



FEMP FIRST THURSDAY
SEMIN@RS 2.0

What you need to know...online, live, and anytime.

Federal Fleet Infrastructure and Electric Vehicles

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www.femp.energy.gov/training



Learner Objectives

After completing this seminar, the learner will:

1. Explain how electric vehicles fit into overall GHG emissions and petroleum reduction strategies
2. List 4 types of electric vehicles and compare them to other vehicle types in terms of cost and performance
3. Discuss the basic requirements and options for creating or expanding an electric vehicle recharging infrastructure
4. Discuss present and future options for the acquisition of EVs and charging infrastructures
5. Incorporate EVs into multi-year fleet strategies
6. Discuss Federal reporting requirements for EVs
7. Access FEMP resources for EVs and EV infrastructures



Agenda

- **FEMP's Fleet Management Program**
- **Why Electric Vehicles**
- **Electric Vehicles and the Federal Fleet**
- **Infrastructure**
- **Acquiring Electric Vehicles**
- **Integrating EVs into a Multi-Year Strategy**
- **Reporting**
- **Resources**

FEMP's Fleet Management Program



FEMP's Fleet Management Program

- Assists Federal agencies with meeting or exceeding requirements for reducing fleet petroleum consumption



FEMP Resources

- **Regulatory guidance**
 - E.O. 13514 Fleet Management Guidance
- **Resources for meeting requirements**
 - E.O. 13514 Fleet Management Handbook
- **Assistance with fulfilling requirements**
 - FAST maintenance, upgrades, training
 - Review of waiver applications, under EPCACT 701
 - Facilitation of agency scorecard submissions to OMB



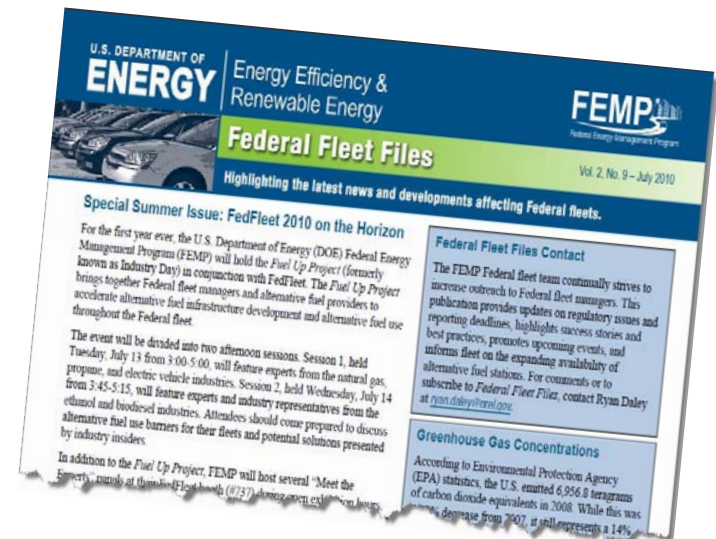
FEMP Resources

- **Technical Assistance with fleet assessments**
 - Vehicle acquisition optimization tool
 - Fuel use analysis tool
 - Station Locator tool
 - Fleet Atlas



FEMP Resources

- Facilitation of alternative fuel use infrastructure development
- Research
 - Vehicle monitoring
- Information sharing
 - INTERFUEL Working Group
 - Federal Fleet Monthly newsletter



FEMP Resources

- Training
 - FedFleet Conference
 - Webinars



Upcoming Guidance on Reporting Electricity for EVs

- Facility energy reporting and fleet fuel reporting are both impacted by electricity used to charge EVs
- FEMP is developing guidance to clarify how to report electricity used to charge EVs
- Guidance anticipated by end of FY 2011
 - Agency input on drafts will be solicited and highly valued



Why Electric Vehicles



Why Electric Vehicles in Federal Fleet: *Benefits*



Petroleum Use

Reduce our dependence on foreign petroleum



GHG Emissions

Source of electricity key factor in scale of reductions



Operating costs

Lower fuel cost per mile and maintenance costs



Support market development

Lead by example in growing the electric vehicle market

Why Electric Vehicles in Federal Fleet: *Challenges*



Acquisition costs

Large price premium for electric vehicles



Availability

Limited production of electric vehicles through 2015

Organizational resistance

New technology requires change

Employee charging

Can the Federal fleet provide charging infrastructure for employees?

Overview of Electric Vehicles



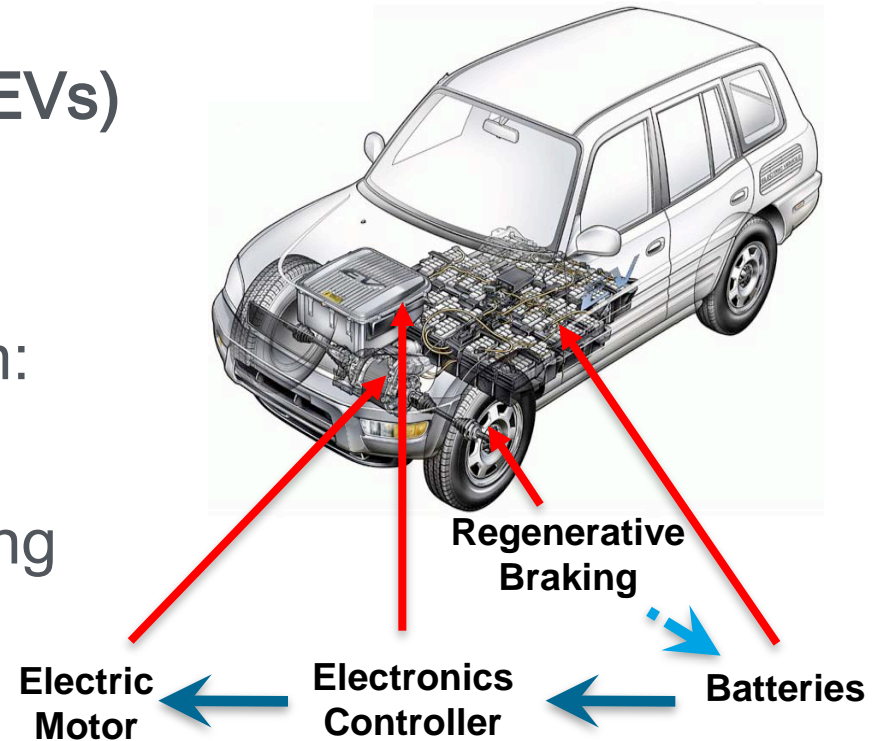
Terminology

EV	Electric Vehicle
HEV	Hybrid Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
BEV	Battery Electric Vehicle
LSEV	Low-speed Electric Vehicle
ZEV	Zero-emission Vehicle
EVSE	Electric Vehicle Supply Equipment
kW	Kilowatt
GHG	Greenhouse Gas

Types of Electric Vehicles

Battery Electric Vehicles (BEVs)

- Electric motor the only power source
- Batteries charged from:
 - Electric grid
 - Regenerative braking



Types of Electric Vehicles



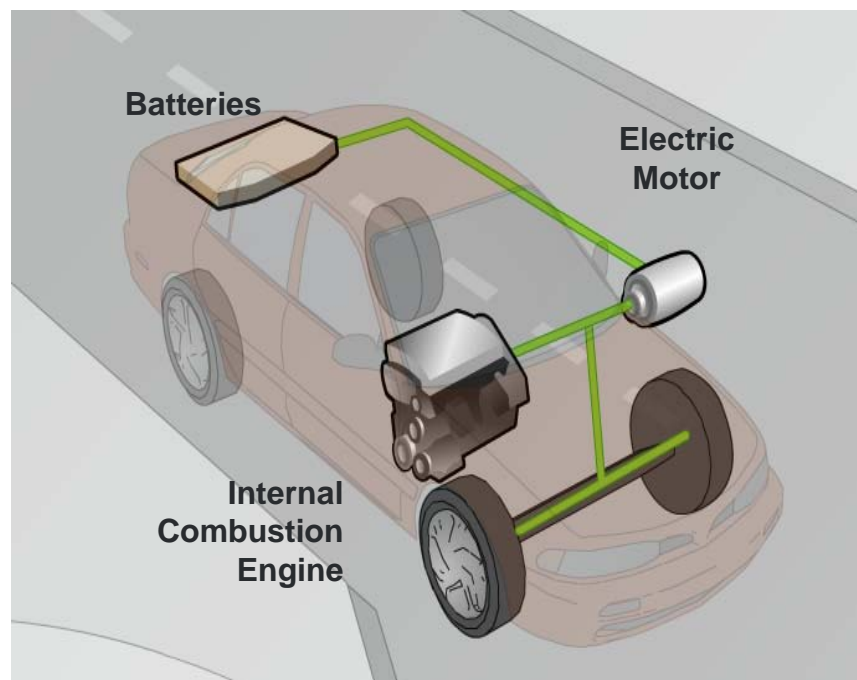
Low Speed Electric Vehicle (LSEV)

- 4-wheeled motor vehicles weighing less than 3,000 pounds
- Top speed of 20 to 25 mph
- Recharge with standard 110 outlet in 6-8 hours
- Not considered vehicles in Federal fleet
- LSEV electricity may be counted in fleet alternative fuel use reporting











Types of Electric Vehicles

Hybrid Electric Vehicles (HEVs)

- Internal combustion engine and electric motor generator
- Recovers kinetic energy from vehicle braking (regenerative braking)
- Electric motor uses the stored energy to assist in powering the vehicle



Hybrid Electric Vehicle Drive Types

	Parallel	Parallel/Series
<i>Braking</i>		
<i>Slow</i>		
<i>Cruising</i>		
<i>Passing</i>		
<i>Stopped</i>		

Types of Electric Vehicles

Plug-in Hybrid Electric Vehicles (PHEV)

- Operates like a **hybrid electric vehicle**
- Can be charged with electricity like a **pure electric vehicle**
- Classified according to their all electric range (PHEV-10, PHEV-40)



Plug-in Hybrid Electric Vehicle Drive Types

Parallel/Series

Series

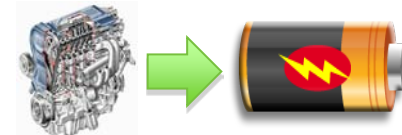
Braking



Initial Range



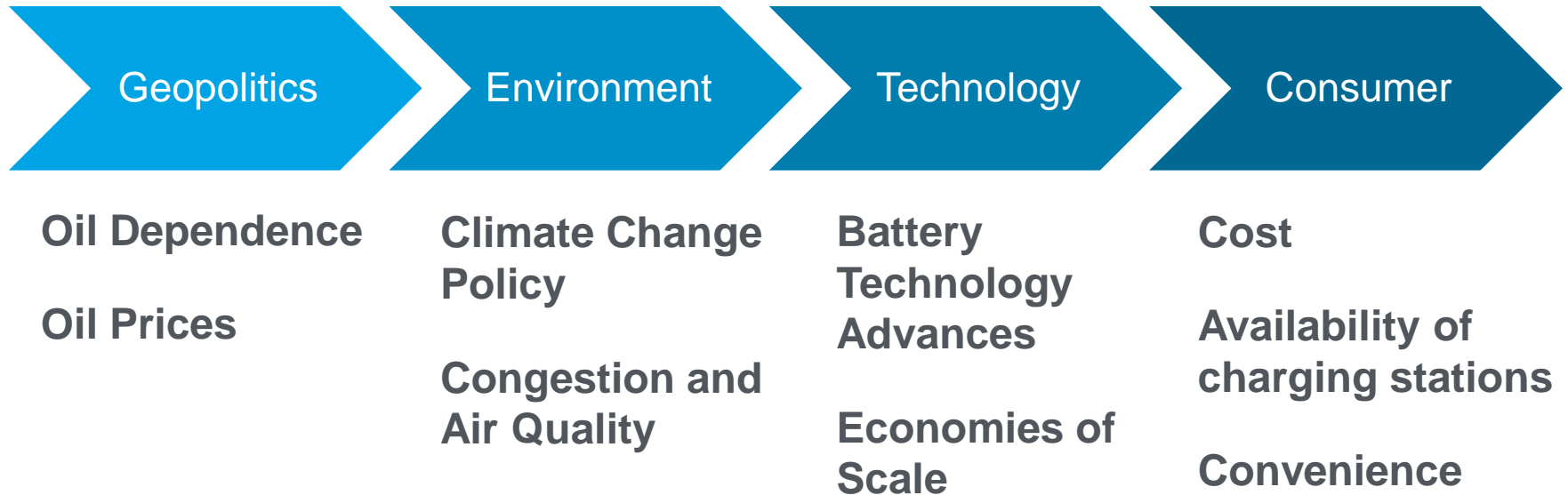
Extended Range



Stopped

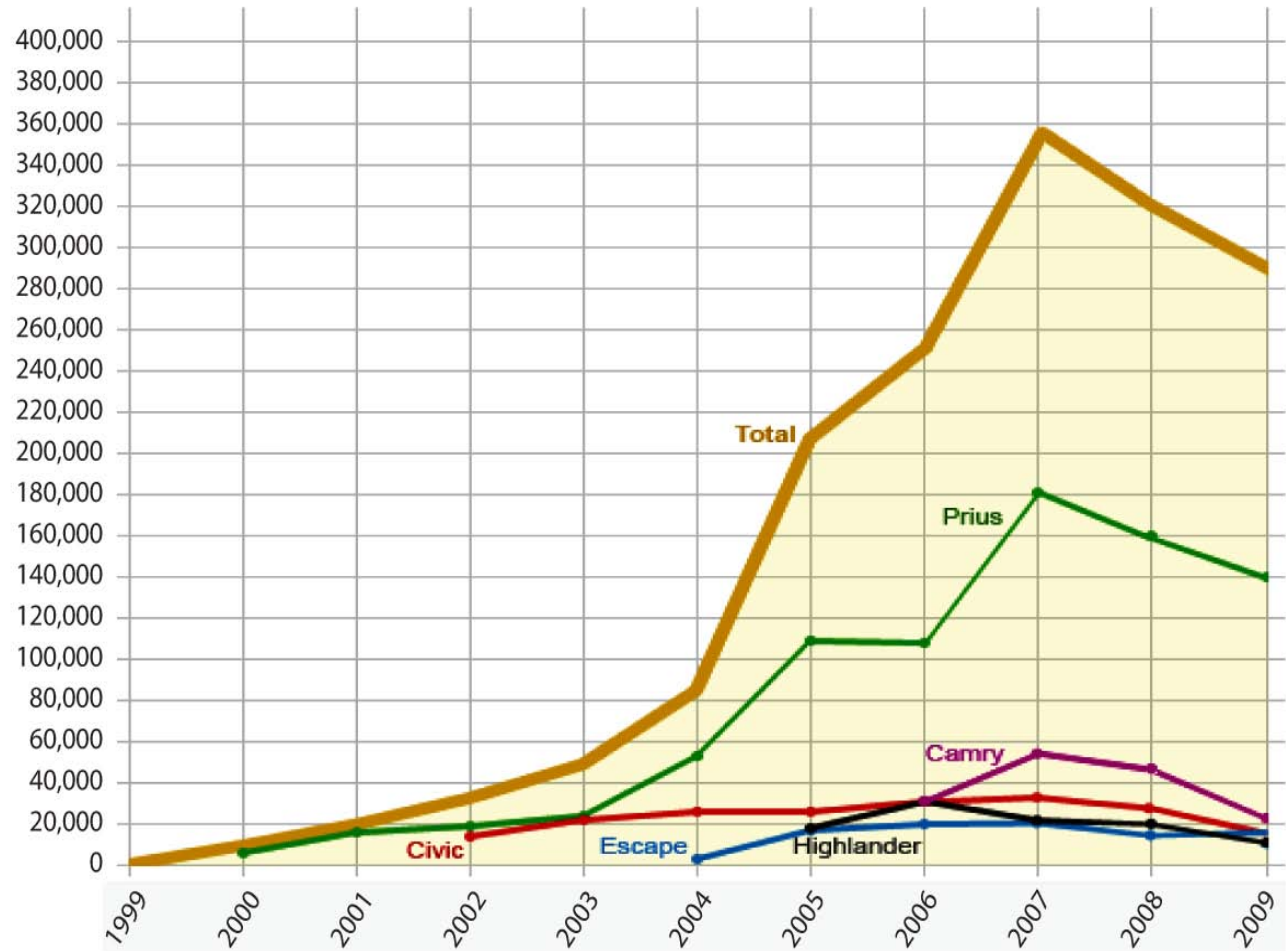


Primary Drivers of EV market growth

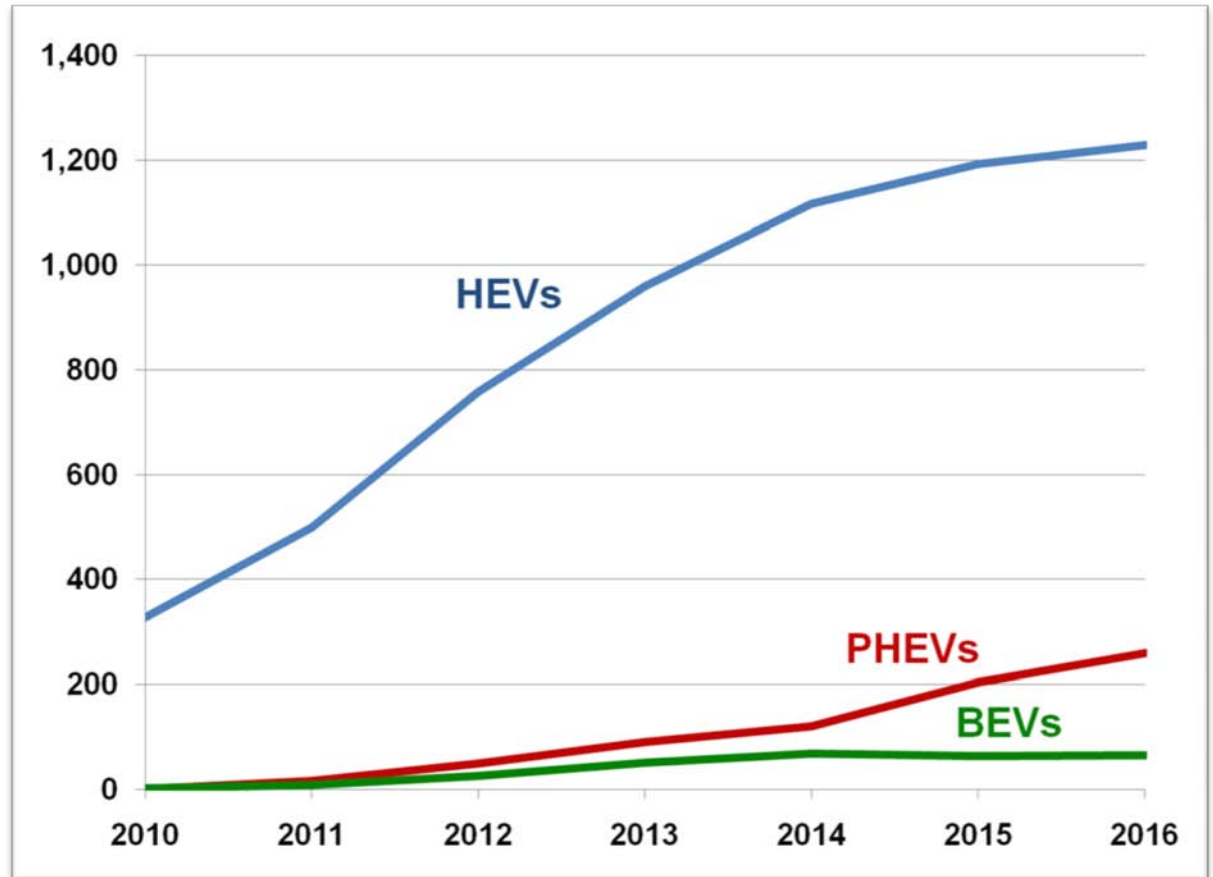


Source: PRTM

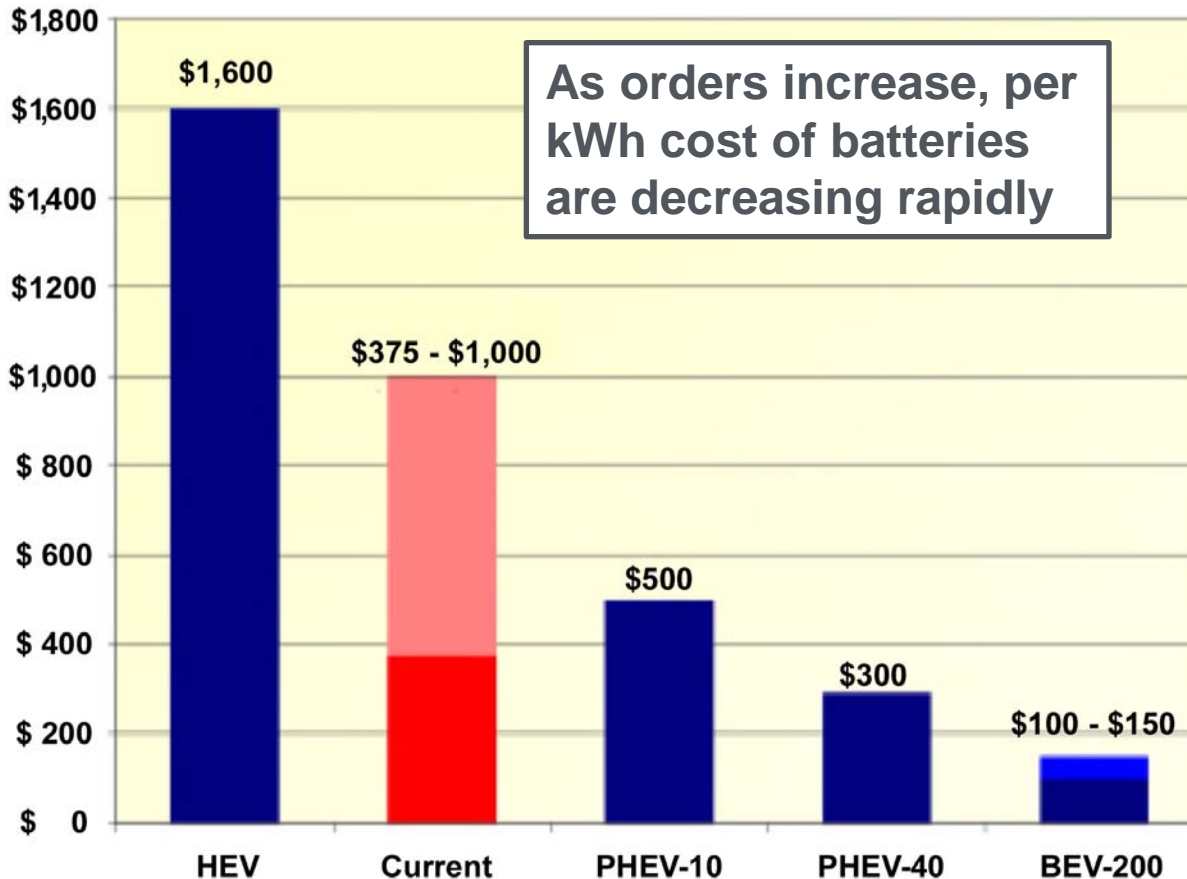
U.S. HEV HISTORICAL SALES (1999 -2009)



U.S. PROJECTED SALES of HEVs, PHEVs, and BEVs

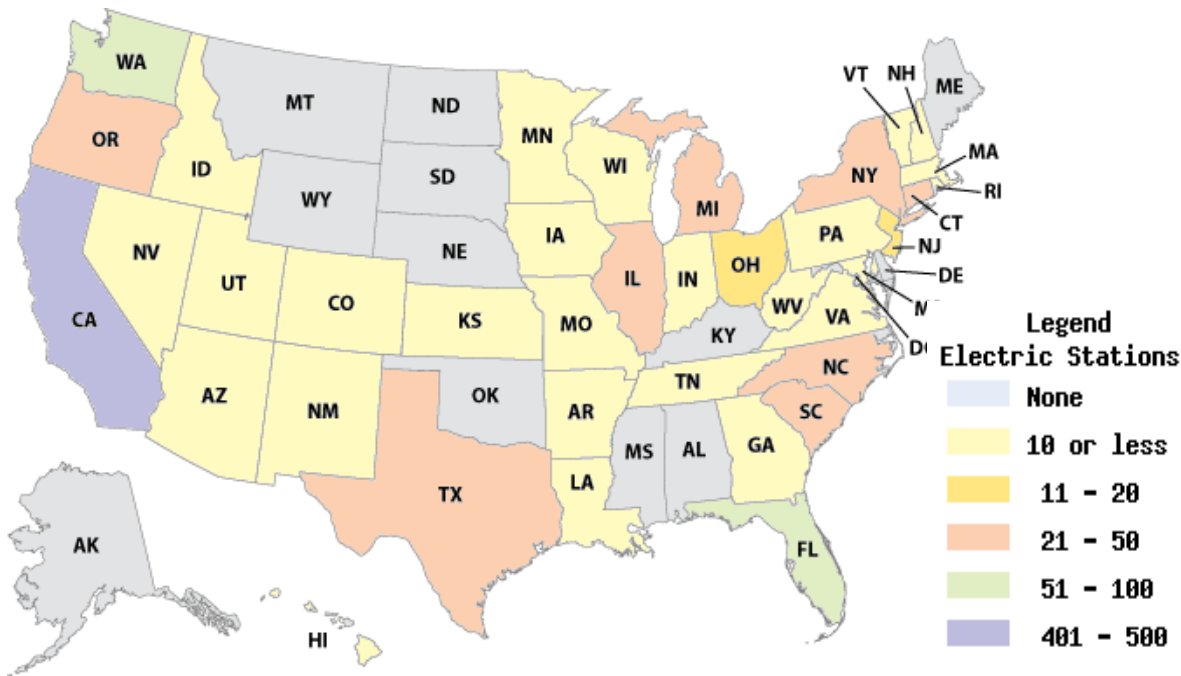


Battery Cost and Performance



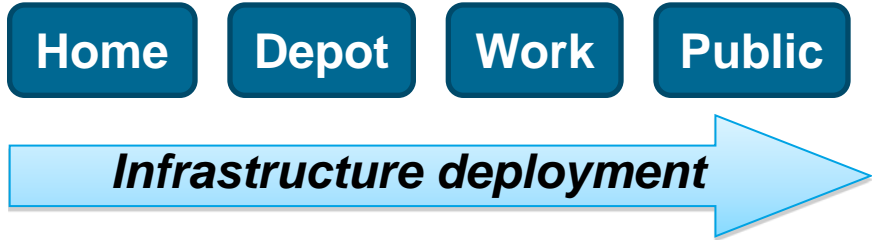
Barriers to commercialization:

- Cost per kWh
- Energy density
- Abuse tolerance
- Life



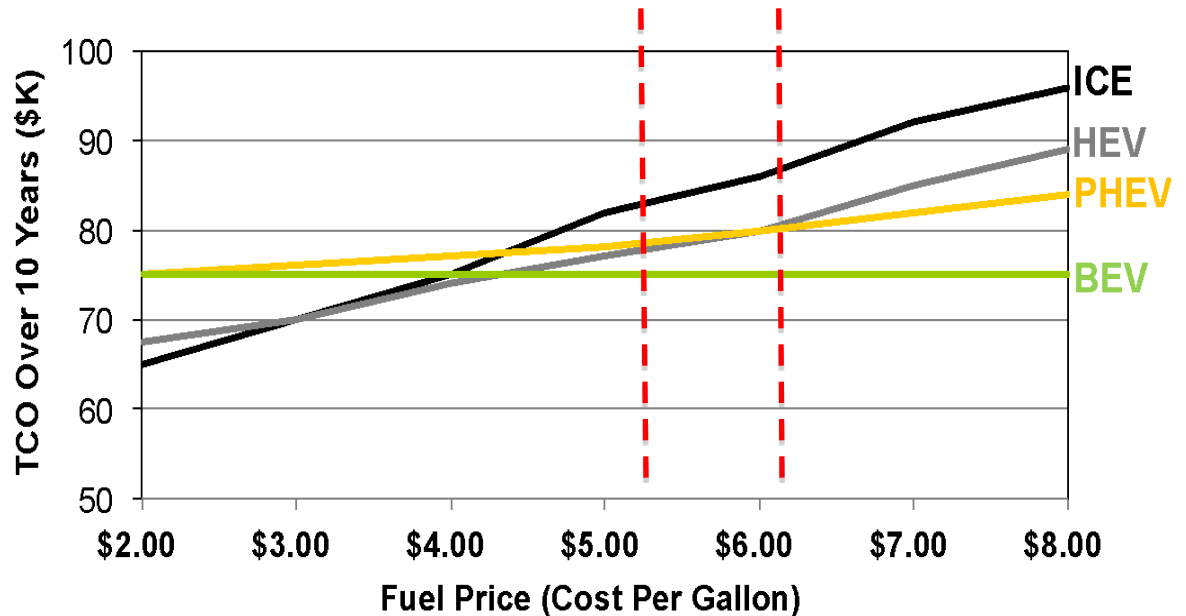
Range Anxiety

- Need 1.8 charging stations/vehicle
- Service station fueling not feasible
- Focus on home and workplace charging
- Drives choices towards PHEVs



Total Cost of Ownership

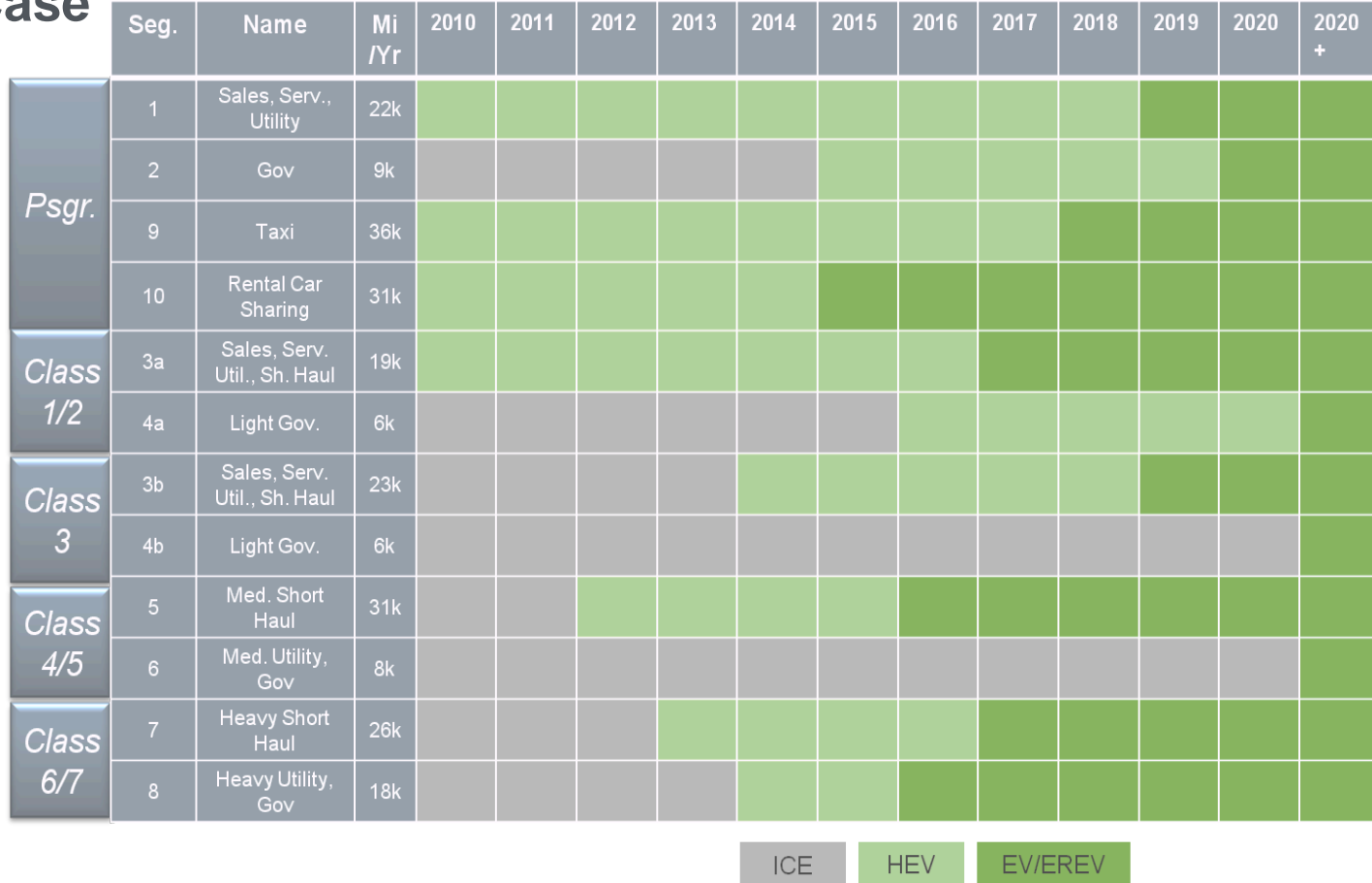
- As fuel costs rise and battery costs decrease, TCO moves further in EVs favor
- HEVs reaching TCO parity today
- BEV/PHEV parity projected to begin after 2016



Source: GE

Base Case

Lowest TCO Drivetrain Technology by Year and Segment



Source: PRTM

EVs and Federal Fleets



Electric Vehicles in Overall Federal Fleet Strategy

Core component of petroleum reduction strategy	Effective at reducing petroleum consumption, especially in locations where alternative fuel is not available
AFV credits where alternative fuel not available	Federal fleets can get AFV credits for acquisition of most EVs
Meet E.O. 13423 alternative fuel use targets	Electricity use (from grid) counts towards alternative fuel use targets
Lower fuel cost	Electricity used in EVs typically costs <\$1 per GGE
Reduce dependence on foreign energy	Almost all electricity is produced domestically

EV and Federal Fleet Requirements

1

AFV Acquisition

- AFVs represent 75% of covered light-duty acquisitions (*EPA Act 92*)
- Use PHEVs when commercially available (*E.O. 13423*)

Electric Vehicle Impact

- EVs receive AFV credits
- GSA will issue fleet order

2

Petroleum Reduction

- 2% annual reduction in petroleum use FY 05 through FY 20 (*E.O. 13514, E.O. 13423, EISA § 142*)

Electric Vehicle Impact

- Use of electricity in EVs displaces petroleum use

EV and Federal Fleet Requirements

3

Alternative Fuel Use

- 10% annual increase in AF use FY 05 through FY 15 (*E.O. 13423*)
- Dual-fueled AFVs use only AF unless waived (*EPA Act 05 §701*)

Electric Vehicle Impact

- Electricity counts towards alternative fuel targets
- TBD

4

Alternative Fuel Infrastructure

- Install renewable pumps at FedFleet refueling centers (*EISA §246*)

Electric Vehicle Impact

- EV charging stations meet requirement (*if sourced with renewable electricity or RECs*)

EV and Federal Fleet Requirements

5

GHG Emissions Reduction

- Acquisition of low-GHG vehicles (*EISA §141*)
- Agency GHG emissions reduction targets (*EO 13514*)

Electric Vehicle Impact

- Almost all EVs are low-GHG vehicles
- Electricity is effective at reducing fleet GHG emissions

6

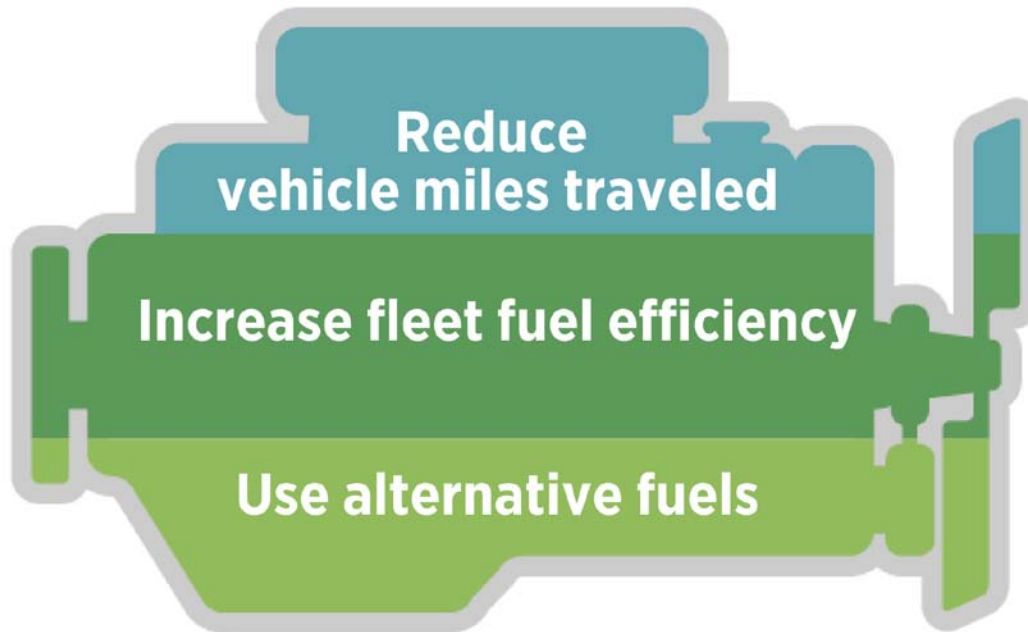
Fleet Planning

- Agency plan to meet sustainability, petroleum and AF goals (*EO 13514, EISA §142*)

Electric Vehicle Impact

- Use of EVs is an important component of fleet planning

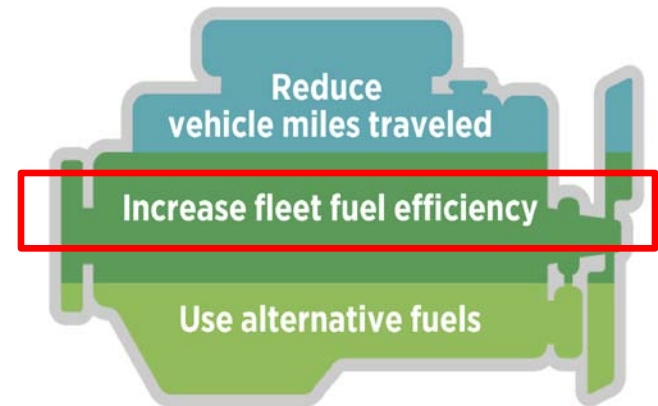
Driving Principles of Petroleum Reduction



Increase Fleet Fuel Efficiency

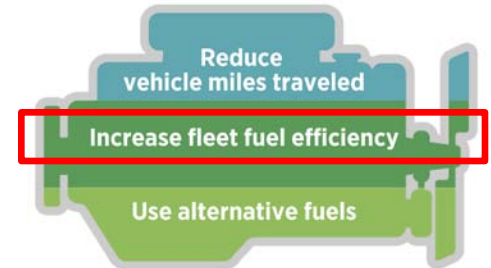
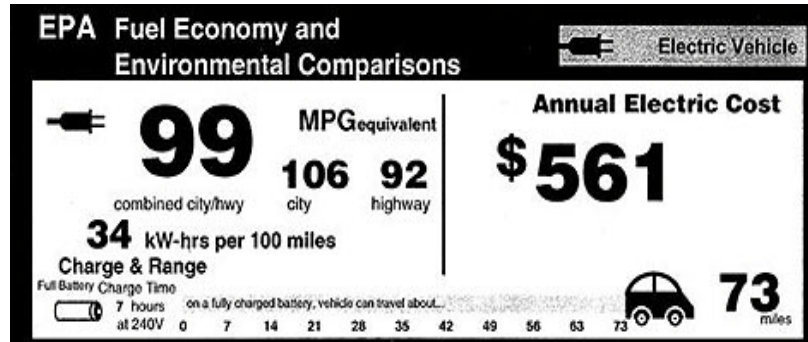
Hybrid electric vehicles

- Can reduce petroleum and GHG emissions by 30% or more
- Locate HEVs in areas lacking access to alternative fuel

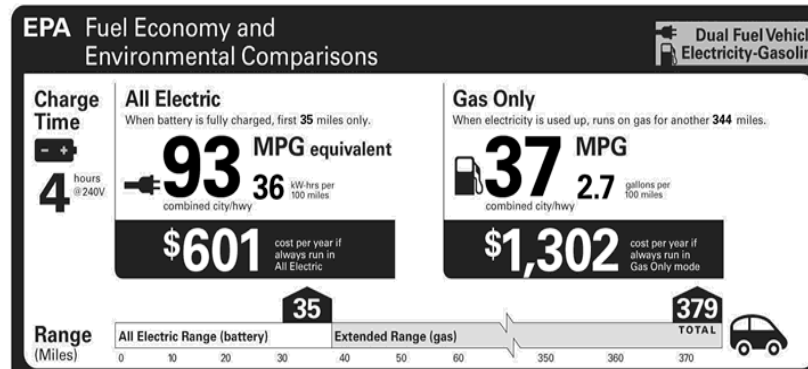


Electricity is More Fuel Efficient

Nissan Leaf
(BEV)

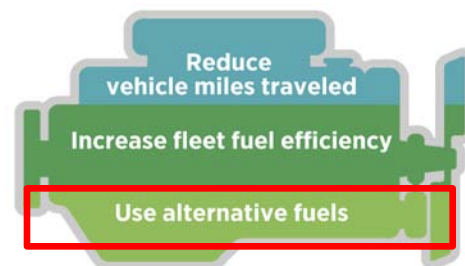


Chevy Volt
(PHEV)



Identifying Optimal Electric Vehicle Strategies

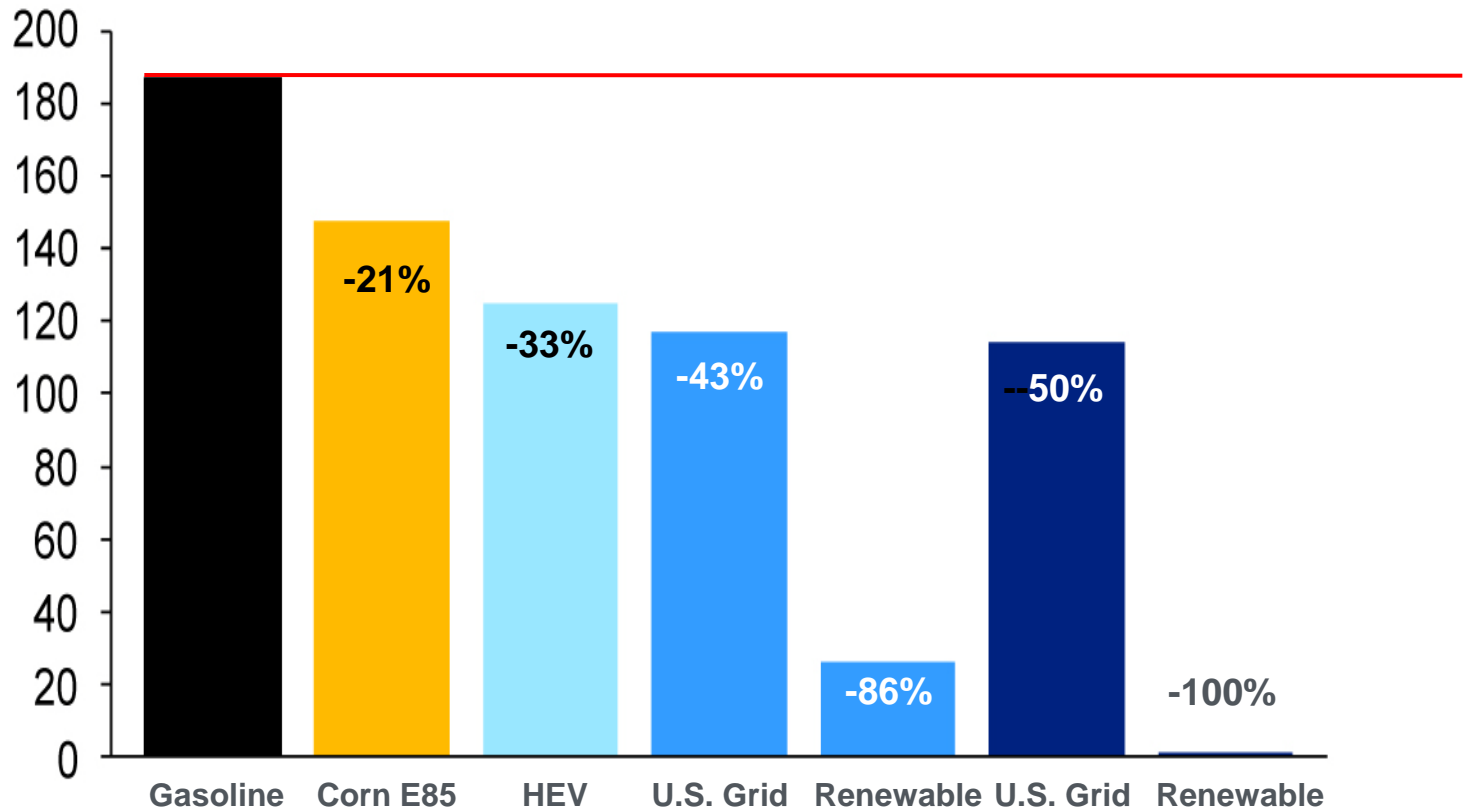
- Step 1:** Identify conventional-fuel vehicles that are *not candidates to be replaced with AFVs or use biodiesel*
- Step 2:** Identify optimal electric vehicle strategies *based on fleet location characteristics*
- Step 3:** *Evaluate availability of EVs* to replace conventional-fuel vehicles
- Step 4:** *Evaluate life cycle costs* for acquisition of EVs













Comparison to Gasoline Vehicles

	HEVs	PHEVs	BEVs	Gasoline
Fuel Economy	+ 50%	+ 210%	+ 230%	~30 mpg
Price Premium	+\$3k	\$6k-\$18k	\$20k+	\$0
Operating Costs	9¢/mi	<6¢/mi	3¢/mi	13.5¢/mi
Range	610 mi	~400 mi	<100 mi	405 mi
Refueling Time	2 min	2 or >1hr	4-8 hr	2 min

CO₂ Emissions



Current Market

	Shopping	Commuting	Traveling	
HEVs				Stop-and-go driving locations Locations without alternative fuel infrastructure
PHEVs		 		Longer range driving needs (>100 mi/day)
BEVs				Shorter range driving needs (<100 mi/day)

FEMP First Thursday Seminars

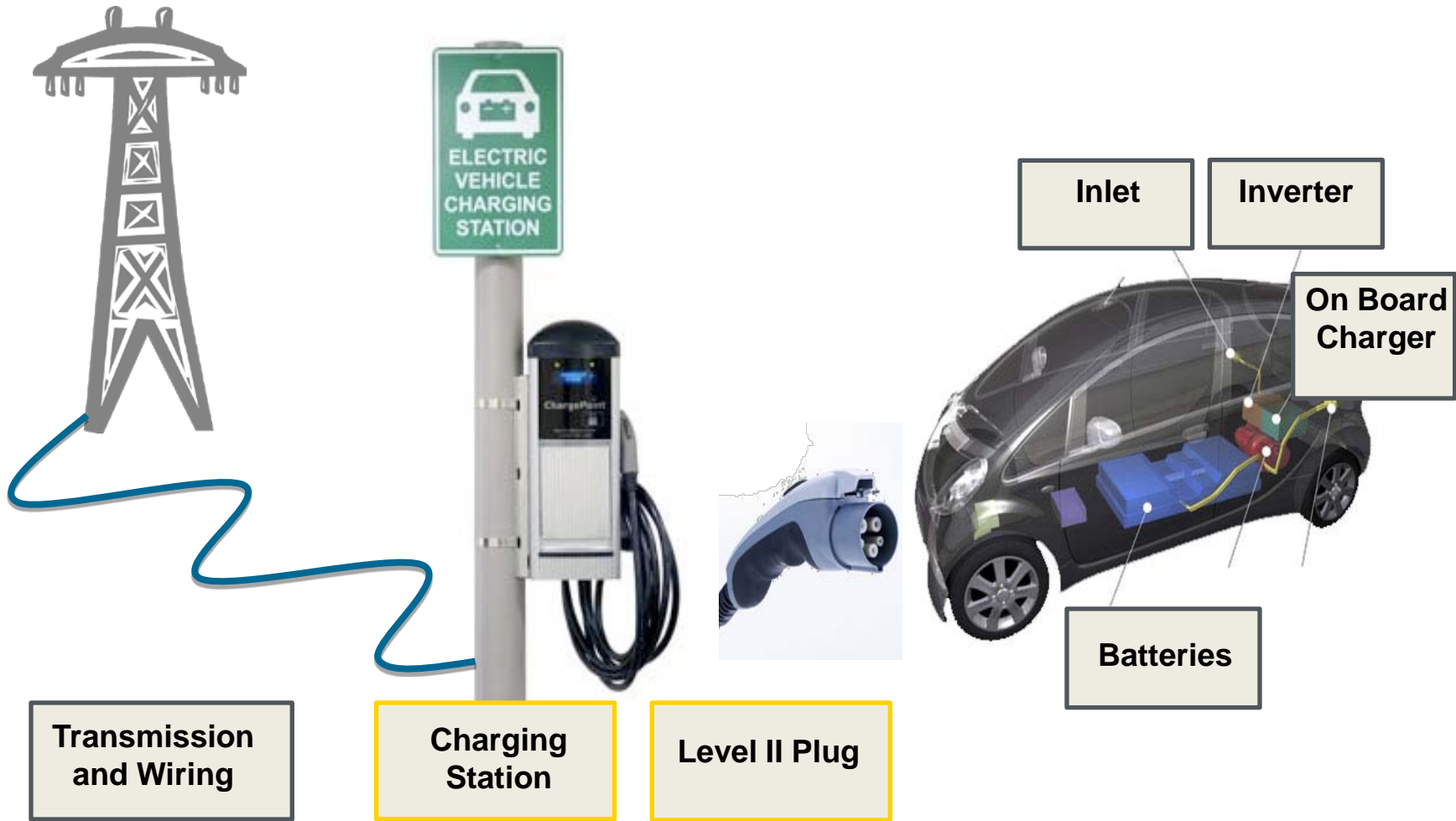
U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy



FEMP 
Federal Energy Management Program

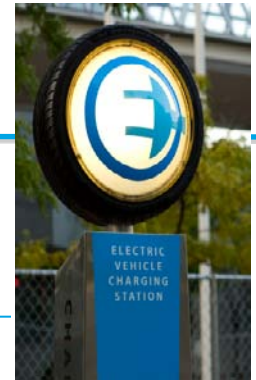
Electric Vehicle Infrastructure Becoming Plug-In Ready





Electric Vehicle Charging Options

	Level 1	Level 2
<i>Outlet</i>	Standard outlet 120 V, 15 A	Dedicated circuit 240 V, 30 A
<i>Charge Time</i>	15-20 hours	4-8 hours
<i>Equipment</i>	Regular outlet, available everywhere	Charging station, installed by electrician
<i>Plug</i>	Included with car	After-market
<i>Best for...</i>	LSEVs and PHEVs w/in 10-20 mile range	BEVs and PHEVs >20 mile range



Electric Vehicle Charging Options

- **Level 3: 480V?**
 - Standards not yet set
 - 15-30 minutes to charge
 - Best for fueling stations and easing range anxiety
- **Battery Swapping**
 - Requires standardized battery packs for vehicles
 - 2-15 minutes to swap
 - Best for fueling stations and easing range anxiety



EVSE Implementation Planning

1 Determine EVSE access

- Public access
- Restricted access
- Open access
- Closed access

3 Identify charging speed

- Long-term parking, irregular use
- Employee charging, daily
- Continual fleet operations

2 Anticipate number of EVs

- Fleet projections
- Other vehicles served

4 Identify EVSE needs

- Other EVSE available?
- Time of use
- Opportunistic vs. scheduled
- # of vehicles simultaneously

EVSE Implementation Site Assessment

- Selection of EVSE location and parking spaces
- Power availability and requirements
- Cord management
- Walkways
- Selection of type/model of EVSE
- Data collection
- ADA considerations
- Area lighting



EVSE Implementation Checklist



- | | | |
|-----|---|--------------------|
| 1) | Decision made to install EVSE | Fleet manager |
| 2) | EVSE specifications identified | Fleet manager |
| 3) | Statement of work drafted | Fleet manager |
| 4) | Installation estimate made | Contractor |
| 5) | Proposals reviewed and award made | Fleet manager |
| 6) | Site plan created; Need for electrical upgrade determined | Contractor/Utility |
| 7) | Permit application filed* | Contractor |
| 8) | Electrical upgrade completed, if required | Utility/Contractor |
| 9) | Power restored | Contractor |
| 10) | Installation | Contractor |
| 11) | Inspection | Inspector |
| 12) | Work completed/Performance verified | Fleet manager |

EV Standards

EV Standards

Vehicle	<i>SAE J2344 – Guidelines for EV Safety</i>
Connector/inlet	<i>SAE J1772 – EV Conductive Charge Coupler</i>
EVSE	<i>UL 2594 – Safety of EVSE (cords, stations, power outlets)</i> <i>NEC 625 – Electric Vehicle Charging System</i>



Infrastructure Costs

- Includes purchase, installation, and maintenance cost components
- Costs vary according to:
 - No. of charging stations
 - Location
(existing wiring, indoor/outdoor, etc.)
 - Average charging stations can range in price from \$500 to \$15,000



Potential Infrastructure Cost Type	Cost (\$)
Charging (and billing) unit	200 – 3,000
Pad Mount	0 – 10,000
Commercial Feeder and Cable Pole	0 – 10,000
Higher Ampage Main Circuit Breaker	0 – 7,500
Termination of fusible switches feeding PHEVs	0 – 20,000
Sawcutting and Trenching	0 – 24,000
Conduit and Wiring	0 – 2,500
Labor	0 – 3,000
Average per charging station	500 – 15,000

Acquiring Electric Vehicles



GSA's Recent EV Contract Award



Chevy Volt PHEV
40 mile all electric range



Think City BEV
113 mile range



Nissan Leaf BEV
73 mile range

Other EVs Available Through GSA



Smith Newton BEV Truck

100 mile range, \$61k incremental

Zero Truck BEV Truck

100 mile range, \$117k incremental



LSEVs through GSA Schedule 23V

GSA's EV Pilot Program

- 116 vehicles acquired
- Leased to 20 agencies
- Five cities
(*D.C., Detroit, LA, SF, San Diego*)
- GSA will assist in installing
EVSE in pilot cities



U.S. BEV Deployment Plans

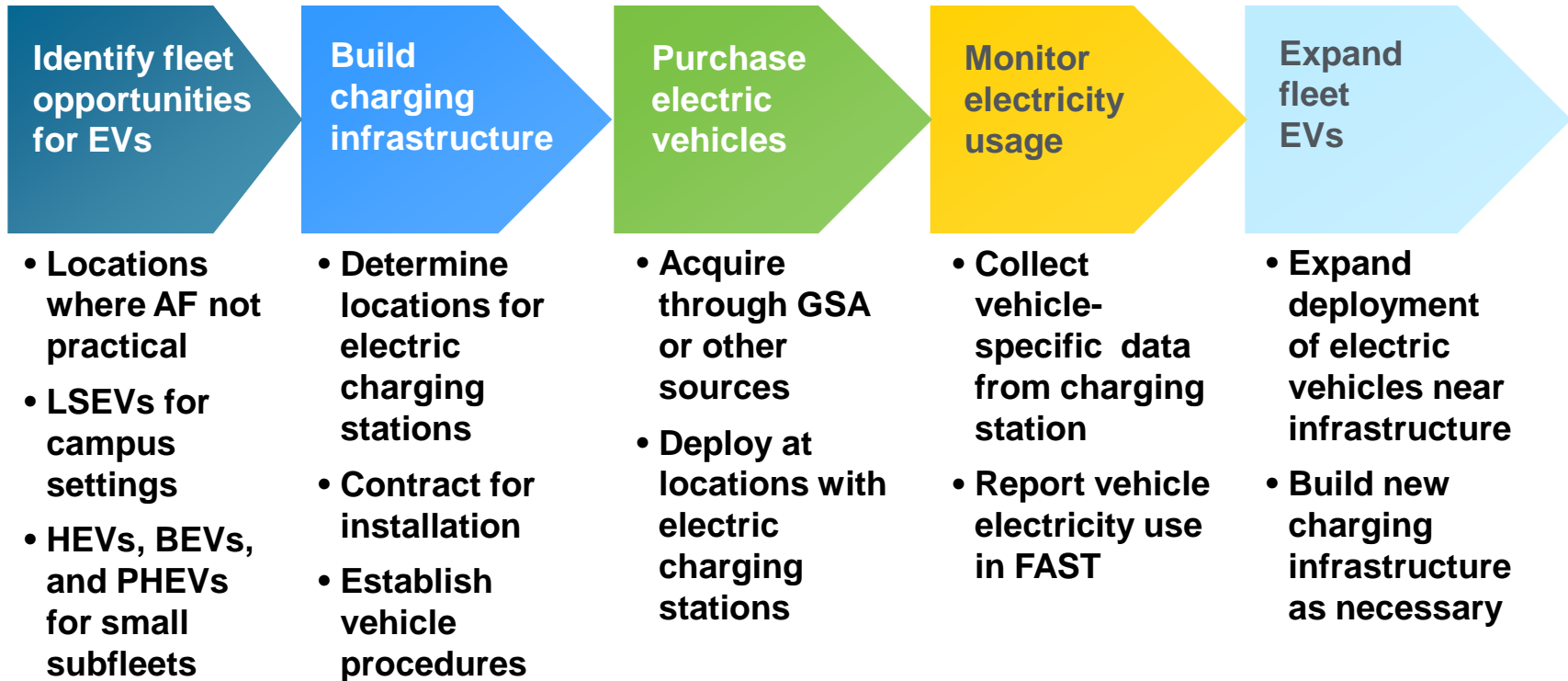
		Electric Range (mi)	U.S. Target Intro. Date
Nissan	Leaf	73	2010
Ford	Transit Connect Electric	100	2010
Tesla	Roadster Sport 2.5	245	2010
Ford	Focus Electric	100	2011
Mitsubishi	iMiEV	70-100	2011
Wheego	Whip LiFe	100	2011
TH!NK	City	113	2011
Coda	Sedan	90-130	2011
BMW	ActiveE	100	2011

U.S. PHEV Deployment Plans

		All Electric Range (mi)	U.S. Target Intro. Date
Chevrolet	Volt	40	2010
BYD F3DM	Plug-in Hybrid	60	2011
Toyota	Prius Plug-in Hybrid	12.4-18.6	2012
Ford	Escape Plug-in Hybrid	40	2012
Fisker	Karma S Plug-in Hybrid	50	2012
Bright	IDEA Plug-in Hybrid	40	2012
Ford	C-MAX Energi	TBD	2012

Integrating EV into Multi-Year Fleet Strategy





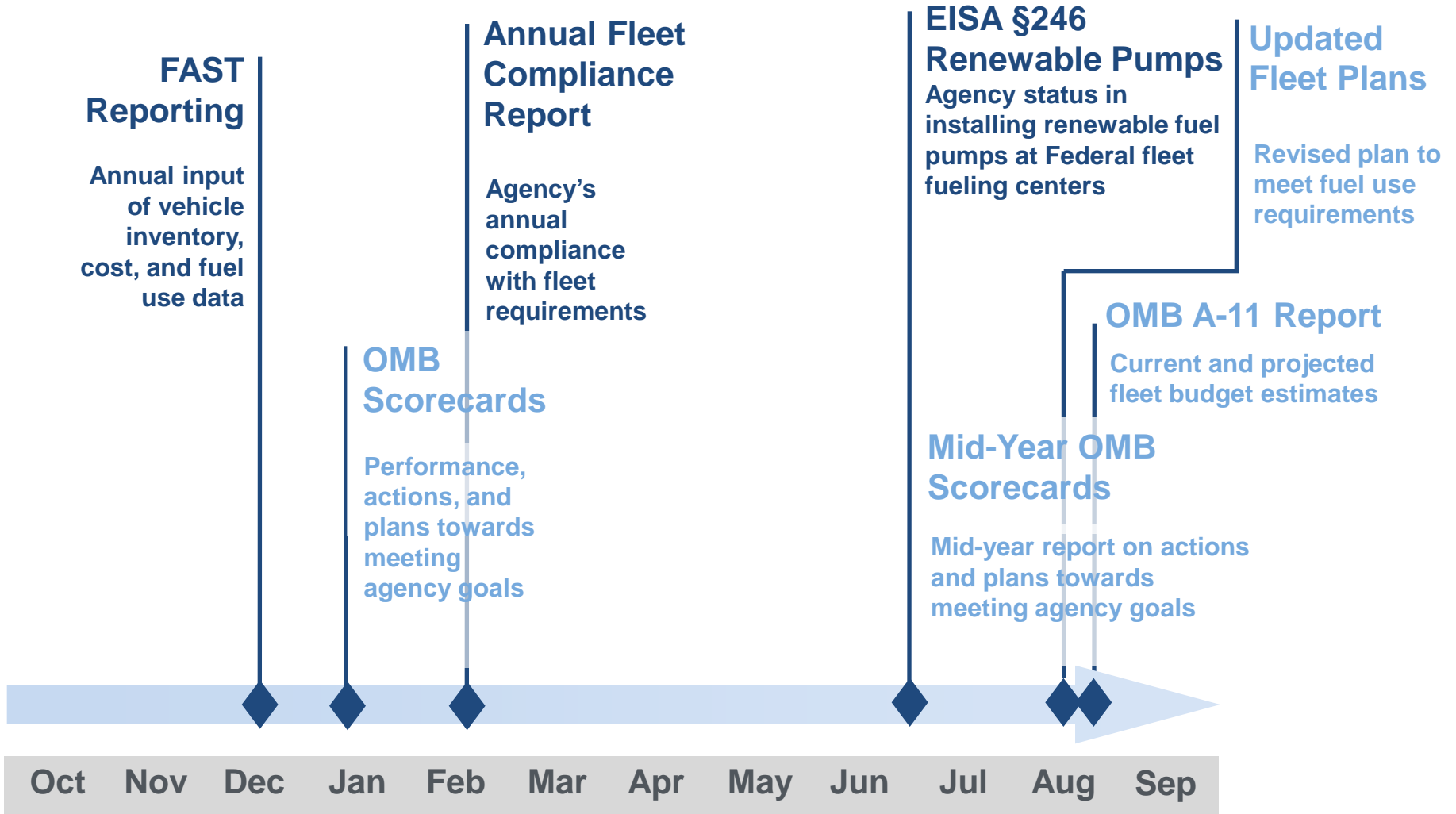
Getting Ready

- Are EVs right for my fleet? What type?
- How many stations will I need?
- When and how will I acquire EVs?
- Who will install and maintain the stations?
- What is the cost and how will we pay for it?



Reporting Requirements





Reporting Requirements via FAST each December

Reporting Requirement	Electric Vehicles
Alternative Fuel Use	<p><u>BEVs and LSEVs</u> All electricity used to charge BEVs and LSEVs counted</p> <p><u>PHEVs</u> All electricity used to charge PHEVs will be counted (Does not include electricity generated by internal combustion engine or regenerative braking)</p>

Measuring Electricity Used in EV On-Site

Charging Infrastructure

Electricity Use Data

On-site separate infrastructure *with metering capability*

Collect and report **sub-metered electric vehicle consumption data** (provides the most accurate information on electricity use)

On-site separate infrastructure, *no metering capability*

Use **protocols** established through the **measurement and verification standards** used for buildings

Use of **informally-metered data** (e.g., Kill A Watt™)

Use of **vehicle mileage** in conjunction **with a calibrated vendor-provided vehicle efficiency factor** to calculate consumption

Measuring Electricity Used in EV Off-Site

Charging Infrastructure

Electricity Use Data

Off-site charging infrastructure *with reported electricity consumption*

Collect and report electricity consumption on transaction receipt

Off-site separate infrastructure, *without reported electricity consumption*

Use of **vehicle mileage** in conjunction **with a calibrated vendor-provided vehicle efficiency factor** to calculate fuel consumption

Use charging time and kW

Measuring Electricity Used in EV

(Based on 12,000 Annual Miles)

BEV (LEAF) 34kW/100 miles (EPA)

Estimated electricity use **4,080 kWh**

PHEV (Chevy Volt) 36kWh/100 miles (EPA)

Estimated electricity use **4,320 kWh**

LSEV (4 passenger GEM) 16.9 kWh/100 miles (DOE)

Estimated electricity use **2,028 kWh**

EV Acquisition Reporting via FAST each December

Reporting Requirement

Electric Vehicles

Acquisition of AFVs

(Agencies must accumulate 75 AFV credits per 100 covered vehicles acquired within fiscal year)

BEVs are dedicated AFVs

- light duty – 2 credits
- medium duty – 3 credits
- heavy duty – 4 credits

PHEVs are also AFVs (NDAA 08)

- All PHEVs – 1 credit

LSEVs are are not considered vehicles (EPAAct)

- All LSEVs – 0 credits

EISA Section 246 Reporting via FAST Each June

Reporting Requirement

Agencies must install renewable fuel pump at each Federal fueling center in US by 1/1/10

Renewable fuels include E85, B20, and renewable electricity

Electric Vehicles

- Electric charging infrastructure satisfies requirement if:
 - renewable source of energy
 - non renewably generated electricity (if RECs equal to or greater than electricity used)

Acquisition of PHEVs

Reporting Requirement

Agencies must acquire PHEVs when commercially available at a cost reasonably comparable, on the basis of life-cycle cost, to non-PHEVs

Electric Vehicles

GSA will issue a fleet order for PHEVs in all vehicle categories when applicable

Acquisition of Low GHG Emitting Vehicles

Reporting Requirement	Electric Vehicles
<p>Section 141 prohibits Federal agencies from acquiring light-duty motor vehicles and MDPVs that are not low-GHG-emitting vehicles</p>	<p>EPA Green Vehicles Guide provides data to evaluate vehicle GHG emissions</p> <p>All BEVs and PHEVs on EPA's <i>Green Vehicles Guide</i> are low-GHG-emitting vehicles</p>
<p>EPA guidance requires each agency to self-report</p>	<p>LSEVs are not considered “vehicles”</p>

Resources

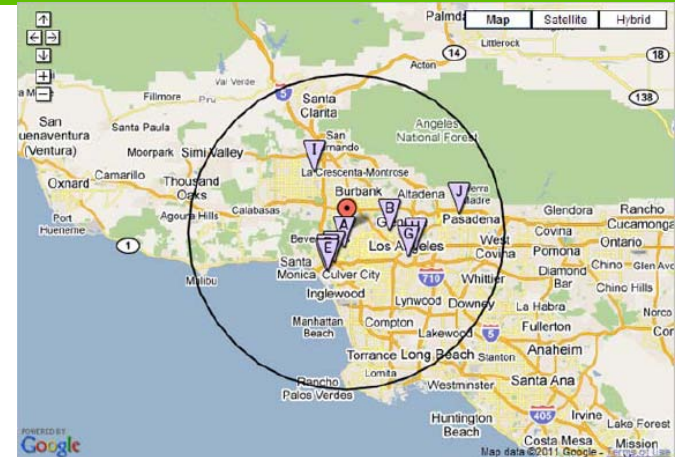


AFDC



Alternative Fuels & Advanced Vehicles Data Center

- Comprehensive geo-database of EVSE locations (*GeoEVSE Forum*)
- Basics of EV vehicles
- Deployment case studies



www.afdc.energy.gov

FedFleet EVSE Project (end of FY11)



FedFleet Guidance and Support

- EVSE implementation
- EV deployment and acquisition
- Best practices and common pitfalls
- Case studies

FedFleet EVSE and EV project surveys

- Share data and lessons learned
- Benchmark costs

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