes
- $15,968 lower TCO per vehicle
- 95% reduction in life-cycle GHG emissions
- Estimated $1,964,148 in financial savings

2

City of Houston: Parking and Zoning Enforcement

- 27 LEAFs in fleet
- Estimated $110,000 savings in first year maintenance and fuel
- 47% utilization rate among 480 drivers

Source: FleetCarma, Electrification Coalition

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Case Study: EV Fleets in Practice

3

City of Seattle : 43 Nissan LEAFs in Fleet

- 17 Reserved for individual users: housing inspectors, parking enforcement, deliveries, etc.
- 26 LEAFs in Employee Motor Pool
  - All with dedicated L2 charging
  - Accessible to all city employees
  - Easy to use online reservation and key kiosk system
  - High utilization by city employees
- Trial Nissan LEAF with DCFC in 2014
- Savings:
  - 375,000 gas free miles & counting
- Charging Costs:
  - To date paid total ~$9000 in power bills averaging $300/month for 26 LEAFs

Nissan LEAF VMTs & Fuel Saved in Gallons by Year

Year	LEAF VMTs	Fuel Saved*
2011	25,068	612.9
2012	149,109	3,645.7
2013	192,561	4,708.1
2014 (Feb)	7,621	186.3
Total	**374,359**	**9,153**

***Assuming 40.9 mpg of Hybrid Prius**

Source: City of Seattle

Information Resources

Clean Cities 2016 Vehicle Buyer's Guide

State Specific Fuel and Vehicle Data www.afdc.energy.gov/stats/

afdc.energy.gov/vehicles/search

Cleancities.energy.gov

Fueleconomy.gov

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Thank you.

The end.

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Electric Vehicle Services for Commercial Properties

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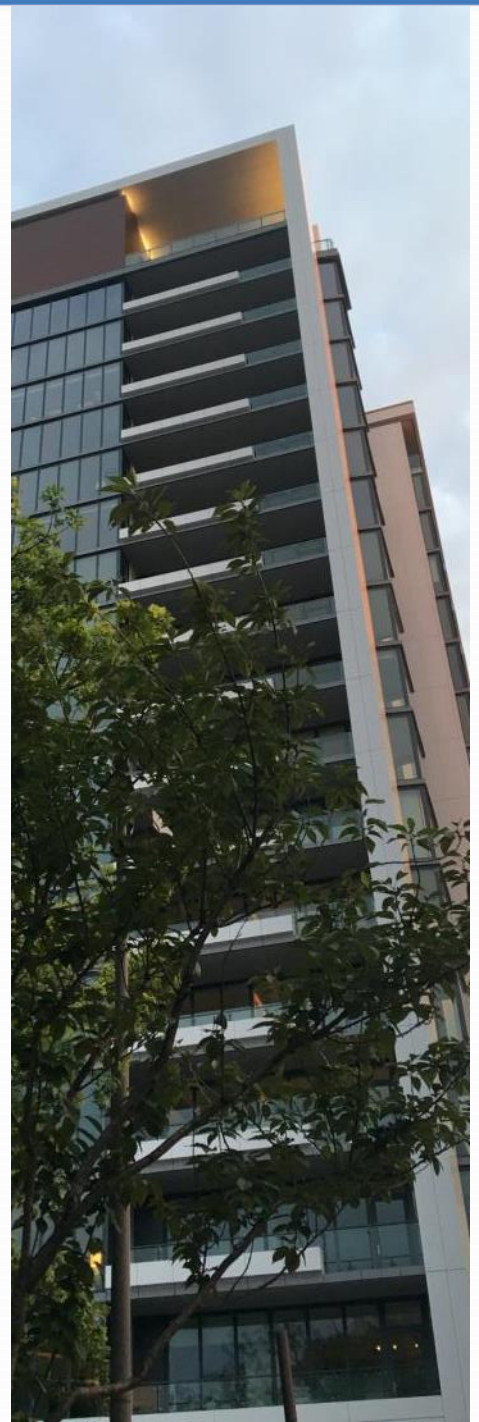
SemaConnect™



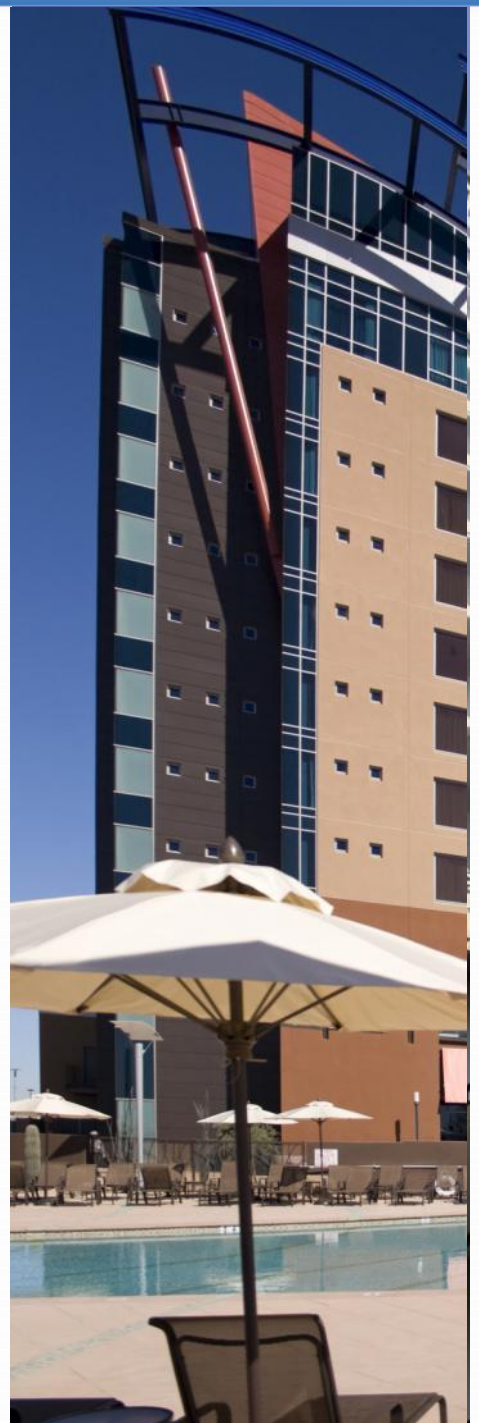
Contents

- EV Charging Basics
- Commercial Property – EV Charging

Electrical Vehicle Charging Standard

A major standard helping to speed adoption of EV's in North America:

- **<u>Standard Charging Plug</u>:** There is a ***standard plug*** for all mass market EV's in North America: **<u>J1772</u>**
  - Developed by Society of Automotive Engineers
  - Used by all major car companies
  - Includes safety features to protect drivers and general public



Electrical Vehicle Charging Standards

Charging Level	Power Level	Rate of Charge	Availability
Level I	120 V, 12 amps	5 miles per hour	All Evs
Level II	240 V, 30 amps	25 miles per hour	All Evs
Fast Charging	480 V, 100+ amps	20-30 minutes	Select EVs

Commercial Property
EV Charging Services

The Solution: Commercial EV Charging Station

Key Commercial Requirements

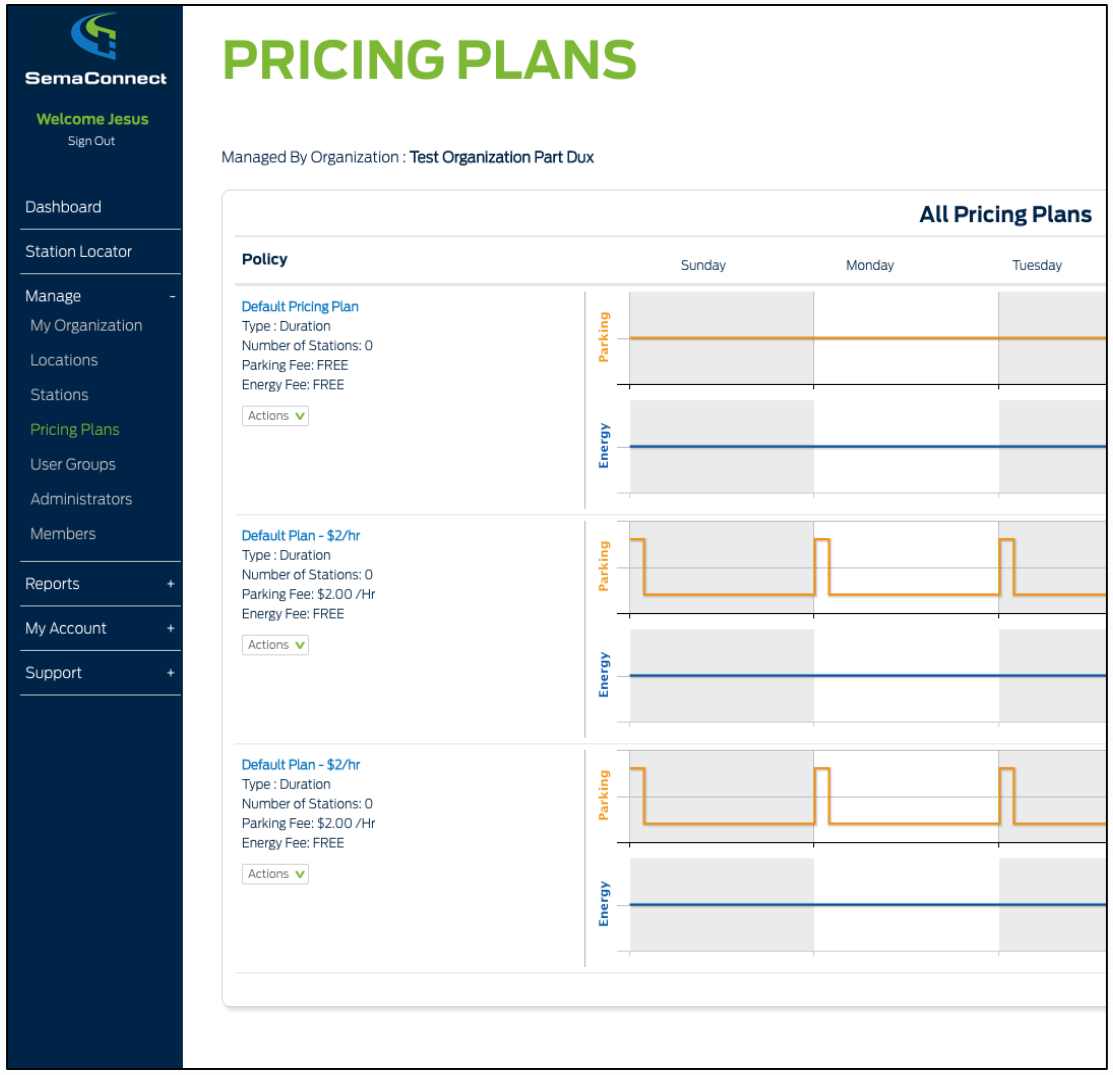
- Dumb vs Smart
- Cloud-based station management
- Access Control
- Revenue Capture / PlugShare
- Enable Sharing
- Ease of Service

The Solution: Commercial EV Charging Station

Enclosure / Physical Features

- Sleek and compact form factor
- Rugged outdoor-rated enclosure
- “At-a-Glance” LED status
- No assembly required

Station Management Software



Configure Your Program

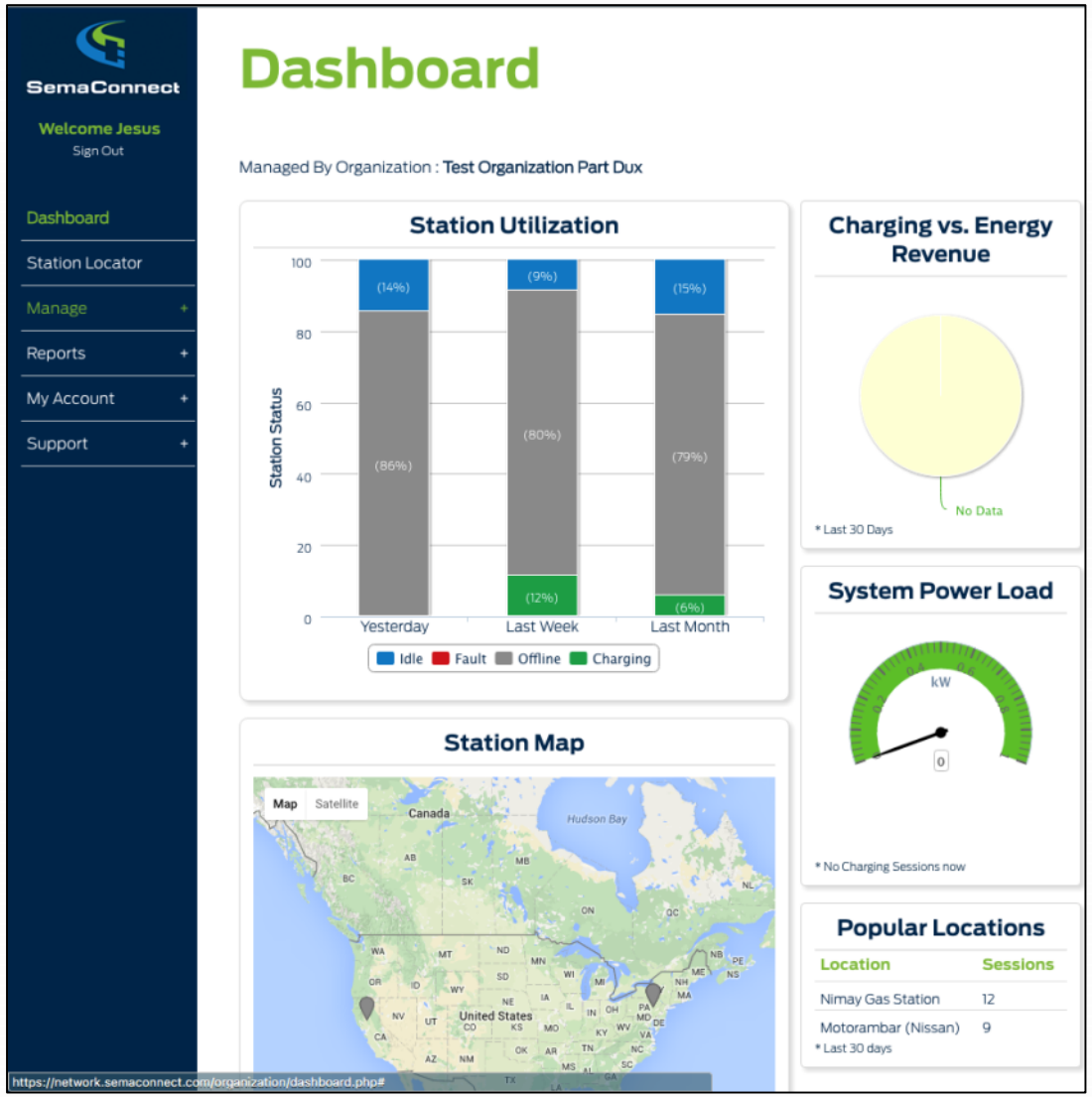
Pricing Policy: Easily implement desired pricing policy using 3 pre-packaged programs

- Duration-based Pricing
- Time-of-Use Pricing
- kWh Pricing

Access Policy: Easily establish desired access policy using pre-packaged member groups

- Public, private, or multi-group access
- Public station can be listed in popular public mapping services
  - Web-based
  - Smart phone apps,
  - Electric car navigation screens

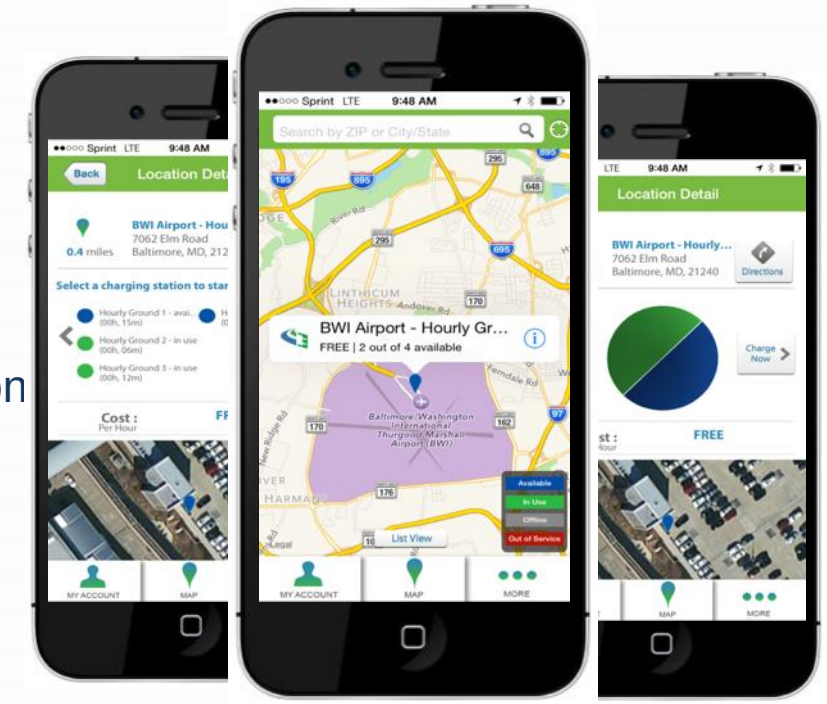
Station Management Software



Monitor Your Program with Usage Reports

- Transaction
  - Detailed per session data
- Energy
  - kWh's delivered & electricity cost
- Revenue
  - Driver revenue captured, organized by station group
- Utilization
  - Station utilization, organized by station group
- Daily Usage Analysis
  - Usage frequency break-down by hour of the day
- Sustainability
  - Carbon offset and fossil fuel reduced reports

Driver Software



Smart Phone Apps

- Find public stations
- Check real-time availability of station
- Start and pay for sessions
- Get sharing alerts

Account Software

- Set up preferred messaging alerts (via email or text)
- Provide credit card information for automated station payment
- Monitor charging session history (including fees incurred, energy delivered)

Installation Requirements

1. Two-pole 40 amp breaker

- Install in low voltage 120/208 or 120/240 panels

2. Dedicated circuit for each station

- Size wire to carry a maximum of 30 Amps

3. May want to increase conduit size for expansion

- May install 2 stations but have conduit ready for 6

4. Data communications

- Wireless with SemaConnect

5. Permitting

- Permit authorities are increasingly treating charging stations as a typical commercial appliance

Financial Considerations

Driver Usage Fees

- No market pricing yet
- Varies by customer:
  - Employer
  - Commercial Office / Multi-Family
  - Retail

Electricity Cost

- 6.6 kWh or $0.79/hour at $0.12 kWh rates
- MD and VA can just mark up their kWh rates

Income

- Greatly varies, the real benefits / ROI are:
  - Keeping / attracting employees
  - Keeping / attracting tenants / residents
  - Attracting drivers to parking space

Thank You!

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EVs and EV CHARGING 101

Plugging Into Maryland's EV Future

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Panel Topics

EVSE Levels/Types and Best Practices

Traveling Out of State – What's happening outside of Maryland?

Innovative Partnerships

Charge Levels and Best Practices

AC

LEVEL I

120Vac @ 8A - 16A
.96kW – 1.9kW

- Tied to a standard 120V circuit.
- Load selection dependent on vehicle settings and on-board charger (8A, 12A, 16A)
- Charge Times from Empty:
  - 2017 Volt: **13 hours**
  - 2017 LEAF: **16 hours**
  - 2017 Bolt: **31 hours**

LEVEL II

240Vac @ 16A – 80A
3.3kW – 19.2kW

- Tied to a 240V circuit
- Load dependent on EVSE and installed circuit (16A – 80A) and on-board charger (3.3-20kW).
- Most common load is 30A EVSE on 40A circuit.
- Charge Times from Empty:
  - 2017 Volt: **4 hours**
  - 2017 LEAF: **5 hours**
  - 2017 Bolt: **8.5 hours**

DC

LEVEL III or DCFC

20kW – 50kW
50kW – 150kW

- Tied into grid power- 208V or 480V
- Current power outputs of 20-50kW.
- Future outputs of 150kW+
- Most common output is 50kW
- Charge Times from Empty- 25kW:
  - 2017 LEAF: **1.2 hours**
  - 2017 Bolt: **2.5 hours**
- Charge Times from Empty- 50kW:
  - 2017 LEAF: **.6 hours**
  - 2017 Bolt: **1.2 hours**

AC CHARGING

Each vehicle has an on-board charger that converts the AC power into the needed DC power to charge battery cells. The on-board charger dictates the maximum allowable load for charging.

DC CHARGING

The conversion of AC power to DC power occurs in the DCFC. This type of charging bypasses the on-board charger and can therefore allow much higher power levels.

Charge Levels and Best Practices

LEVEL I

Dwell Time:
8+ hours

- Public: long-term parking
  - Airports
  - Public Transportation
- Workplace and MUD
  - Mix LVI's with LVIIs to accommodate short commute drivers without taking up a LVII.
- Fleet
  - Low use fleet vehicles

LEVEL II

Dwell Time:
2 – 8 hours

- Public: 2-4 hour dwell time
  - Hotels, restaurants, mixed retail, public parking.
- Workplace: 4-8 hour dwell time.
  - Generally estimate 4 hours per employee.
  - Open to public after business hours.
- Residential (MUD): 8 hour dwell time scheduled overnight.
- Fleet
  - End of Cycle (EOC) charging i.e. overnight.

LEVEL III or DCFC

Dwell Time:
20 min. – 1 hour

- Public
  - Coffee shops, mixed retail, restaurants, gas stations, rest stops.
- Workplace
  - Supplement LVIIs with 20-25kW DCFC for emergency use.
- Fleet
  - Supplement EOC charging with depot and opportunity charging for emergencies, scheduling issues, and range extension.
  - 45-50kW DCFCs

NETWORKED CHARGERS PROVIDE:

- Access control and alternate access options (RFID, mobile app, customer support).
- The ability to transact payments.
- Session and network data to include vehicle information, net energy and transaction.

PLAN FOR EXPANSION

While wiring your circuits, consider running conduit to possible future charger locations to save on overall installation cost.

What's Happening Outside of Maryland?

Infrastructure Development

Distributed Energy Technology Pilots/Programs

Utility Pilots/Program Filings

Infrastructure Development

Electrify America / VW Settlement

- $1.2B over the next 10 years in ZEV infrastructure outside of CA
- Four 30-month cycles funded at $300M each.
  - Cycle 1 (Q1 2017 – Q2 2019):
    - $250M on charging infrastructure
      - » $200M on nationwide highway fast charging (150kW+)
      - » $50M on community charging (workplace LVII and 50kW DCFC)
    - $25M on public education initiatives

Electrify America Top 16 Metro Area's

1. *Sacramento
2. *San Francisco
3. *San Jose
4. *Los Angeles
5. *San Diego
6. New York
7. Washington DC
8. Chicago
9. Portland
10. Boston
11. Seattle
12. Philadelphia
13. Denver
14. Houston
15. Miami
16. Raleigh

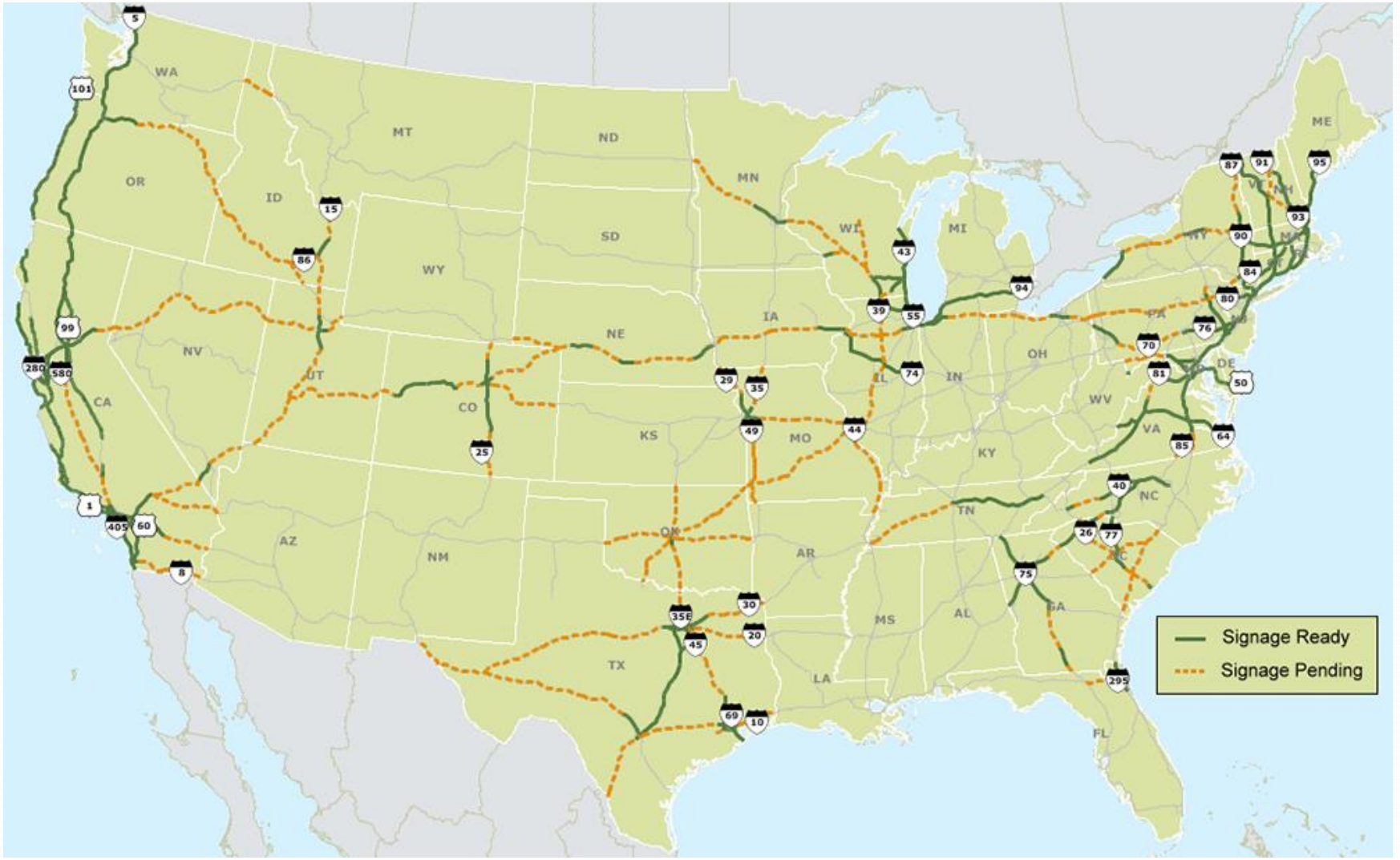
* California Market is separately funded for $800M

Infrastructure Development

National Alternative Fuels Corridors

- Authorized by the Fixing America's Surface Transportation (FAST) Act.
- 55 corridors spanning 35 states- 25,000 miles of highway falling into two categories:
  - **Signage Ready**- sufficient number of refueling facilities to warrant signage.
  - **Signage Pending**- Infrastructure development needed.
  - Distinction is made at 50 mile intervals for EV's.

National Alternative Fuels Corridors



Recent Utility EV Infrastructure Pilot/Program Filings

State	Utility	Budget	Approved Budget/Status	Description
CA	Edison/Southern California	$355M	$22M	1,500 L2 make-ready/rebate workplace, MUD
	Pacific Gas & Electric	$654M	$130M	7,500 L2 utility-owned MUD, make-ready/rebate workplace, MUD
	Sempra/San Diego	$103M	$45M	3,500 L2 utility-owned workplace, MUD
	Edison/Southern California	$573.8M	In Progress	5,000 residential circuits/L1/L2, heavy-duty, make-ready/rebate, DCFC hub, pilots
	Pacific Gas & Electric	$253.2M	In Progress	234 DCFC, heavy-duty make-ready, pilots
	San Diego Gas & Electric	$243.2M	In Progress	90,000 L2 utility-owned residential, heavy duty, DCFC pilots
KS	Great Plains/KCP&L	$5.6M	Denied	315 (KS) L2+DCFC utility-owned
MA	Eversource	$45M	In Progress	4,100 L2, 67 DCFC make-ready/rebate
	National Grid	$24M	In Progress	1,200 L2, 80 DCFC make-ready/rebate
MI	Consumers	$15M	Withdrawn	750 L2, 60 DCFC utility-owned
MO	Ameren	$6M	In Progress	6 DCFC charging islands, utility-owned
	Great Plains/KCP&L			400 L2+DCFC utility owned
OH	AEP-Ohio	$8.1M	In Progress	1,250 L2, 25 DCFC utility-owned workplace/public, residential
OR	Berkshire/Pacific Power	$4.6M	In Progress	7 DCFC charging pods, utility-owned
	Portland General Electric	$8.7M	In Progress	30 DCFCs utility-owned, bus pilot
WA	Avista	$3M	$3M	7 DCFC, 265 L2 utility-owned workplace, public, residential

Pilot: Demand Response-Workplace Charging

Project

DRLC (demand response load control) enabled workplace charging pilot using OpenADR 2.0b with dynamic pricing. 80 Level 2 EVSE that can be curtailed to L1 with dynamic pricing at the point-of-sale across 8 SCE properties in Southern California.

Objective

1. Study real-world usage behavior in response to DR events
2. Determine price elasticity of workplace charging users
3. Observe minimum size of EV fleet for impact on DR program

Timing

Pilot concluded 2016, SCE now expanding to approximately 200 charge stations

Greenlots with Control Module Industries provided the turn-key Level 2 charging system with ADR capabilities.

Upon plug-in, users choose between 3 prices: High for maximum charge, Medium for maximum charge but curtailed to L1 when called, Low for maximum charge and curtailed to zero when called. This pricing is pushed day-ahead to all payment kiosks and web software across locations. Users may also use the mobile app or check the Greenlots portal for the latest pricing and information about the DR event.

When a DR event is called, users have the option to pay a fee to opt-out, unless it is an emergency event. Users are notified via SMS and email during events about the severity and duration.

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Pilot: Demand Response-Workplace Charging

Customer selects station # to use

Select charging fee: Peak or off-peak L1 or L2

Select DR event pricing: Curtail to L1 Curtail to zero No curtailment

Swipe credit card and enter mobile # for notifications.

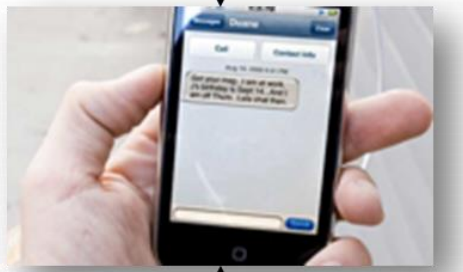
Plug-in and charge!

DR event starts, charging pauses

DR event ends, charging resumes

Charging finishes. Customer notified to move vehicle

If vehicle remains, "parking fee" is applied



Pilot: Storage-Integrated Charging

Project
DCFC with integrated storage to limit demand on grid. Greenlots provided the network management and software integration, including monitoring of battery data

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Objective
1.Deploy a storage supported 50kW DCFC with max 23kW grid demand

2.Observe performance of DCFC under real world use

3.Assess applicability of overall solution as strategy for demand charge reduction

City of Los Angeles Fleet Electrification

Los Angeles Sustainability Plan (pLAn)

50% of new city fleet vehicles to be electric by 2017. 80% of new fleet vehicles by 2025.

LAPD is the largest fleet in the city and the first department to “go electric” with the first 100 BMW i3s out of 500 EVs in total.

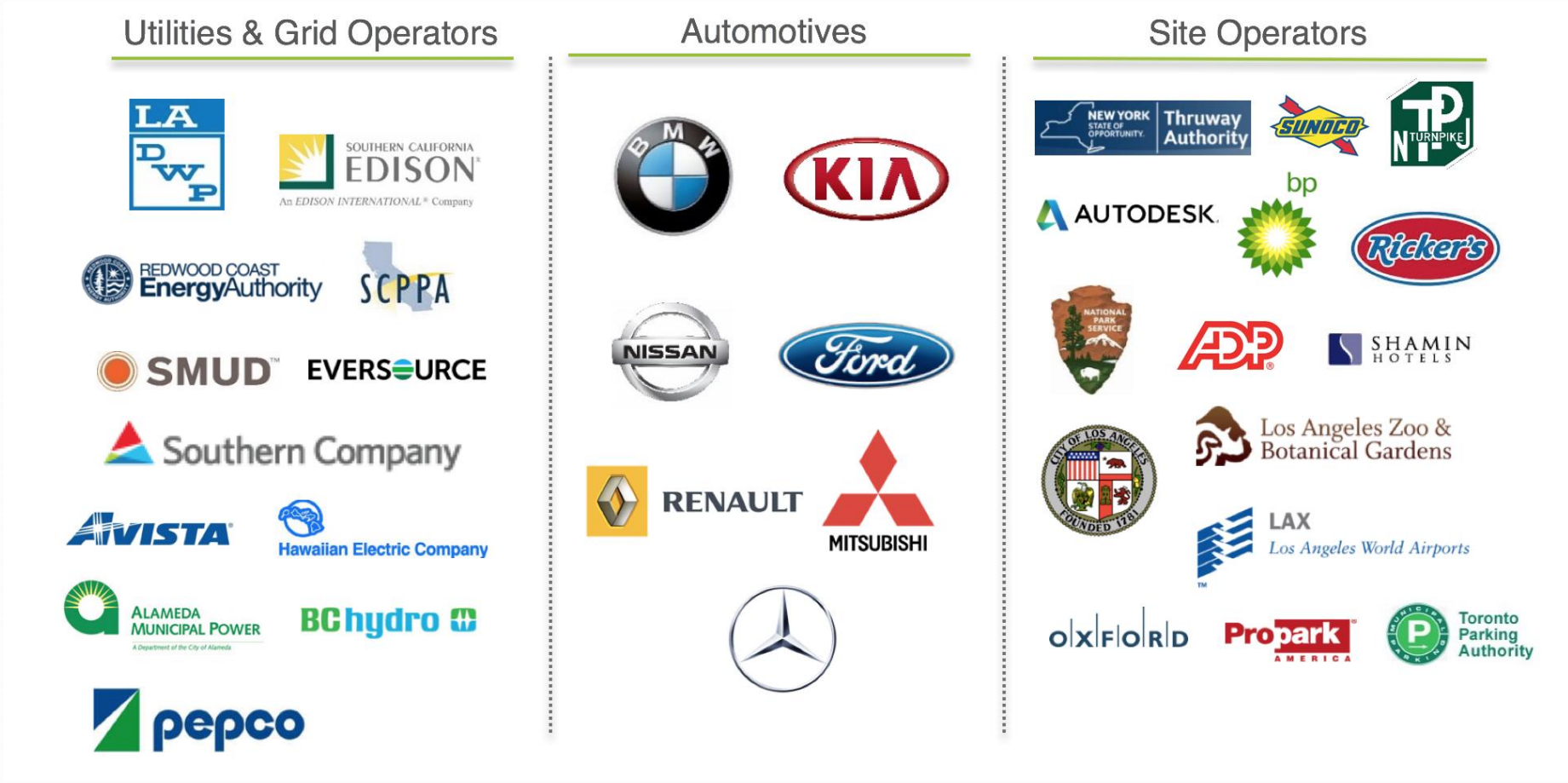
The LAPD charging hub will be a central node that is part of a larger charging eco system.

Building on open standards allows HW to be selected based on specific site requirements.

Efficient Fleet Charging

- 100 Level 2 and 4 DC Fast Chargers at one location
- Load management software avoids expensive electrical infrastructure upgrades and reduces demand charges
- Responds to real-time electricity demand of building
- Charge optimization algorithms with prioritization ensures vehicles are charged when they are needed
- Fleet reporting tracks fleet data, operating cost and efficiencies of an all electric fleet.

Innovative Partnerships

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Questions?