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Federal Fleet Program and Deployment of Electric Vehicles (EVs) and Charging Infrastructure

Energy Exchange August 9th, 2016

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Federal Energy Management Program
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National Renewable Energy Laboratory

FEMP
Federal Energy Management Program

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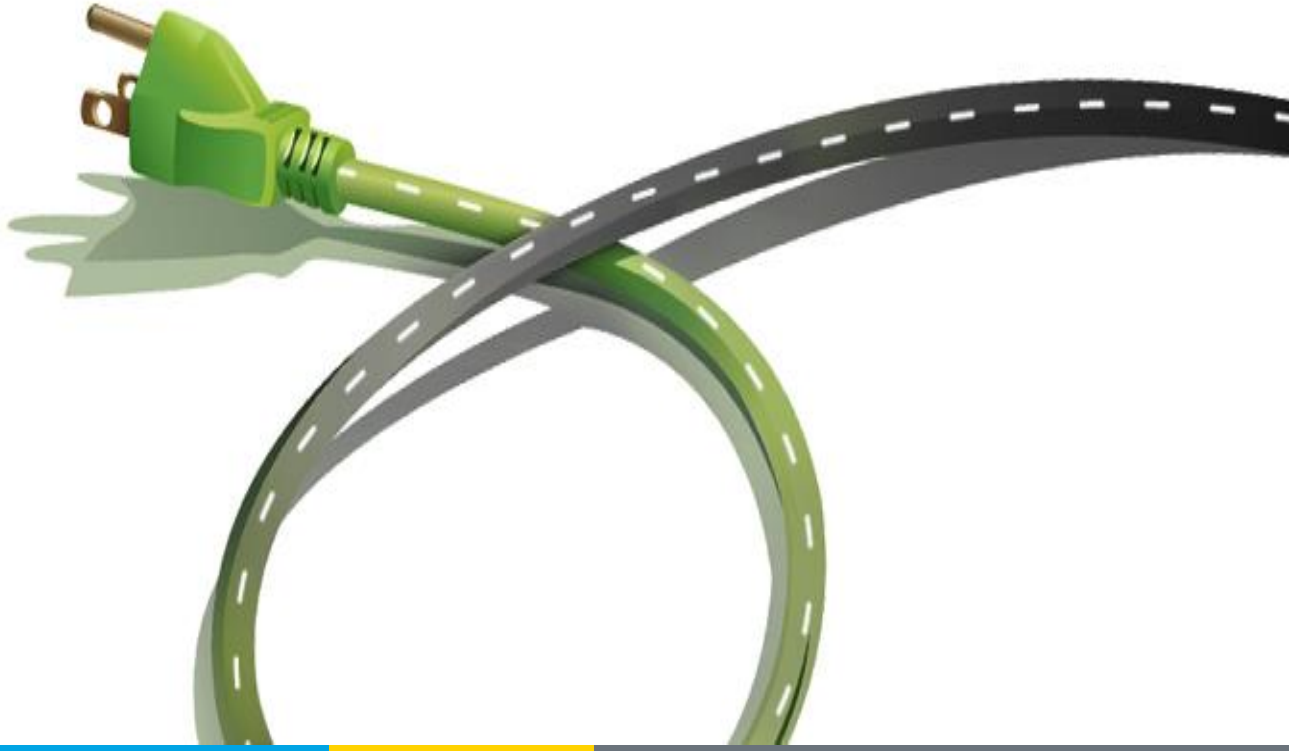
Overview of the Federal Fleet Program



FEMP's Sustainable Federal Fleets Program

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***Mission:* Assist Federal agencies with meeting or exceeding requirements for reducing fleet GHG emissions**

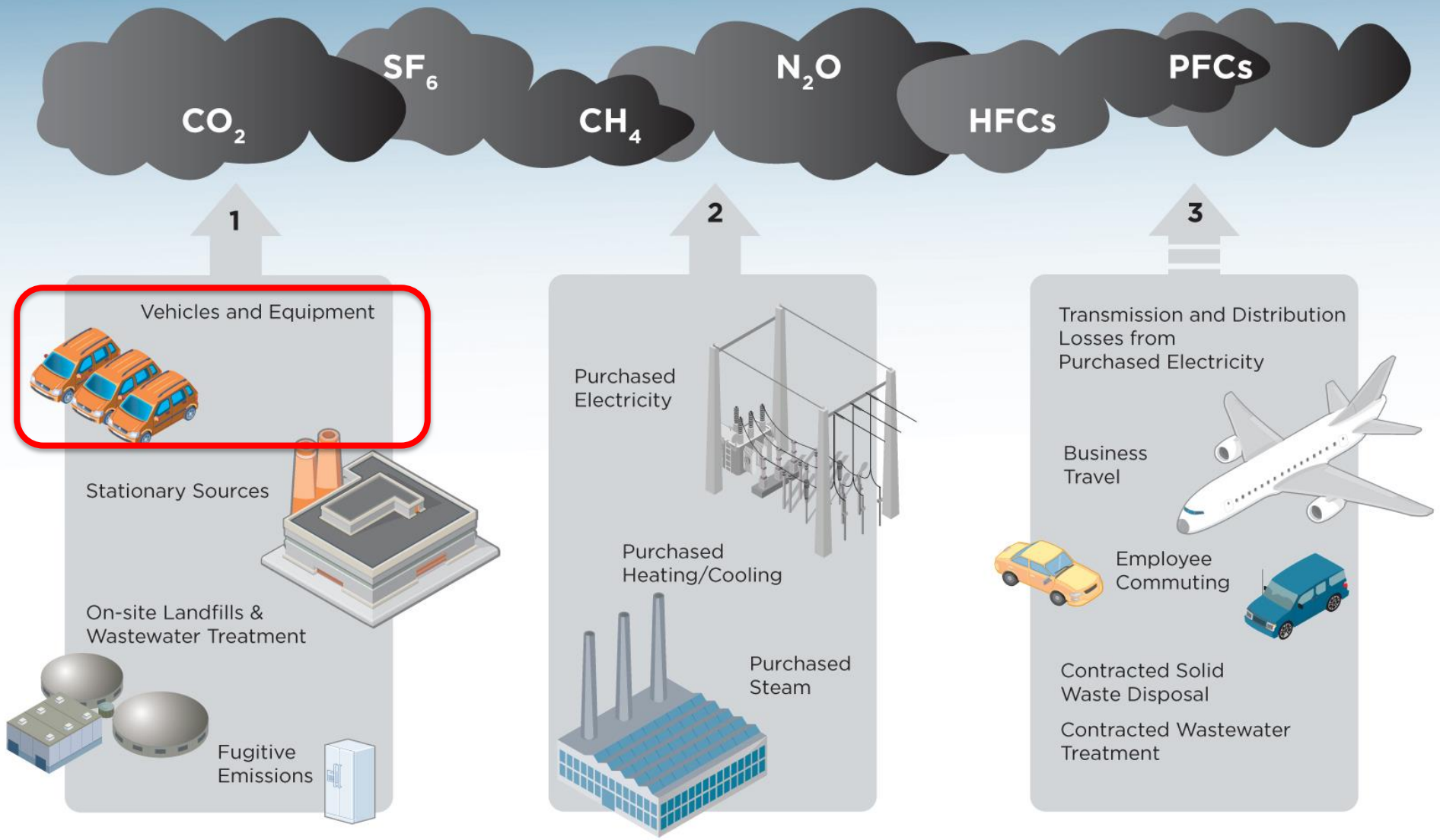
- Understanding and meeting Federal requirements
  - Guidance
  - Handbook
  - FAST system maintenance, upgrades, and training
- Technical assistance, analysis, and tools
  - Fuel consumption dashboard (FleetDASH)
  - Geographic analysis of fleet fueling patterns, for facilitating development of new alternative fuel infrastructure
- Education and communication
  - Federalfleets.energy.gov
  - INTERFUEL working group

Executive Order 13693

Planning for Federal Sustainability in the Next Decade

- Signed on March 19, 2015
- "Maintain Federal leadership in sustainability and greenhouse gas emission reductions"
- "Expanded and updated Federal environmental performance goals"
- "**Continue to drive national greenhouse gas reductions** and support preparations for the impacts of climate change"

Common Sources of Federal Greenhouse Gas Emissions



SCOPE 1:
Greenhouse gas emissions from sources that are owned or controlled by a Federal agency.

SCOPE 2:
Greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by a Federal agency.

SCOPE 3:
Greenhouse gas emissions from sources not owned or directly controlled by a Federal agency but related to agency activities.

Federal Fleet Requirements-Overview

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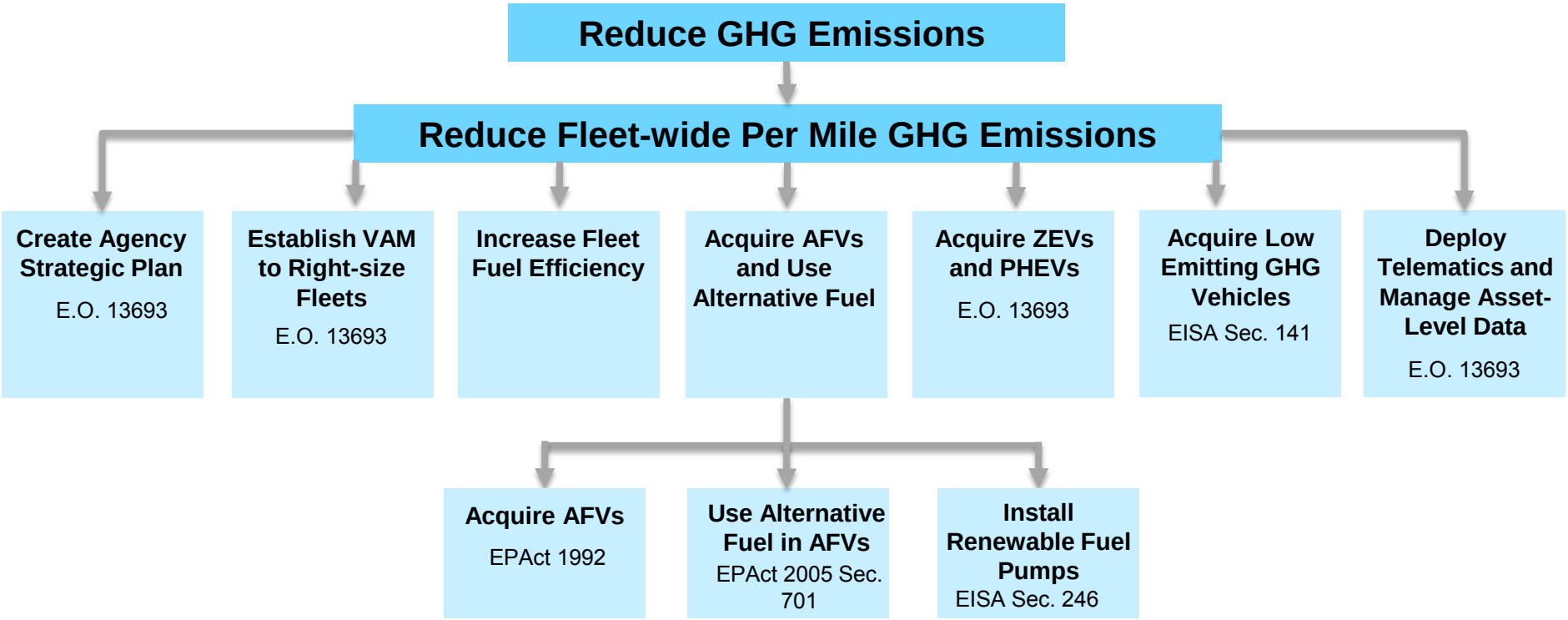
The overarching Federal fleet goal is to **reduce GHG emissions** [and increase efficiency] across Federal operations

New Federal fleet metric: **fleet-wide per mile GHG emissions**



E.O. 13693
Flexibility in Reducing GHG Emissions

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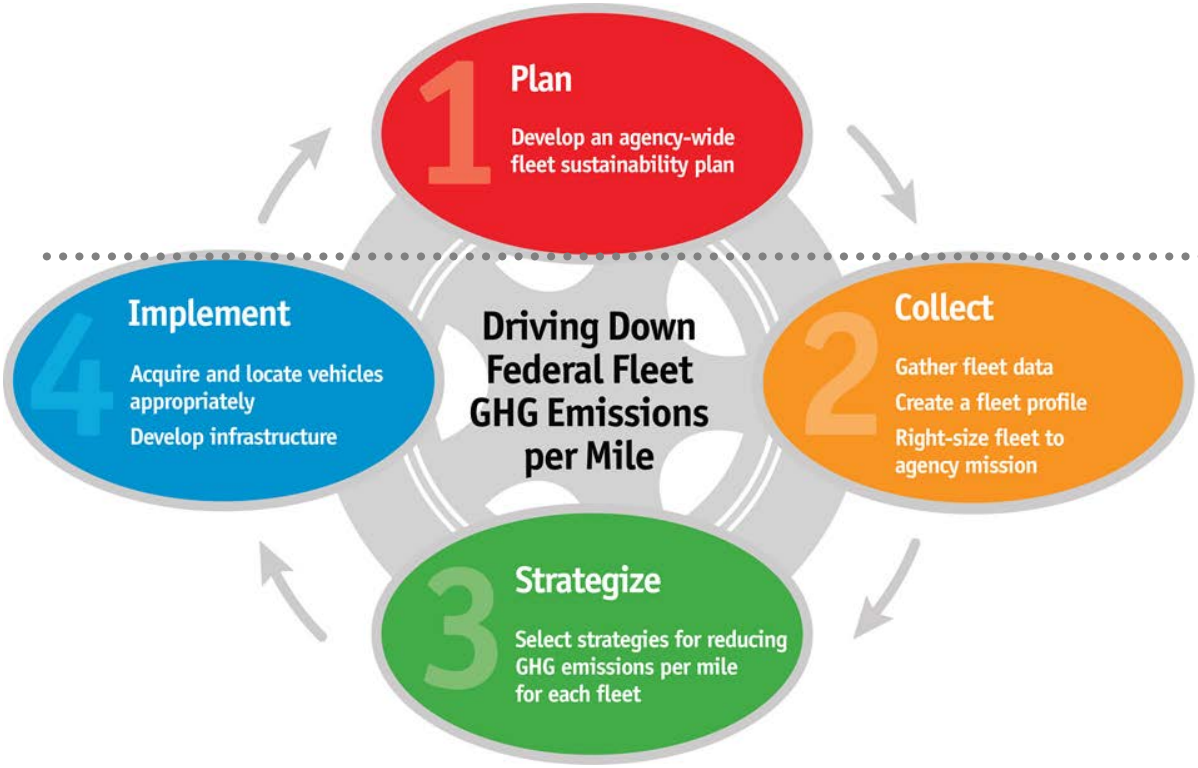
	Old E.O.s 13423 & 13514	New E.O. 13693
Overarching Objective	**Reduce overall annual fleet GHG emissions** as part of agency-established reduction target for FY 2008 to FY 2025	**Same with updated agency targets**
Primary fleet performance metric(s)	***Petroleum Reduction*** Requires **2 percent annual reduction** from FY 2005 to FY 2020 ***Alternative Fuel Use*** Requires **10 percent annual increase** starting from FY 2005 baseline through FY 2015	***Per-Mile GHG Emissions Reduction*** **FY 17: 4 percent reduction** **FY 21: 15 percent reduction** **FY 25: 30 percent reduction** "allows agencies to continue to meet their mission requirements while also achieving significant GHG reductions"

E.O. 13693 Fleet Guidance Framework: Two Documents

Fleet guidance is organized around a cyclical fleet management framework—**plan, collect, strategize, and implement**



E.O. 13693 Guidance Document

- Focuses on requirements
- High Level Planning
- Updated infrequently

E.O. 13693 Comprehensive Federal Fleet Management Handbook

- Guides fleet managers from requirements to implementation
- 100+ pages
- Can be updated regularly

FEMP Federal Fleet Program
Resources

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FEMP Fleet Guidance	*federalfleets.energy.gov* • Guidance and Handbook Documents
FEMP Fleet Training	*federalfleets.energy.gov/information_resources* • Federal Fleet Management 101 (FEMP First Thursday) • Electric Vehicles (FEMP First Thursday) • EPAct 2005 Section 701 • EISA Section 141
Fleet Tools	*federalfleets.energy.gov/FleetDASH/* • Fleet Sustainability Dashboard (FleetDASH) *www.afdc.energy.gov* • Alternative Fuel Station Locator • TransAtlas • Petroleum Reduction Planning Tool
Other Resources	*www.fueleconomy.gov* GHG emissions per mile Fuel economy information and tips *www.epa.gov/greenvehicles* Vehicle ratings based on GHG emissions/fuel economy

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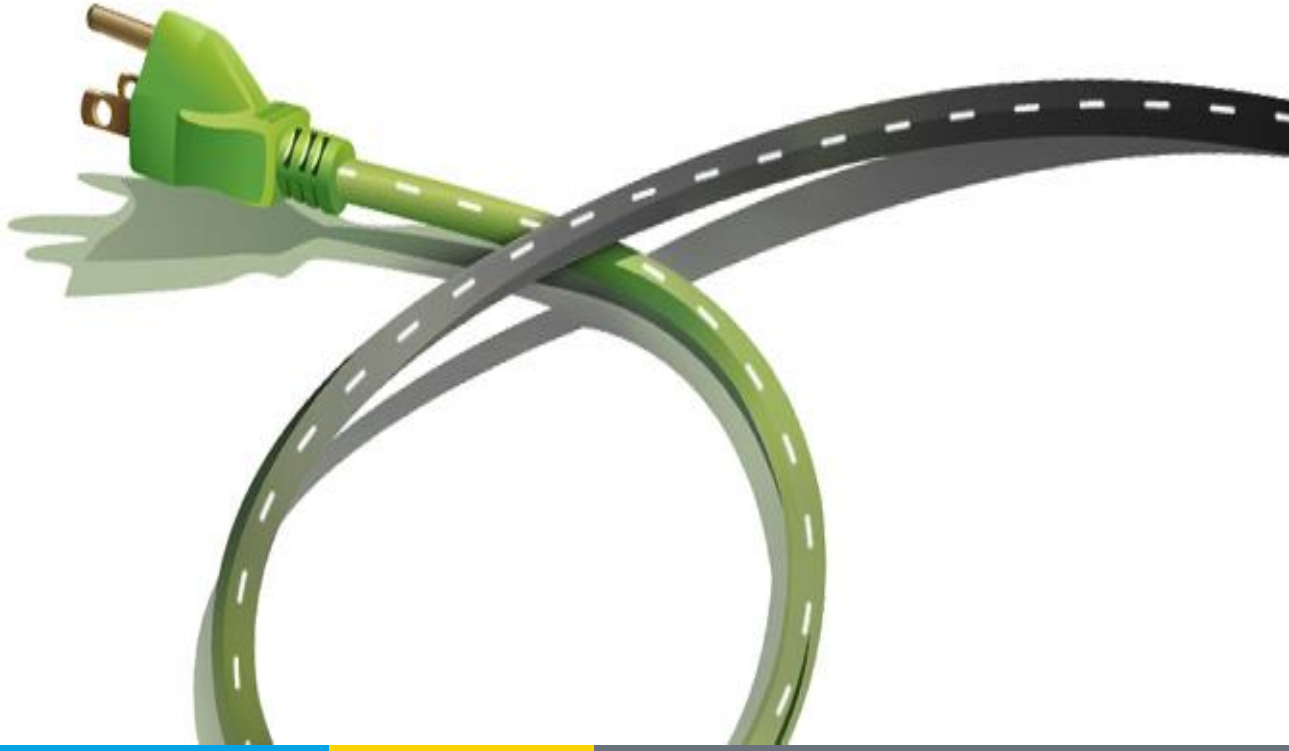
Federal Fleet Sustainability Requirements



Why Electric Vehicles?

GHG Emission Reductions

No fleet GHG emissions counted from use of electricity

Operating costs

Lower fuel cost per mile and maintenance costs

Support market development

Lead by example in growing the electric vehicle market

Performance

Quiet, comfortable, and quick

EVs and Federal Fleet Sustainability Requirements

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	Fleet Requirement	*Statute or Executive Order*	*Description*
GHG	**Reduce per Mile GHG emissions**	E.O. 13693 Sec. 3(g)(ii)	• 4% reduction by FY17 • 15% by FY21 • 30% by FY25
GHG	**Reduce overall GHG emissions**	E.O. 13693 Sec. 2	Reduce fleet GHG emissions as part of agency-established reduction target for FY 2008 to FY 2025
Vehicle Acquisition	**Optimum fleet inventory, right-size fleets**	E.O. 13693 Sec. 3(g)(iv)	Establish a structured VAM to determine the appropriate size and number of motor vehicles
Vehicle Acquisition	**Acquisition of ZEVs and PHEVs**	E.O. 13693 Sec. 3(g)(v)	• 20% of new passenger vehicle acquisitions by FY20 • 50% of new passenger vehicle acquisitions by FY25
Vehicle Acquisition	**Acquisition of AFVs**	EPAct 1992	At least 75 percent of LDVs acquired in MSAs/CMSAs must be AFVs
Vehicle Acquisition	**Acquisition of low GHG-emitting vehicles**	EISA § 141	Prohibits agencies from acquiring vehicles that are not low-GHG-emitting vehicles
AF Use	**Alternative fuel use in AFVs**	EPAct 2005 § 701	All dual-fueled vehicles must use alternative fuel if reasonably available (i.e., unless waivered)
AF Use	**Alternative fuel infrastructure**	EISA § 246	Every federal fleet fueling center must install a renewable fuel pump

EVs and Federal Fleet Sustainability Requirements

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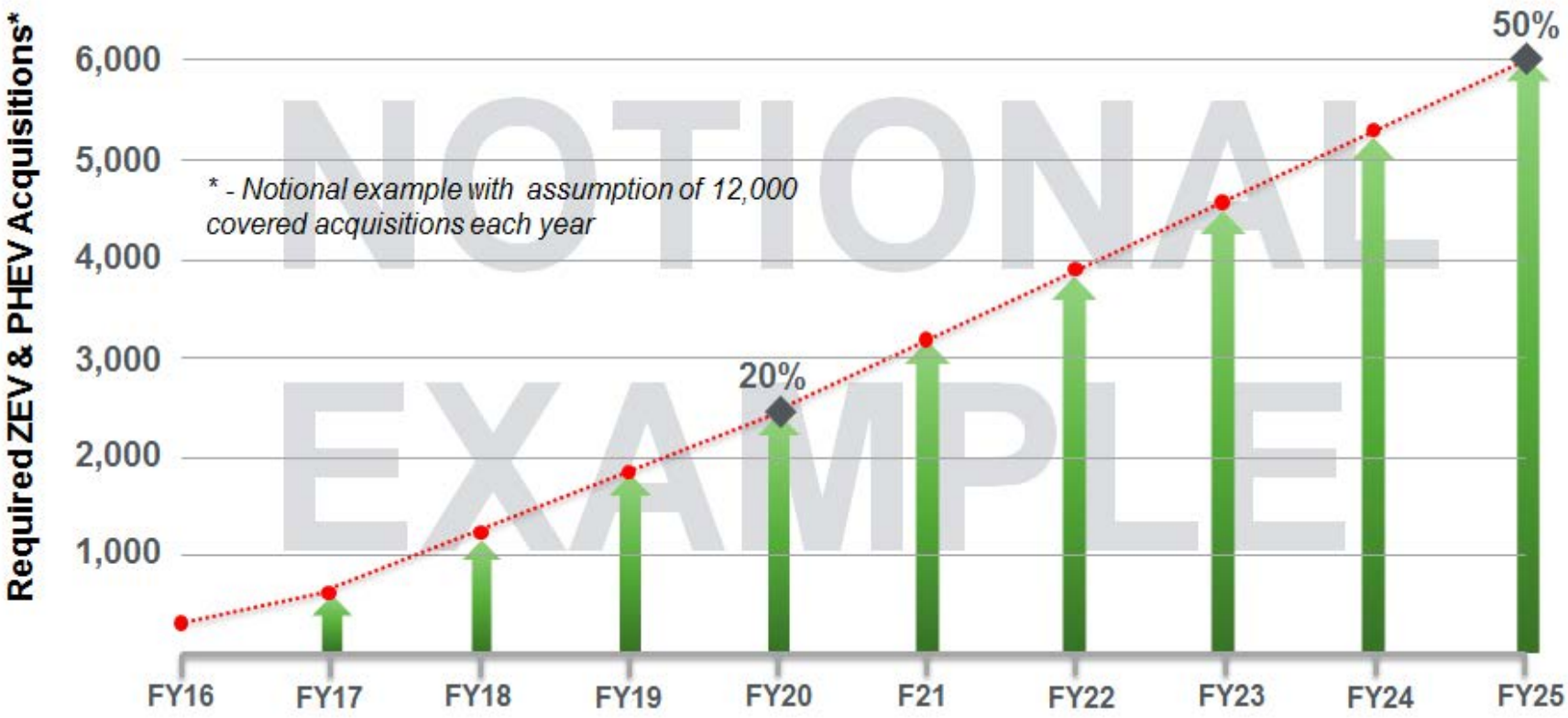
E.O. 13693 EV acquisition requirements increase steadily through FY25; ramping up deployment of electric vehicles (and charging stations) now is **critical**



EVs and Federal Fleet Sustainability Requirements

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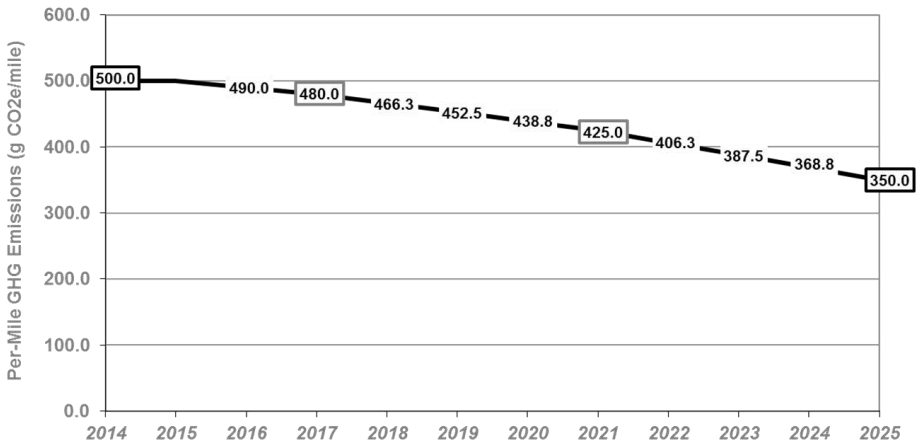
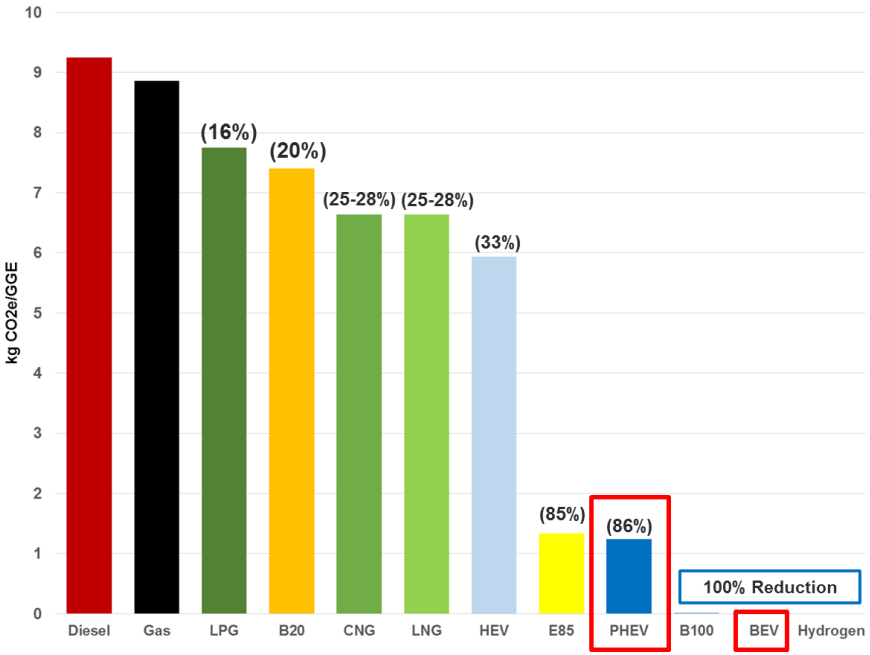
EVs help fleets meet E.O. 13693 per mile GHG emission reduction targets



Example with baseline of 500 g CO_2e/mile

Electricity generates <u>zero</u> tailpipe GHG emissions



EVs and the Core Principles of GHG Emission Reduction

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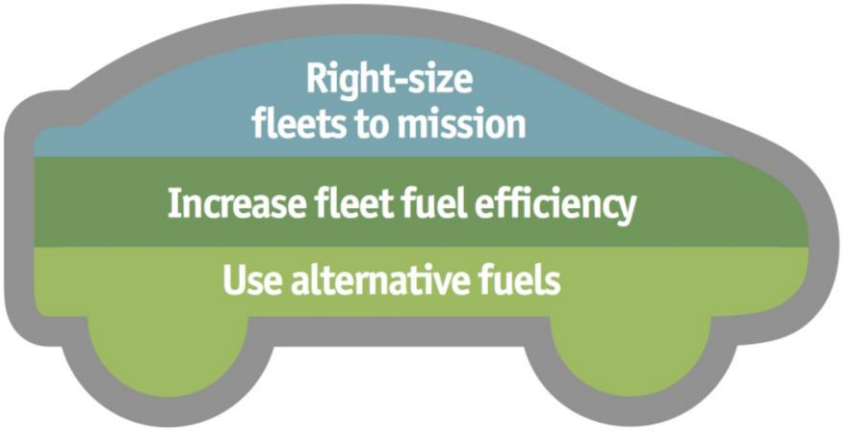


Right-size fleets and vehicles to mission

- *Completing VAM to identify and dispose of inefficient vehicles, and replace them with lower GHG emitting vehicles*
- *Reducing vehicle miles travelled*

Replacing existing vehicles with higher fuel economy vehicles

- *Right-sizing vehicles*
- *Includes HEVs, PHEVs, and LSEVs*

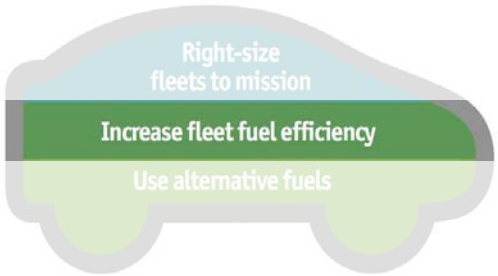
Operational changes

- *Improved maintenance*
- *Driving more efficiently*
- *Avoiding Idling*

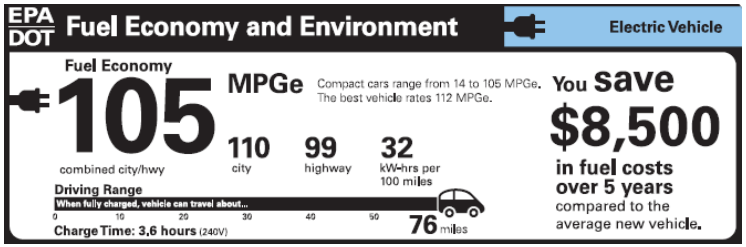
Maximize use of alternative fuels, including electricity

- *ZEVs & PHEVs and charging infrastructure*
- *E85, CNG, etc. that require infrastructure and AFVs*
- *B20 that requires infrastructure*

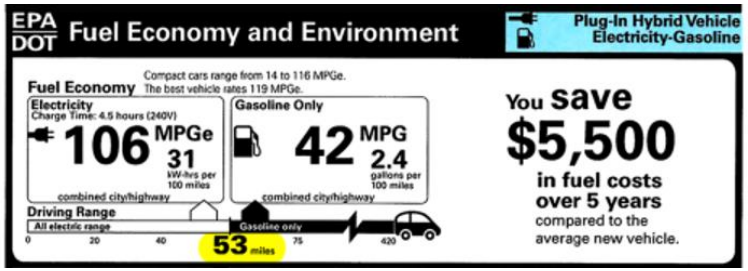
Electricity is an efficient fuel



Ford Focus Electric (BEV)



Chevy Volt (PHEV)



Ford C-Max Energi (PHEV)

Principle 3: Use Alternative Fuels
Electricity Reduces Fleet GHG Emissions

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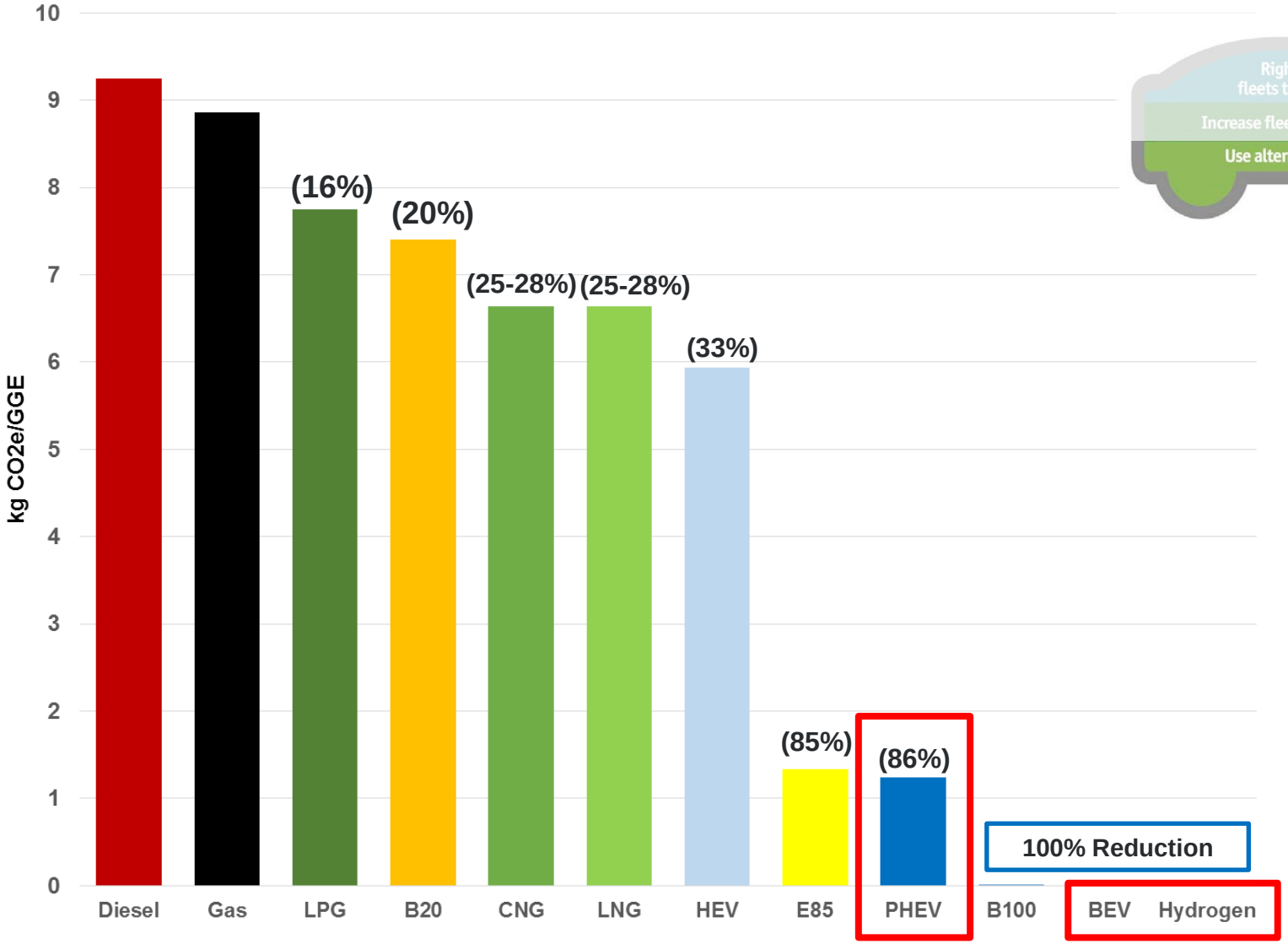

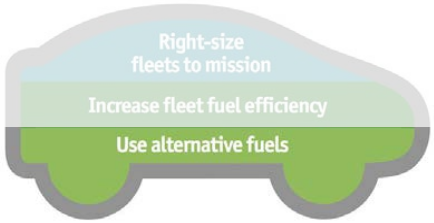

Workplace Charging at Federal Agencies

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FAST Act *2015*

Authorizes GSA and Federal agencies to install, operate, and maintain charging stations for Federal employees and authorized users, and requires the collection of fees to recover costs.

EO 13693 & Implementing Instructions *2015*

Instructs Federal agencies to consider the development of policies to promote sustainable commuting practices including workplace charging and report plans in annual SSPP Multimodal Access Plan.

Council on Environmental Quality Workplace Charging Guidance *2016*

Describes how Federal agencies can provide workplace charging under the FAST Act and report implementation in annual FAST submission. Released in two phases: a) Level 1 charging receptacles (wall outlets), and b) Level 1, Level 2 and DCFC EVSE. GSA will issue separate guidance for GSA-leased facilities.

A few of the 50+ DOE Lawrence Berkeley National Laboratory EV-

Workplace Charging Value & Available Technical Assistance

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Value for Federal Agencies & Employees

- Reduce GHG emissions by displacing commuters' petroleum with lower-emission electricity
- Signal federal leadership & respond to EO 13693 call to action
- Increase range confidence & eVMT of current EV drivers – 6x!
- Increase awareness & education of potential EV drivers

Workplace Charging Challenge
U.S. DEPARTMENT OF ENERGY

8 Federal Facility Workplace Charging Challenge Partners

- Department of Transportation, United States of America
- CDC Centers for Disease Control and Prevention
- Department of Energy, United States of America
- Argonne National Laboratory
- NREL National Renewable Energy Laboratory
- Oak Ridge National Laboratory
- Sandia National Laboratories
- Berkeley Lab

- Federal agencies can receive recognition & tech assistance through the Workplace Charging Challenge.
- The Challenge draws from experiences of 350+ partner employers with 5,500+ EVSE at 600+ worksites.
- Learn more by contacting WorkplaceCharging@ee.doe.gov

Workplace Charging Challenge Key Resource Highlights

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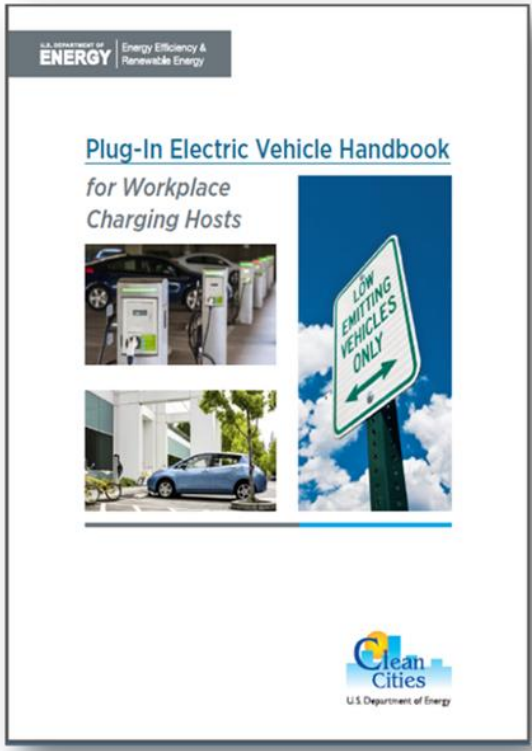
Install & Manage Workplace Charging

- ✓ Assess demand with sample employee survey
- ✓ EVSE incentive database and equipment guides
- ✓ Sample Request for Proposal
- ✓ Workplace-focused guidance on ADA and signage
- ✓ Employer-informed resources on program administration, registration, liability, pricing and station-sharing policy



Promote Workplace Charging

- ✓ Employee outreach toolkit
- ✓ Workplace Ride & Drive guide
- ✓ Vehicle cost and emissions calculators and Find a Car tool

Resources available at: http://energy.gov/eere/vehicles/ev-everywhere-workplace-charging-challeng

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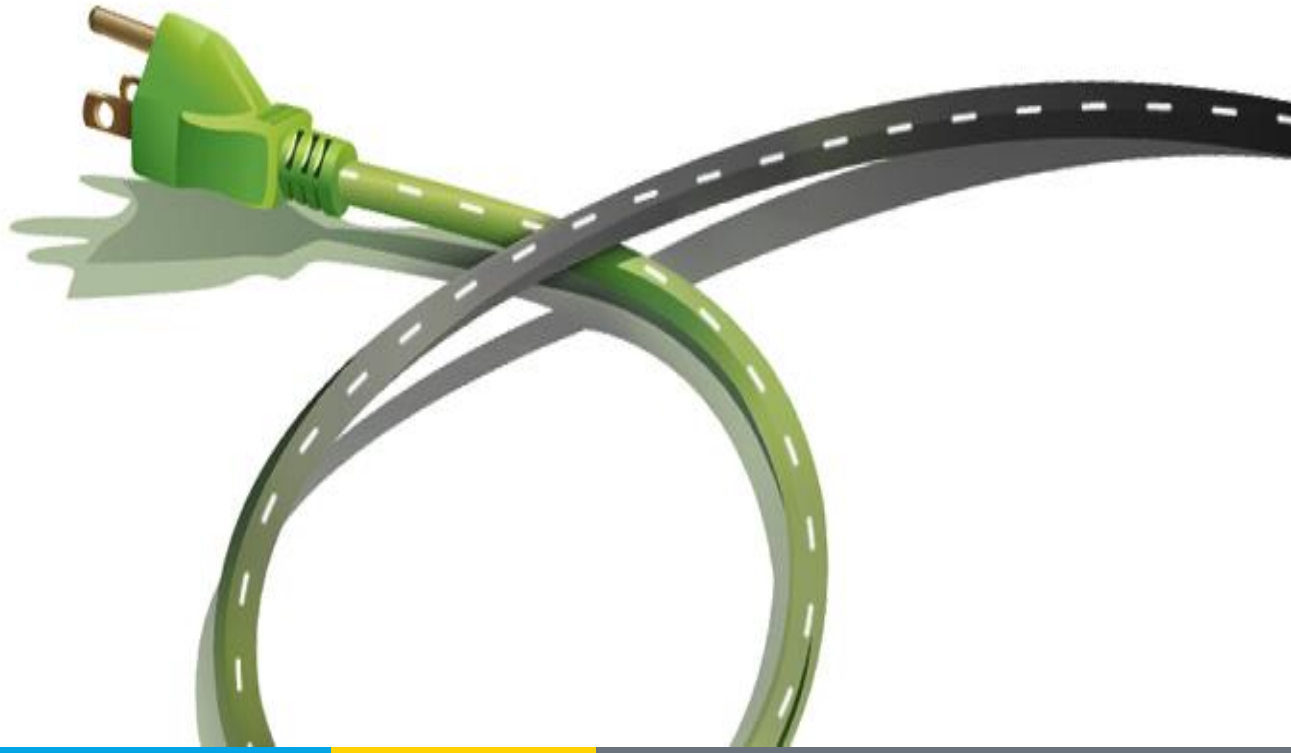
Electric Vehicle Overview



Types of Electric Vehicles

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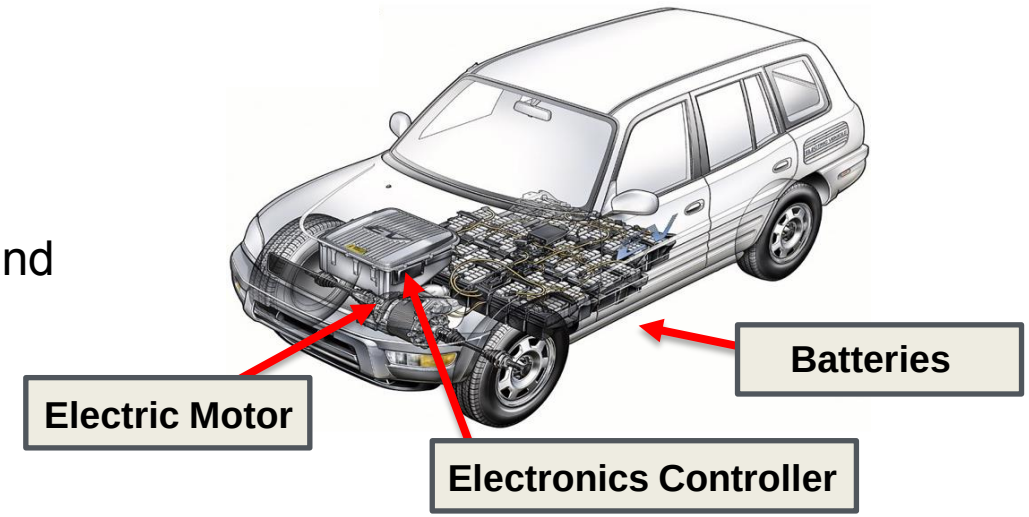
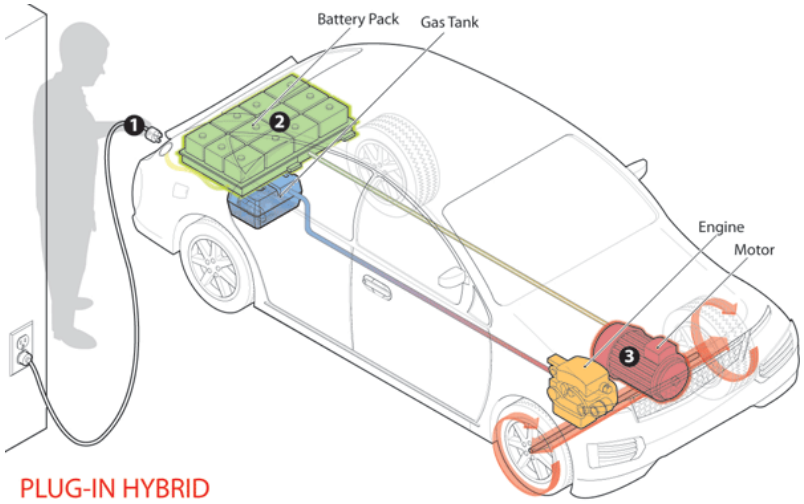
Battery Electric Vehicles (BEVs)

- **Electric motor** only power source
- Batteries charged from electric grid and regenerative braking



Plug-in Hybrid Electric Vehicles (PHEVs)

- Operates like a **hybrid electric vehicle,** but **battery > 4 kw-hours**
- Batteries can be charged with electricity like a **pure electric vehicle**



Source: PluginCars.com

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Low-speed Electric Vehicles (LSEVs)

- LSEVs are **pure electric** low-speed vehicles (LSVs)
  - 4-wheeled motor vehicles weighing <3,000 pounds
  - Top speeds of 20 to 25 miles per hour
  - Also referred to as neighborhood electric vehicles (NEVs)
- Federal fleet: not considered vehicles
- Recharge using 110-volt outlet in 6-8 hours
- **Acquisition of LSEVs count as ZEV credits**
- **LSEV electricity use may be counted in fleet alternative fuel use reporting**

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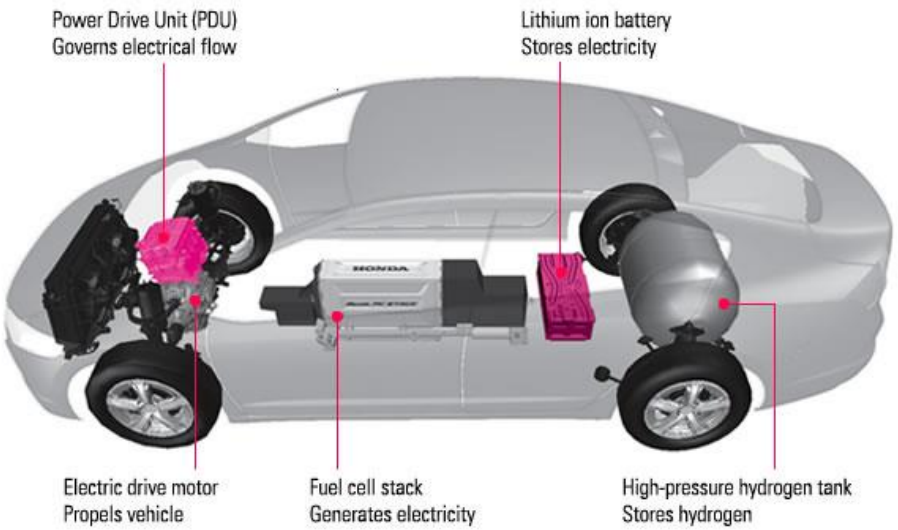
Fuel Cell Electric Vehicles (FCEVs)

- Operates like a **battery electric vehicle,** but **uses hydrogen gas to produce electricity**
- Refill with high pressure hydrogen gas at station **(quick refueling)**
- **Battery** to store energy from **regenerative braking**
- **Benefits:** Quick refueling, range
- **Challenges:** Infrastructure, costs, availability



U.S. Hydrogen Stations

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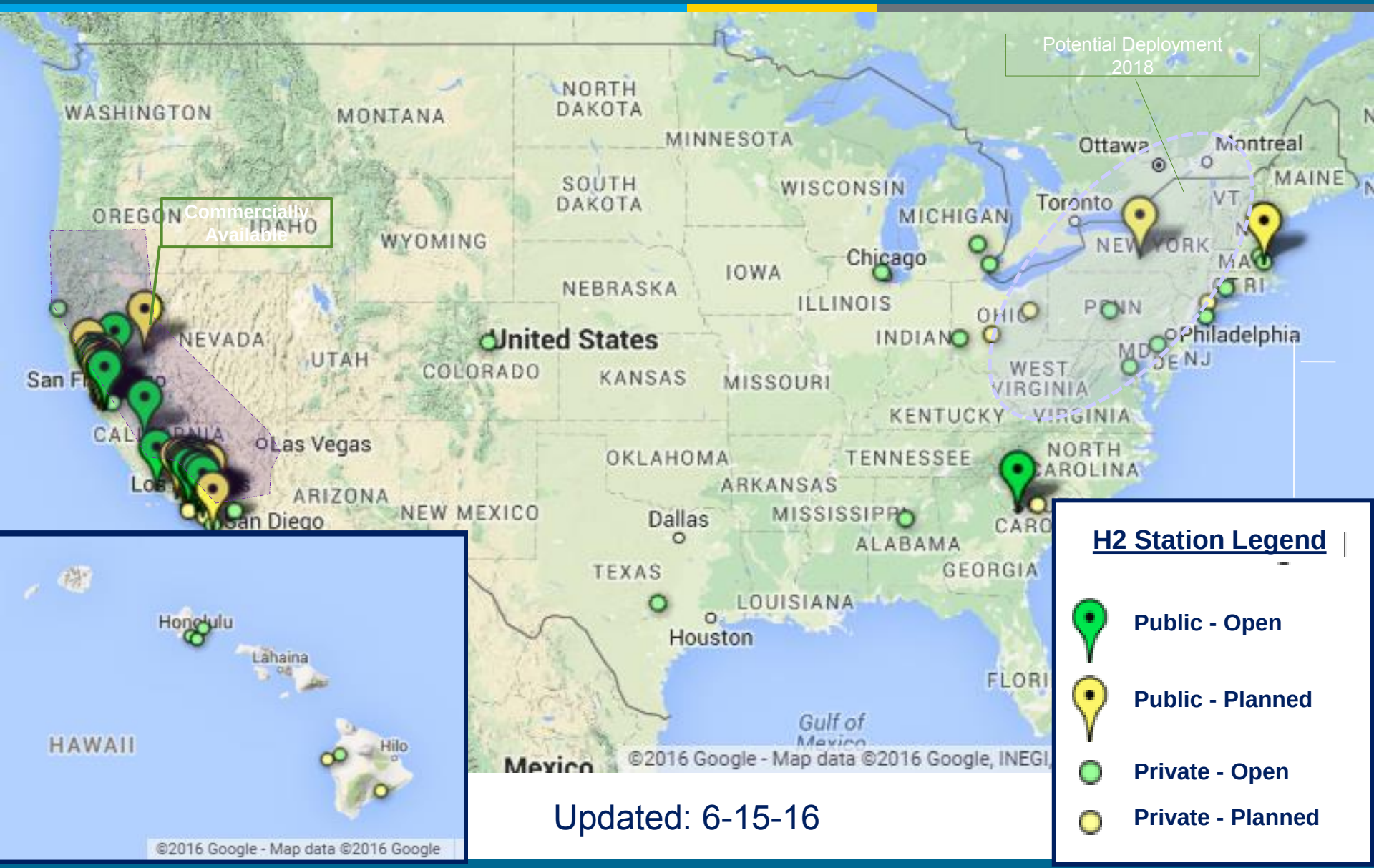

Updated: 6-15-16

California Hydrogen Stations

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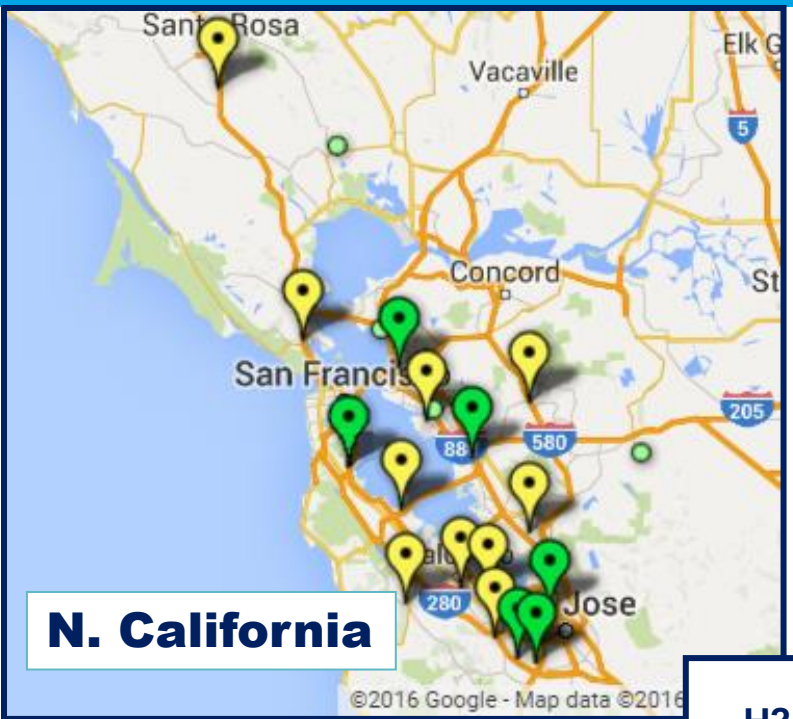
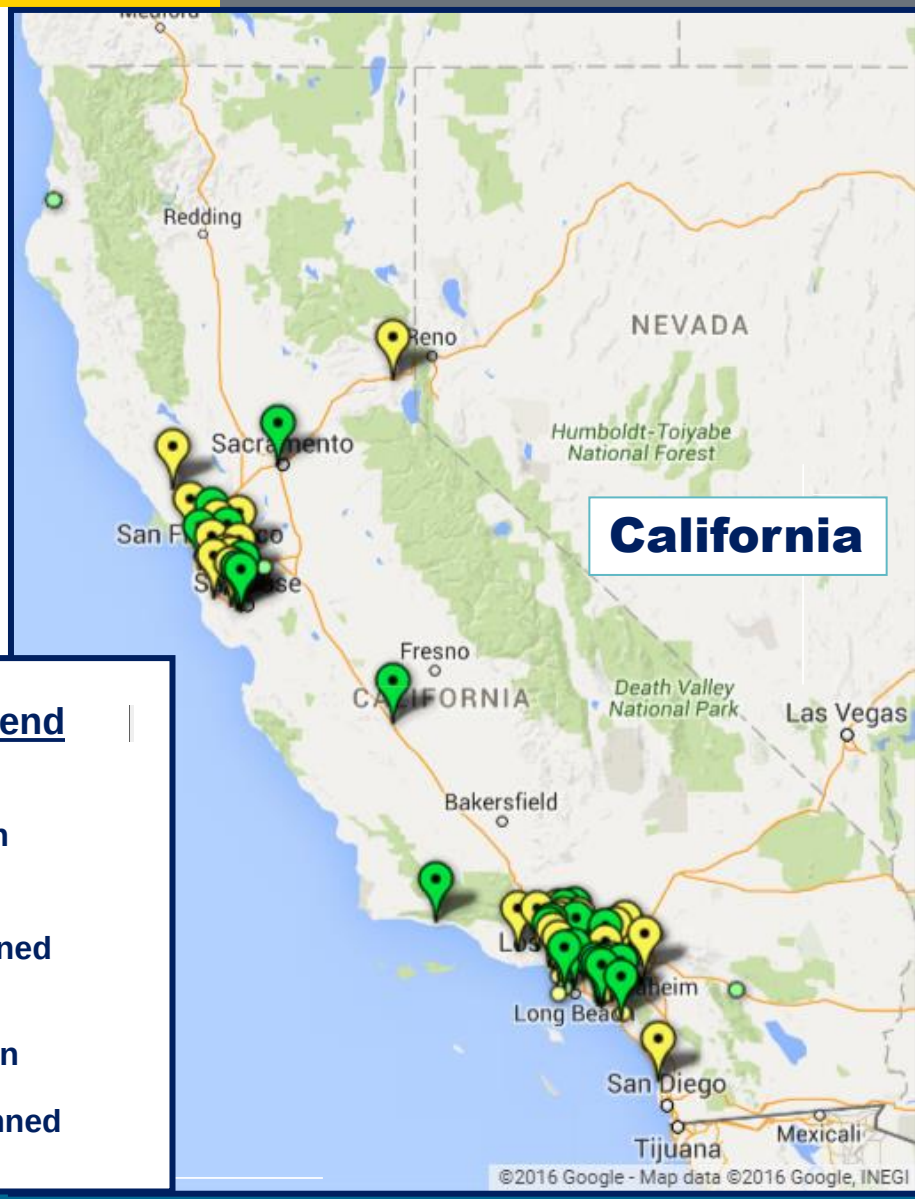


Updated: 6-15-16

H2 Station Legend

- Public - Open
- Public - Planned
- Private - Open
- Private - Planned



PEV Safety

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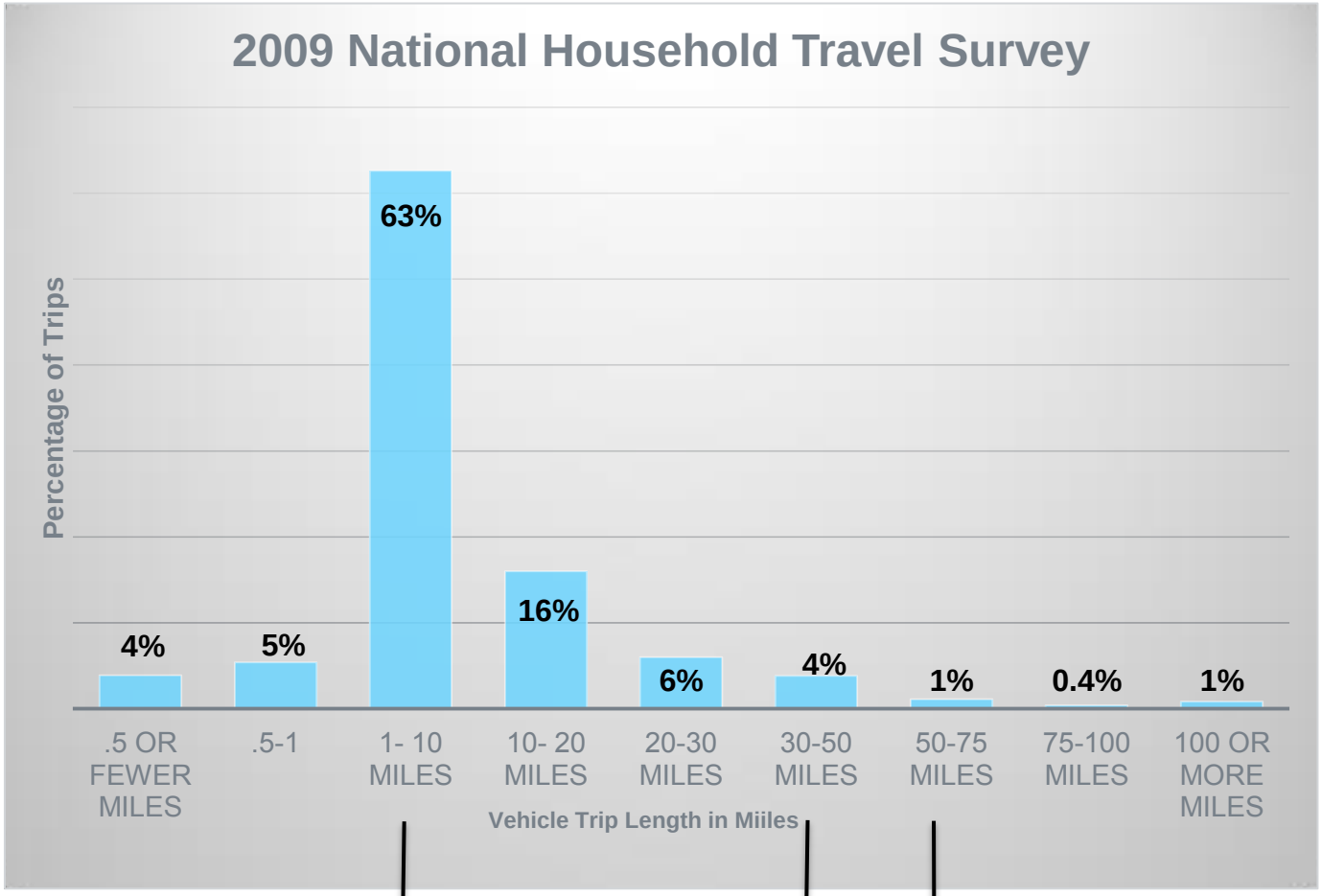
- Risk of shock when operating or charging an electric drive vehicle is very low
  - The pins in the connector are completely enclosed when plugged into the PEV, minimizing the chance of human contact
  - Power does not flow until the PEV communicates it's readiness, after the connector has been plugged in to the PEV
  - The J1772 standard 5-pin connector used for charging has 2 pins dedicated to safety:
    - Proximity detection ensures that the car cannot move while charging
    - Control pilot is a communication line that coordinates power flow, charging level, and other charging information

Training programs are available for maintenance technicians and first responders:

- *National Fire Protection Association (NFPA) EV Safety Training*
- *National Alternative Fuels Training Consortium (NAFTC)*
- *Automotive Career Development Center (ACDC).*

Driving Range and PEVs



Average trip length is 10 miles

Average weekday VMT is 34 miles

85% commute less than 50 miles roundtrip

Driving Range in 2016 Models

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Make and Model							Range			Charge Time (hr)		
Name	Model	Photo	EV Type	Battery size (kWh)	Price	Price w/Federal Rebate	Electric Range (miles)	Total Range (miles)	Charging Rate (kW)	Level 1 120v	Level 2 240v	DCFC 400+v
BMW	i3		BEV	22	$43,300	$35,800	81	80/150	7.4	20.3	3.7	0.5
Chevrolet	Volt		EREV	18.4	$34,995	$27,495	53	420	3.6	13.3	2.9	N/A
Ford	C-Max Energi		PHEV	7.6	$32,950	$28,943	21	620	3.3	5.3	2.8	N/A
Ford	Focus Electric		BEV	23	$29,170	$21,670	76	76	6.6	19.0	3.3	N/A
Ford	Fusion Energi		PHEV	7.6	$38,700	$34,693	21	620	3.3	5.3	2.8	N/A
Nissan	Leaf S		BEV	24	$29,010	$21,510	84	84	6.6	21.0	3.5	0.5
Nissan	Leaf SV		BEV	30	$34,200	$26,700	107	107	6.6	26.8	3.6	0.5

Coming Soon: 200+ miles

Factors that Affect PEV Range

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- Driver Behavior
- Weather
- Maintenance
- Terrain

Range Factors - Driver Behavior

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Speeding

- Quick acceleration and driving at high speeds reduce fuel economy in all vehicles and range in PEVs

Braking

- Regenerative braking recharges batteries more efficiently with slower, controlled stops

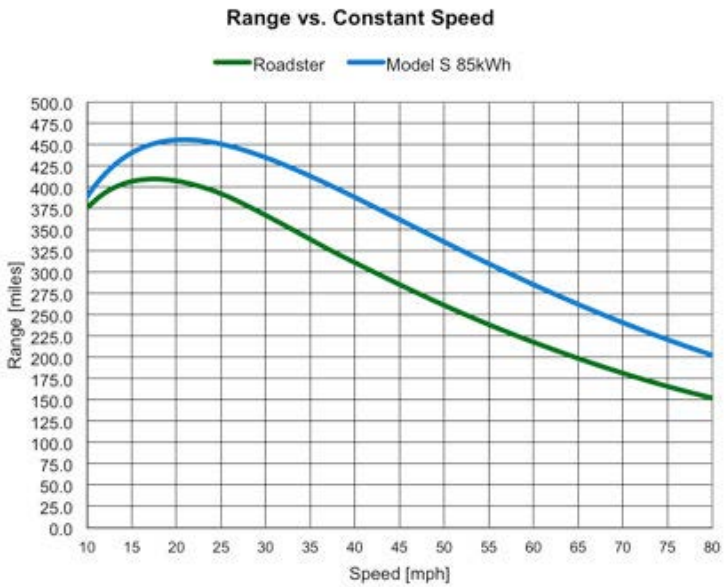
City vs. Highway Miles

- Range is often improved in city driving because of regenerative braking

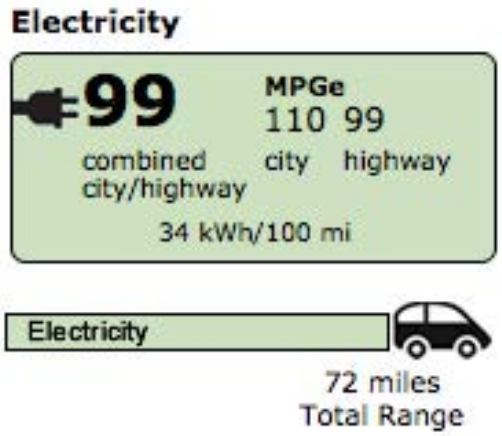
Tips:

- *Use eco-mode to extend your range.*
- *Avoid high speeds and burning rubber.*
- *Give yourself plenty of time to slow down.*

Tesla Range to Speed Ratio



Ford Focus Electric



Range Factors - Winter Driving

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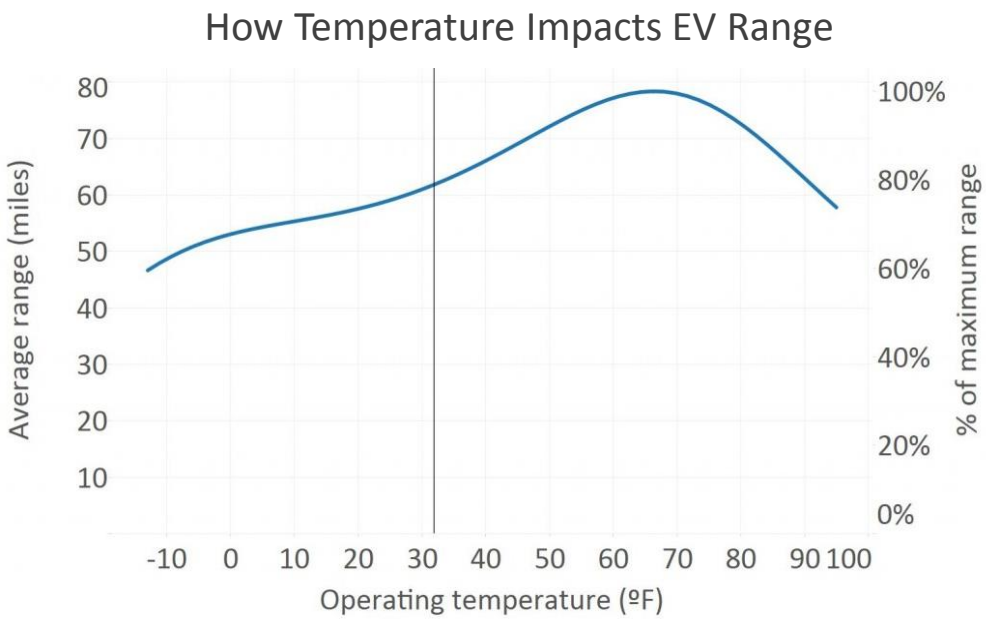
Cold-weather factors:

- Range can drop significantly in PEVs
- Seat heaters, cabin heaters, and defrosters can also lower fuel economy



Tips:

- *Park in warmer places.*
- *Preheat the cabin while charging.*
- *Use the seat warmers vs. cabin heater.*

Range Factors - Summer Driving

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Warm-weather factors:

- Air conditioning (AC can reduce fuel economy by more than 25% in conventional or electric vehicles)
- Driving with your windows down

Tips:

- *Don't use the AC more than needed.*
- *Open windows at lower speeds; use the AC at highway speeds.*
- *Drive with the windows open for a short time before using the AC.*
- *Park in the shade or use a sunshade.*
- *Pre-cool while plugged in*

Range Factors – Proper Maintenance

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BEVs generally require less maintenance

However, properly inflated tires are still an important factor with fuel economy and therefore range

TIRE SIZE		TIRE INFLATION PRESSURE kPa (psi)	
		FRONT	REAR
P255/70R16 109S	Ⓐ	180 (26)	180 (26)
	Ⓑ	180 (26)	180 (26)

Ⓐ : TO 5 PASSENGERS
Ⓑ : Ⓐ TO MAX. LOAD OR TRAILER TOWING

PART NO. : MR491176 E

Resulting Savings:

- ***Fuel Economy / Effect on Range:*** *up to 3% (0.3% reduction for every decrease in pressure by 1 pound per square inch for four tires)*

Tips:

- *Use the tire pressure printed on your vehicle's driver side door jamb, driver's manual, or glove box, not the maximum pressure on the tire's sidewall*

Range Factors – Terrain

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Terrain:

- Ascending mountains can decrease range
- However, downhill driving enables regenerative braking, allowing vehicles to regain some range as the vehicle descends
- Fuel economy and range estimates are based on flat terrain

Pike's Peak International Hill Climb

Altitude:

- Natural aspirated gasoline engines lose significant efficiency at altitude
- Electric motors lose little if any efficiency at altitude

Light-Duty EVs Available Through GSA

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PHEVs

Chevy Volt
50 mile all electric range
Incremental: **$15,655**

Ford C-Max Energi
21 mile all electric range
Incremental: **$14,519**

Ford Fusion Energi
(closed 1/8/16)
21 mile all electric range
Incremental: **$12,362**

BEVs

Ford Focus Electric
76 mile range
Incremental: **$12,039**

Find more examples:

- *Alternative Fuels Data Center (AFDC):* ***Alternative Fuel and Advanced Vehicle Search***
- *FuelEconomy.gov:* ***Find a Car***

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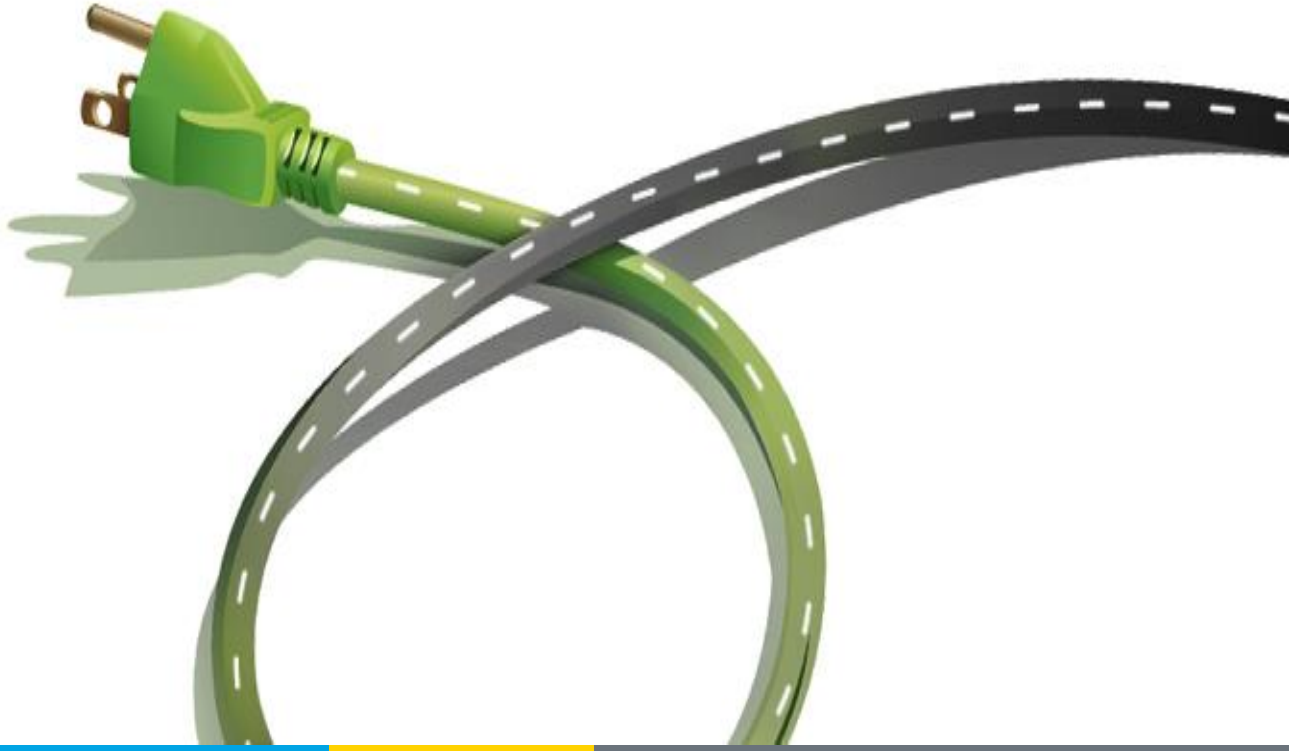
Electric Vehicle Supply Equipment (EVSE)



PEV Charging Infrastructure

Utility Service or Generation

EVSE (Electric Vehicle Supply Equipment)

Electric Vehicle

Electric Vehicle Charging Options

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	Level 1	Level 2	DC Fast Charging
Circuit	Standard outlet 120 V, 15-20 A	Dedicated circuit 240 V, 30-40 A	Dedicated circuit 480 V, 125 A
Cord set	J1772	J1772	J1772 CHAdeMO
Power	~1.4 kW	~3.3-6.6 kW	~50 kW
Time	2-5 miles range/hour	10-20 miles range/hour	50-70 miles in 20 minutes
Cost	Minimal	$1k-$4k + install	$10k-$30k + install

Electric Vehicle Charging Options: *Level 1*

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Pros

- **No infrastructure costs** (in many cases)
- **Readily available**

Cons

- **Long charge time**
  - 17 hours for BEV
  - 7 hours for PHEV
- **Limited data collection or management**

Electric Vehicle Charging Options: *Level 2*

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Pros

- **Reasonable charging times**
  - 3.5 to 7 hours for BEV
  - 1.5 to 3.5 hours for PHEV
- **Limit access to fleet vehicles**
- **Manage and collect data**

Cons

- **Adds costs for infrastructure**
  - EVSE purchase
  - Installation costs
- **Charging time still hours not minutes**
- **Multiple stations needed for multiple vehicles**

Electric Vehicle Charging Options: *DC Fast Charging*

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Pros

- Provides gas station experience (15-30 minutes)
- Fewer stations needed per vehicle

Cons

- Varying Standards
  - CHAdeMO (Nissan, Mitsubishi)
  - SAE Combo (GM, BMW, VW)
  - Tesla Supercharger
- Expensive
- High power requirements
- Demand charge impacts

Best for fueling stations and easing range anxiety

EVSE Costs

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EVSE Type (single port)	EVSE Unit Cost Range
Level 1	$300-$1,500
Level 2	$400-$6,500
DCFC	$10,000-$40,000

For Level 2 commercial EVSE in the EPRI study, the installation cost break down is approximately:

- Labor: 55 - 60%
- Materials: 30 - 35%
- Permits: 5%
- Tax: 5%.

EVSE Type	Average Installation Cost (per unit)	Installation Cost Range (per unit)
Level 1	not available	$0-$3,000* *Source: Industry Interviews*
Level 2	~$3,000 *EV Project (INL 2015b)*	$600-$12,700 *EV Project (INL 2015b)*
DCFC	~$21,000 *EV Project (INL 2015d)*	$4,000-$51,000 *EV Project (INL 2015d) and (OUC 2014)*

Example Level 2 EVSE Available from GSA

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Wall Mount EV Station

Siemens VersiCharge
$856

GE WattStation, Wall Mount
$1,535

Schneider EV230WSR
$1,441

Leviton Fleet Wall Mount Gateway
$3,744

Leviton Local Head Unit
$3,111

Pedestal EV Station

Schneider EVlink
$1,935 (single)
$3,710 (dual)

GE WattStation Pedestal
$7,997

GE Durastation, Pedestal
$2,549 (single)
$4,125 (dual)

Leviton CTHDR
$4,433

ChargePoint
$3,764 (single)
$6,845 (dual)

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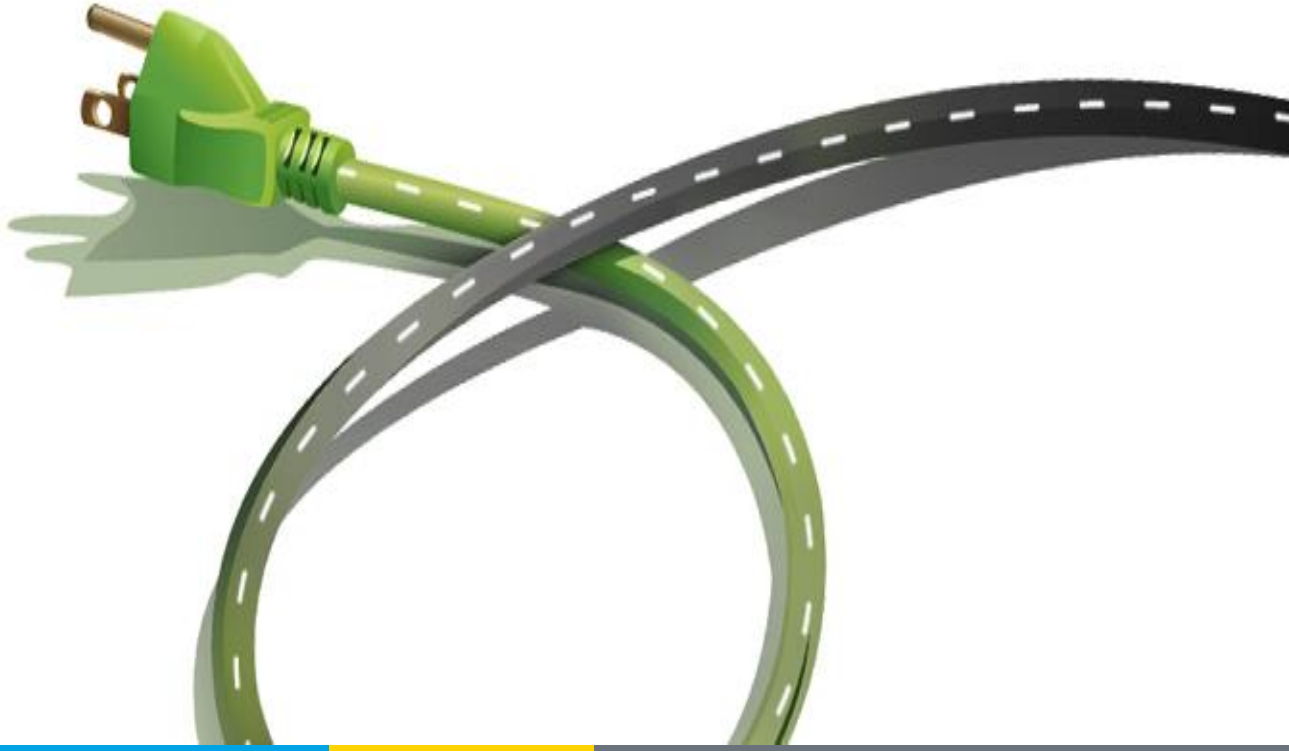
FEMP Assistance in Deploying PEVs and EVSE



Planning for EV Deployment

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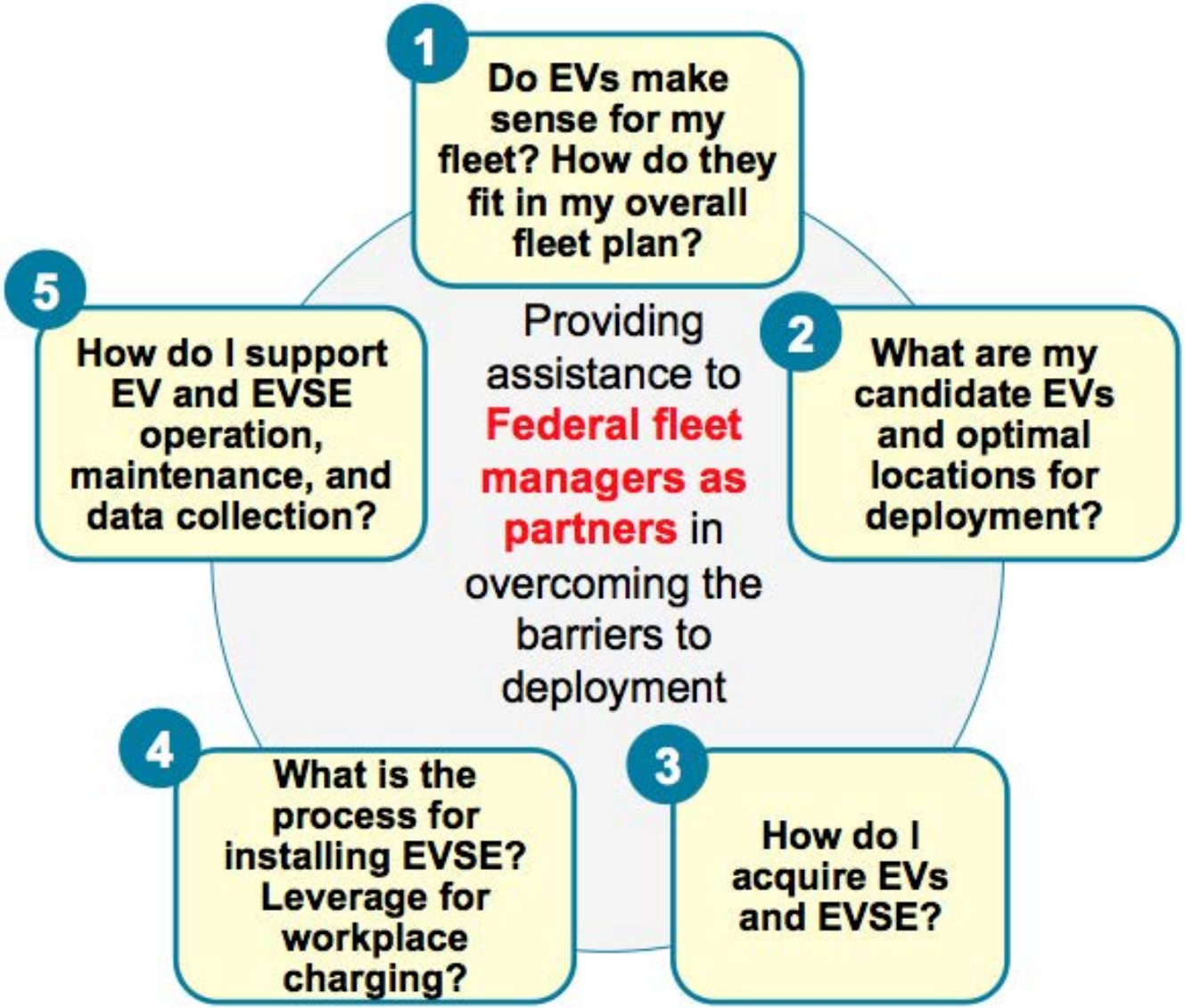

Assessing Optimal EVSE Locations

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Identify opportunities → **Refine with fleets** → **Recommend locations** → **EVSE Tiger Teams** → **Long term planning**

- Fleet concentrations and operating characteristics

- Fleets refine opportunities based on mission, funding, and priorities

- Determine optimal locations based on cost/benefit and scale
- Preference to existing EVSE and no existing AF

- Preliminary EVSE site investigations
- Tiger Team on-site visits
- Detailed site assessments

- Assist agencies in developing detailed multi-year implementation plans

EVSE Needs by Specific Location

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Determine EVSE Access → **Estimate Number of PEVs** → **Identify Charging Speed** → **Data/ Payment Needs**

Options:
- Fleet
- Employees
- Public

How many?
- BEVs
- PHEVs
- Now and in Future

Factors:
- Anticipated utilization (VMT)
- Vehicle battery capacity
- Vehicle charging speed

Considerations:
- Payment
- Reporting requirements
- Manual or automatic data collection

EVSE Installation Considerations

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- Parking spaces
- Power availability
- Speed of charging
- Mounting
- Walkways
- Data collection
- Type/model of EVSE
- ADA
- Lighting
- Electricity charges

EVSE Tiger Teams

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Deploying Electric Vehicles and Electric Vehicle Supply Equipment

Tiger Teams offer project assistance for federal fleets

EVSE Tiger Teams

- EVSE experts and electrical engineers from NREL
- Develop planning of EV infrastructure with fleet managers
- Virtual planning support
- Conduct site visits to locations in limited cases

FEMP Federal Energy Management Program

Federal Fleet EVSE Tiger Team
Questionnaire for Federal Fleet EVSE Planning

Example EVSE Installation Process

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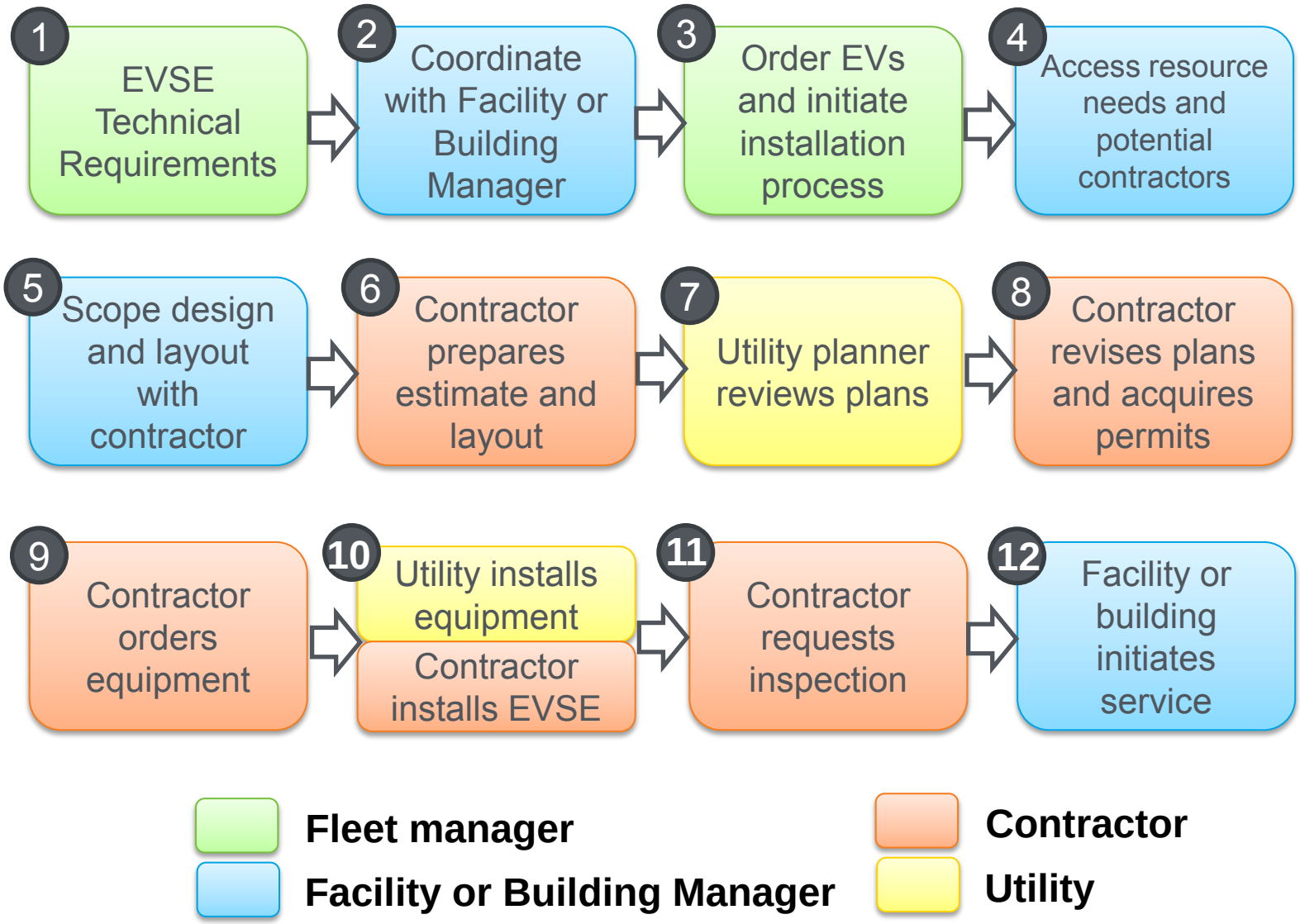

AFDC Station Locator

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Alternative Fueling Station Locator

Find alternative fueling stations near an address or ZIP code or along a route in the United States. Enter a state to see a station count.

Find Stations | Plan a Route

address, ZIP, or state... Go

Electric

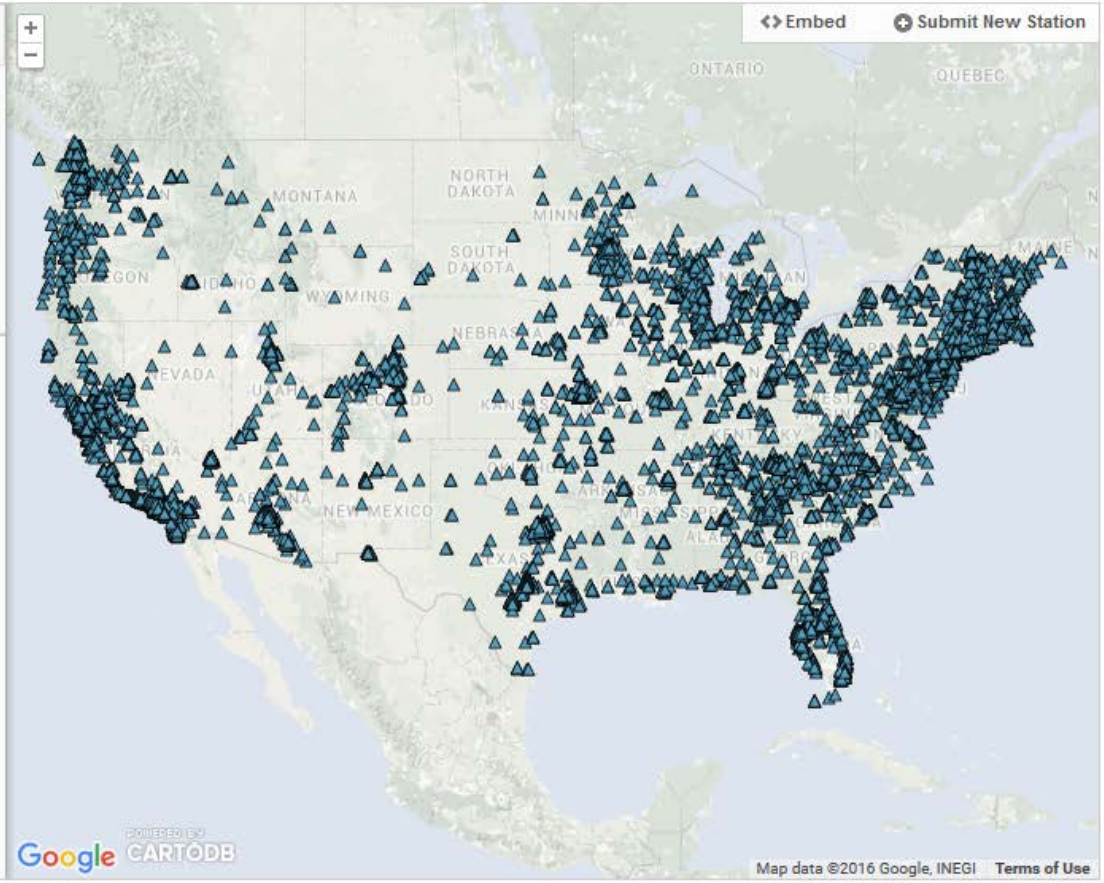
more search options

11,944 electric stations
30,191 charging outlets
in the United States

Excluding private stations

Location details are subject to change. We recommend calling the stations to verify location, hours of operation, and access.

ABOUT THE DATA



Go to mobile version
Download iPhone app

www.afdc.energy.gov

Download Data | Developer APIs

Data last updated: 01/18/2016

AFDC Web Tools

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Calculators

Vehicle Cost Calculator

Compare cost of ownership and emissions for most vehicle models. mobile

Petroleum Reduction Planning Tool

Create a plan for your fleet to reduce petroleum consumption and emissions.

CNG VICE Model 2.0

Evaluate ROI and payback period for natural gas vehicles and infrastructure.

AFLEET Tool

Calculate a fleet's petroleum use, cost of ownership, and air pollutant and GHG emissions.

www.afdc.energy.gov

Vehicle Cost Calculator

Choose vehicles to compare

Select up to eight vehicles to compare from the makes and models below

2016 | Ford

Vehicle	Annual Fuel Use	Annual Electricity Use	Annual Fuel/Elec Cost	Annual Operating Cost	Cost Per Mile	Annual Emissions (lbs CO2)
2016 Ford Focus Electric EV	0 gal	3,896 kWh	$505	$2,610	$0.22	4,675
2016 Ford Focus FWD Gasoline	362 gal	0 kWh	$1,267	$3,524	$0.30	8,687

Petroleum Reduction and Planning Tool

SET GOAL | CLEAR PLAN

Savings Methods		Petroleum Reduction gal/yr	GHG Reduction tons CO_2/yr	Fuel Cost Savings $/yr	Impact on Plan percent
Replace Vehicles	ADD TO PLAN	0	0	$0	0%
Use Alternative Fuel in Existing Vehicles	ADD TO PLAN	0	0	$0	0%
Reduce Idling	ADD TO PLAN	0	0	$0	0%
Reduce Mileage	ADD TO PLAN	0	0	$0	0%
Drive Efficiently	ADD TO PLAN	0	0	$0	0%
Total savings from plan per year		**0** gallons	**0** tons of CO_2	**$0**	**100%**

Clean Cities Framework

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Local & National Partnerships

Information & Education

Competitively Awarded Financial Assistance

Technical & Problem Solving Assistance

Clean Cities coalitions are locally based with the ability to tap national resources.

Local Clean Cities Coalitions

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- National network of nearly **100 local coalitions**
- **82% of the total U.S. population** lives inside coalition boundaries
- Nearly **500,000 alternative fuel vehicles (AFVs)**

FEMP Federal Fleet Program
Contacts

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