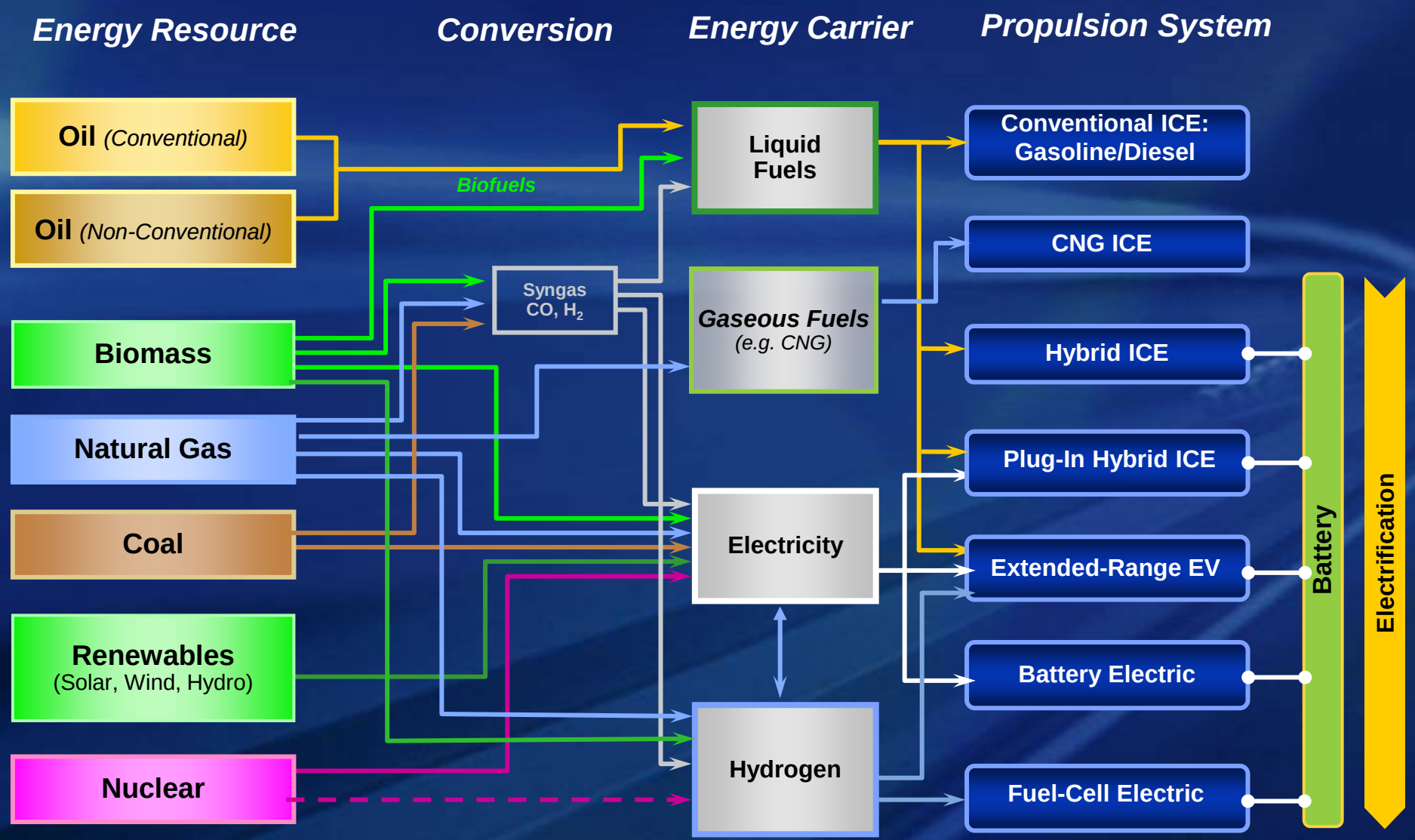
Alex Keros

Manager, Vehicle, Fuels & Advanced Technology Policy

Energy Diversity & Key Energy Supply Chains



General Motors | PEV Products

VOLT

HEVs, PHEVs and BEVs have delivered functionality and emotional appeal to meet early customer needs.

Spark EV

The Most Fuel-Efficient Vehicle Available in the U.S. – *EPA*

"Quite possibly the best all electric small car on the market." – AutoGuide

"Once you drive it, there's no question this motor's got muscle." – Car And Driver

"The (Spark) EV feels crazy quick, with 400lb-ft of torque, and a relatively small and light car, it just gets up and goes." – Consumer Reports

"We think that it's not just one of the best-driving electric cars yet, but one of the most affordable ways yet to make your daily driving completely gasoline-free." – Green Car Reports

CADILLAC ELR

General Motors | Continued Commitment

Volt
2nd Generation

January 2015 Announcement:
- All-new exterior, interior
- All-new propulsion system.
- MSRP: $33,995; As low as $24,995 in CA

Lighter, Faster, Further!
- **EV range = 50 miles**
- Twin-motor drive – 5% more efficient and 100 pounds lighter
- 19% stronger 0-30 mph
- Battery capacity increase to 18.4 kWh
- New 1.5L range extender, with combined fuel efficiency of 41 mpg (est.)
- Five-passenger seating
- Regen on Demand
- Location-based charging

Bolt
Concept

January 2015 Announcement:
- Long-range all-electric vehicle
- Designed to start around $30,000
- Designed for daily driving needs with more than 200 miles range
- Designed for 50 states, global markets
- Hi-Tech Infusion: smartphone as key fob, ride-sharing management, automatic park-and-retrieval.

February 2015 Announcement:
- Confirmed production of next-gen electric vehicle based on Bolt at Michigan's Orion Assembly Plant

Growing & Understanding the Market | Collaboration

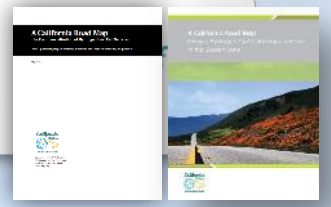
Private-Public Forums: Leadership, Resources, Execution

Clean Cities

Drive Oregon
Innovator in Electric Mobility

California Plug-In Electric Vehicle Collaborative

California Fuel Cell Partnership



Massachusetts MEVI Electric Vehicle Initiative

Central Florida Electric Vehicle Association

Maryland Electric Vehicle Infrastructure Council

Drive Electric Ohio
An initiative of CleanFuelsOhio

Central Texas Fuel Independence Project

Stakeholders (Examples):

- City Officials
  - Mayor's Offices
  - Permitting Officials
  - Fleet Managers
- State Officials
  - Governor's Offices
  - Energy Offices
  - Environmental Offices
  - Public Utility Commissions
- National Labs
  - INL, NREL
  - Clean Cities
- NGOs
  - Consumer Advocacy
  - Environmental
  - Clean Transportation
  - Community Groups
- Codes & Standards
- Universities

Activities (Examples):

DOE EV Readiness Planning
Letters of Support (e.g. NGOs, Infrastructure)
ZEV Action Plan(s)
Permit Guidebooks
Go-Fast Teams (e.g. GO-Biz Green Team)

New forums: Public Utilities Commissions

Massachusetts

New York State of Opportunity. Public Service Commission

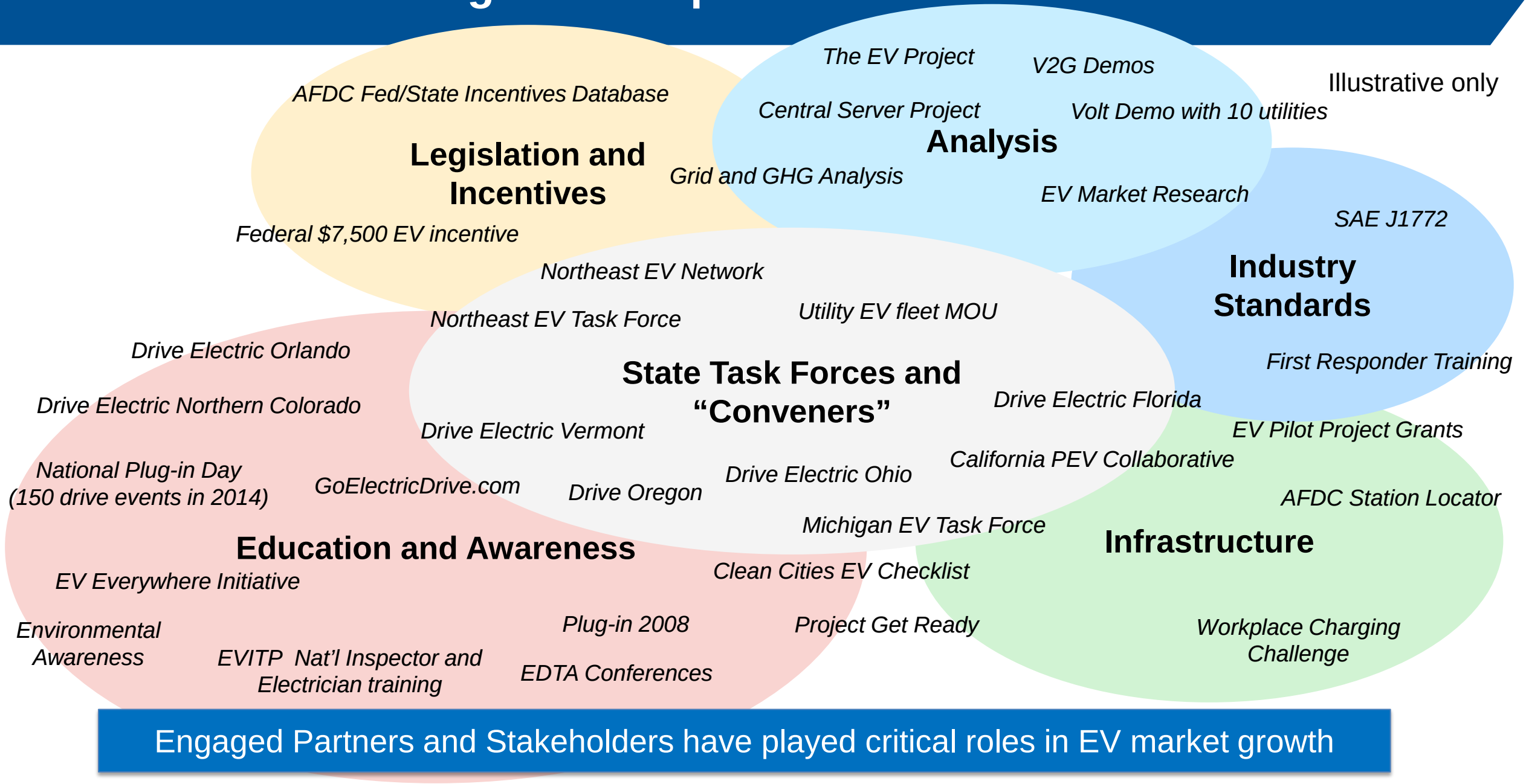
National Association of Regulatory Utility Commissioners

U.S. PEV Partnering Landscape

Illustrative only

Engaged Partners and Stakeholders have played critical roles in EV market growth

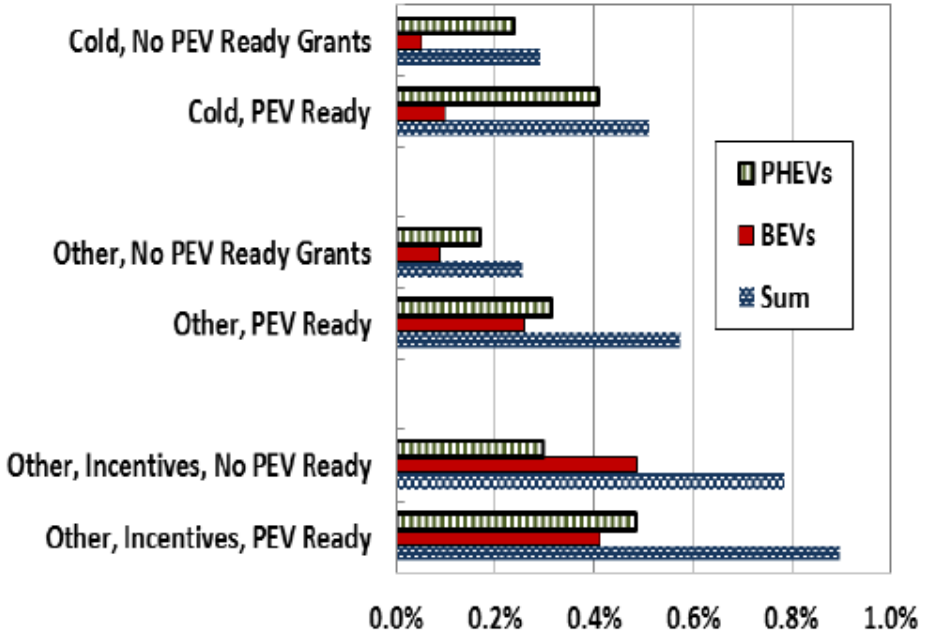
U.S. PEV Partnering Landscape: Initiatives



Engaged Partners and Stakeholders have played critical roles in EV market growth

Cold Climate, Incentives and DOE Clean Cities Readiness Grants

Cold climate (BEV range penalty) reduced BEV shares while incentives (mostly states in air quality nonattainment) helped



Average PEV shares by group

PHEV/EREV fare better in cold climates – incentives and stakeholder engagement always move the needle.

Infrastructure | Deployment Strategies

Tools are in place:

- Workplaces, Public Guidance
- Case Studies
- Decision Guides
- Survey Tools
- Siting, Designing, Permitting
- Cluster Analysis
- Electric Highway Considerations

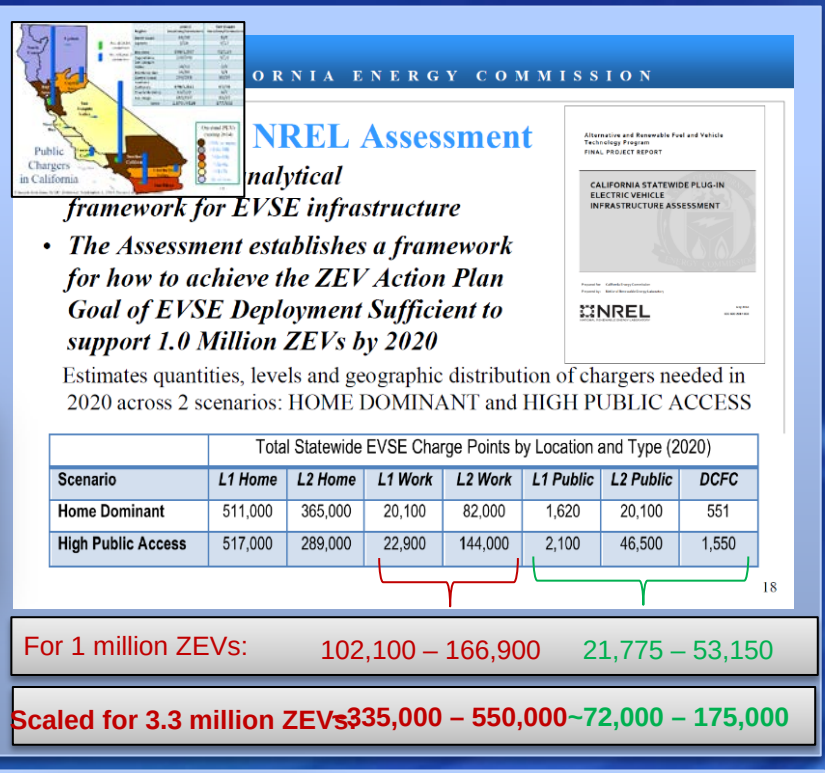
EMPLOYER EV INITIATIVE

CALIFORNIA PLUG-IN ELECTRIC VEHICLE COLLABORATIVE

Project Get Ready AN RMI INITIATIVE

EV CITY CASEBOOK

WEST COAST ELECTRIC HIGHWAY

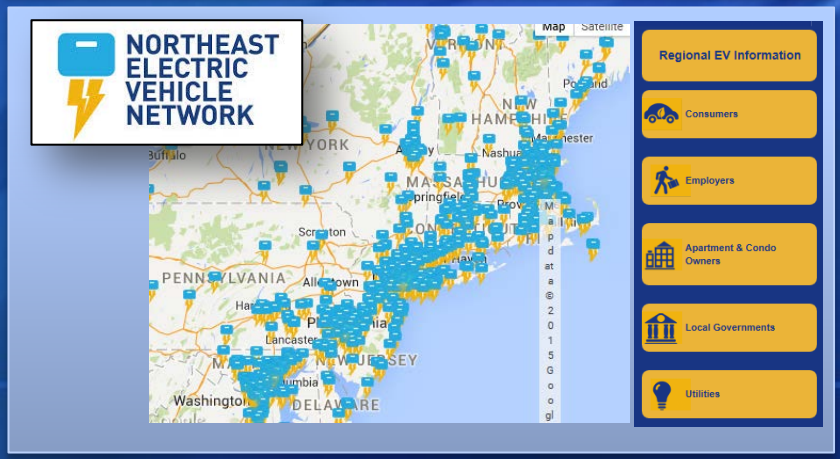


For 1 million ZEVs: 102,100 – 166,900 21,775 – 53,150

Scaled for 3.3 million ZEVs: 335,000 – 550,000 ~72,000 – 175,000

(re)Consideration Scale:

- Regional infrastructure deployments
  - CA vs NE (different patterns)
  - Role of connectors
  - Integrated cities / density
  - Managing growth at workplaces
- Re-imagining Scale
  - New paradigms may be necessary
  - CA utility proposal 60,000 locations in 5 years. (Current: ~7,000)
- Educating & Outreach
  - Not enough to have the tools.



501 GM WORKPLACE CHARGING STATIONS
Including 25 Assembly Plants

(19% Solar; 2 ADA friendly; 400 add'l private; 66% 240V and 33% 120V)

Also: Chevrolet and Cadillac dealers have installed approximately 5,900 charge stations at their locations for owner use – 17 of these dealerships use solar charging canopies.

DOE's Workplace Charging Challenge Partners

➔ Goal is tenfold increase in partnering companies in 5 years!

Currently
175 Partners

Employees of companies with workplace charging are **20x more likely** to purchase an EV, than companies with no workplace charging (DOE)

Source: DOE's Energy Efficiency and Renewable Energy (EERE); eere.energy.gov

Infrastructure | New Roles

Utility Role

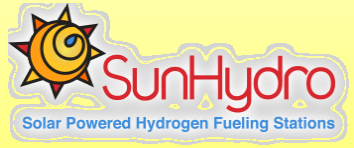
Public Service Commission

California PUC
- R. 13-11-007 Alt Fuel Vehicle
- A.14-02-006 Energy Storage
- Utility Proposals
  - SDG&E (A.14-04-014)
  - SCE (A.14-10-014)
  - PG&E (A.15-02-009)
- R.11-03-012 Low Carbon Fuel Standard

Massachusetts DPU
- EV Proceeding

New York PSC
- Reforming the Energy Vision

H_2 Station



Industry Gas Suppliers
- Air Products, Linde, Air Liquide, United Hydrogen, etc

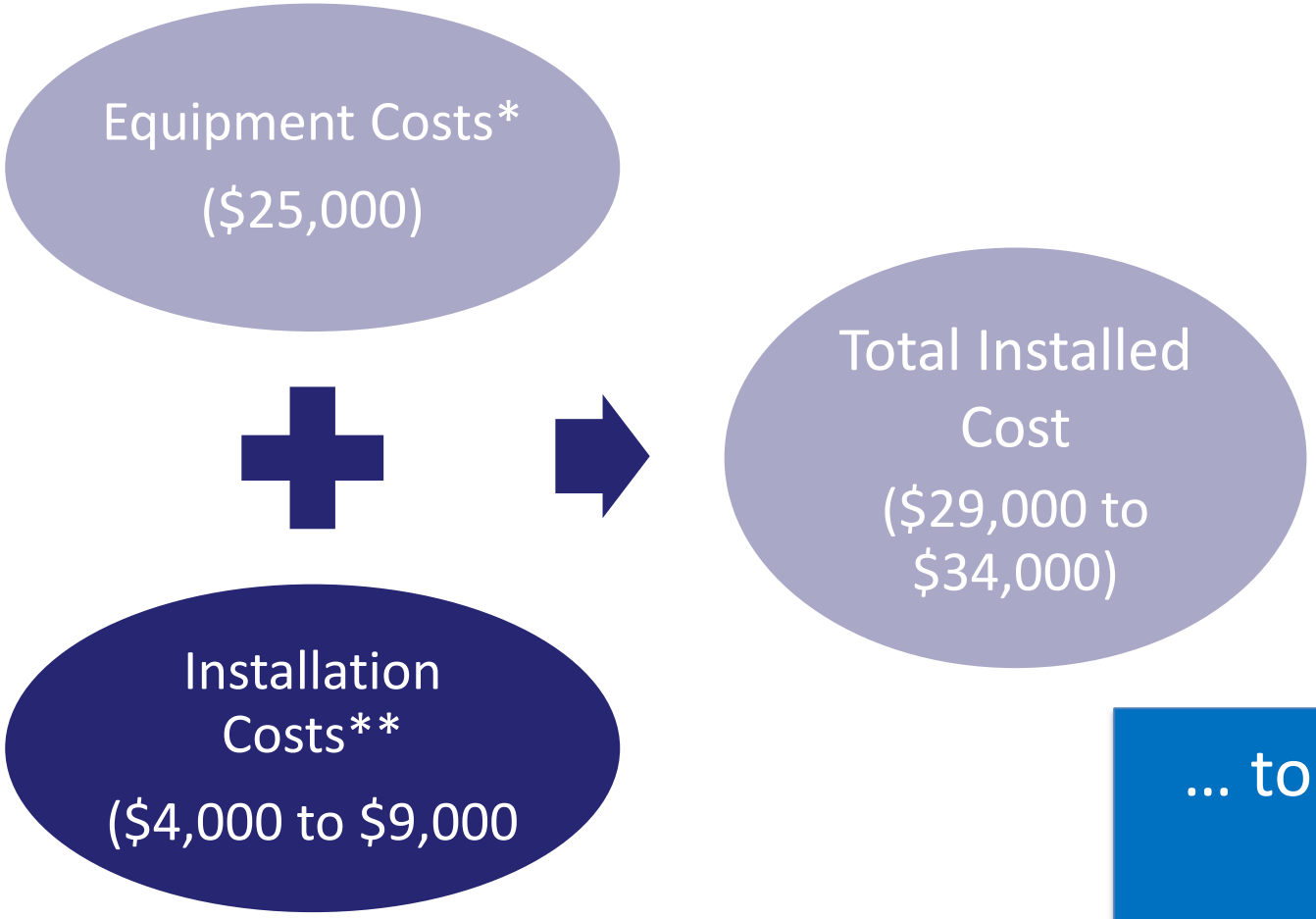
Retail Providers
- First Element, H2 Frontier, SunHydro, HyGen, Stratos, etc

Technology Providers
- ITM, Hydrogenics, Ballard, HTEC, Plug Power, etc

Oil Companies
- Shell, etc

Automakers are working with infrastructure providers to establish sustainable infrastructure business models that ensure focused on customer needs

Why should a utility have a role in installing infrastructure?



OUC installed 5x 40kW DC fast-charge stations in Orlando, FL

- Siting wisely is key
- Focused on locations with easy access to transformer
- Installation cost was $4k-$9k per site (well below other nationally reported efforts)

… to expertly manage station siting and installation to keep costs low

***Units provided through Donor**
****Data based on the installation of 5 stations in Orlando, FL**

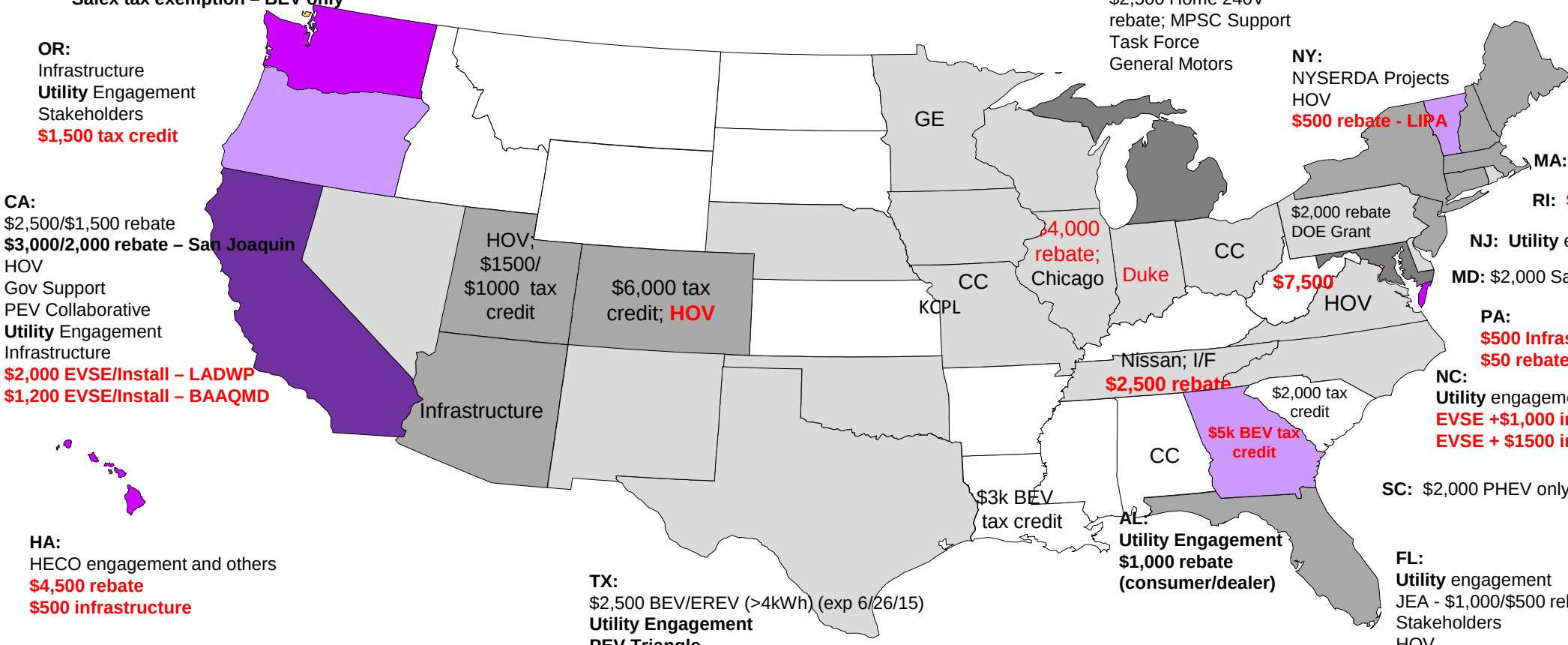
OUC's DC Fast-Charger Installation Cost Breakdown by Site

Location	Installation ($)	Step Down Required?
Rosen Shingle Creek	$8,780	YES
UCF Medical School	$8,040	YES
Chamber of Commerce	$4,046	NO
OUC Gardenia	$8,928	YES
OUC Reliable Plaza	$6,939	YES
Average	**$7,347**	

red = expired

PEV Sales per Capita (BEVs, EREVs, and PHEVs)

Sales per 100,000 people – through October 2014



WA:
Infrastructure
Stakeholders
Salex tax exemption – BEV only

OR:
Infrastructure
Utility Engagement
Stakeholders
$1,500 tax credit

CA:
$2,500/$1,500 rebate
$3,000/2,000 rebate – San Joaquin
HOV
Gov Support
PEV Collaborative
Utility Engagement
Infrastructure
$2,000 EVSE/Install – LADWP
$1,200 EVSE/Install – BAAQMD

HA:
HECO engagement and others
$4,500 rebate
$500 infrastructure

TX:
$2,500 BEV/EREV (>4kWh) (exp 6/26/15)
Utility Engagement
PEV Triangle
$1,000 rebate – CPS Energy

MI:
$2,500 Home 240V
rebate; MPSC Support
Task Force
General Motors

NY:
NYSERDA Projects
HOV
$500 rebate - LIPA

NE States:
C2ES
Georgetown Univ
Delaware Val.
NE **Utilities**
VEIC
Vt – Green Mtn Pwr

MA: $2500 rebate

RI: $1875 tax credit

NJ: Utility engagement; HOV

MD: $2,000 Sales tax; HOV

PA:
$500 Infrastructure rebate
$50 rebate - PECO

NC:
Utility engagement
EVSE +$1,000 install – Duke
EVSE + $1500 install - Progress

SC: $2,000 PHEV only (?) – tax credit

AL:
Utility Engagement
$1,000 rebate
(consumer/dealer)

FL:
Utility engagement
JEA - $1,000/$500 rebate
Stakeholders
HOV

PEV Sales per 100,000

- >300
- >150
- >100
- >75
- >50
- >25
- <25

Good correlation between states with PEV sales and those states with strong stakeholder engagement efforts.

How does a state benefit economically from PEV incentives?

1. **Electricity is cheaper than gasoline**
   - PEV owners spend less on fuel costs and thus can spend more on other locally/state-produced goods and services
2. **Federal tax credits**
   - PEV purchasers qualify for the federal $7,500 EV income tax credit, which increases cash inflows to the state's households

Washington* value of EV sales tax exemption:

- State GDP increases **$25mil** over 5 years ($68mil through 2030)
- EV drivers save **$29mil** in fuel costs over five years ($145mil through 2030)

Oregon* value of proposed EV rebate:

- State GDP increases **$38mil** over 5 years ($83mil through 2030)
- EV drivers save **$32mil** in fuel costs over five years ($153mil through 2030)

Georgia* value of EV tax credit:

- State GDP increases **$107mil** over 5 years ($252mil through 2030)
- EV drivers save **$95mil** in fuel costs over 5 years ($453mil through 2030)

**Economic studies commissioned by Securing America's Future Energy (SAFE) and the Electrification Coalition, and prepared under the direction of Keybridge's Robert F. Wescott, Ph.D., former economic advisor to President Clinton; uses the REMI, Inc. economic model.*

Ohio value of EV sales:**

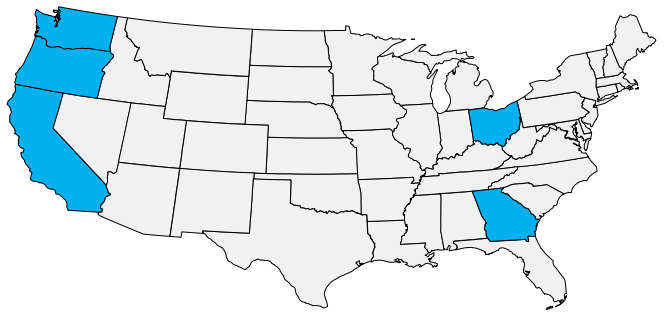
- For every $1 spent on gasoline, only 16.4 cents remains in Ohio's economy
- If 5% of Ohio's vehicles were PEVs, EV drivers would save **$600mil/yr**, freeing up spending for other locally/state-produced goods and services

***Economic analysis performed by AECOM, with Quercus*

California* value of EV sales:**

- Net benefit of a PEV is approximately **$5,000** over the life of the vehicle

****CalETC's Transportation Electrification Assessment (October 23, 2014)*



Reframe our thinking:

At launch: Cost of incentives, impact on grid, etc.

Today: Benefits (ROI (market/household), grid) to communities

What will it take to Grow the PEV Market?

- Drive Consumer Demand!
  - Keep a Laser-like Focus on the Vehicles
- Build Awareness
  - National Awareness Campaign
  - Ride and Drives → Butts-in-Seats
- Workplace charging
  - Provides daily charging for those without convenient home charging
  - Doubles the potential for daily electric miles driven
  - Provides a visible showcase of PEVs to potential new car buyers (employees, execs, fleet managers)
- Continue to grow state/regional task forces to align policies (incl. incentives), education and awareness efforts

(re)Consider Scale of complementary market development efforts

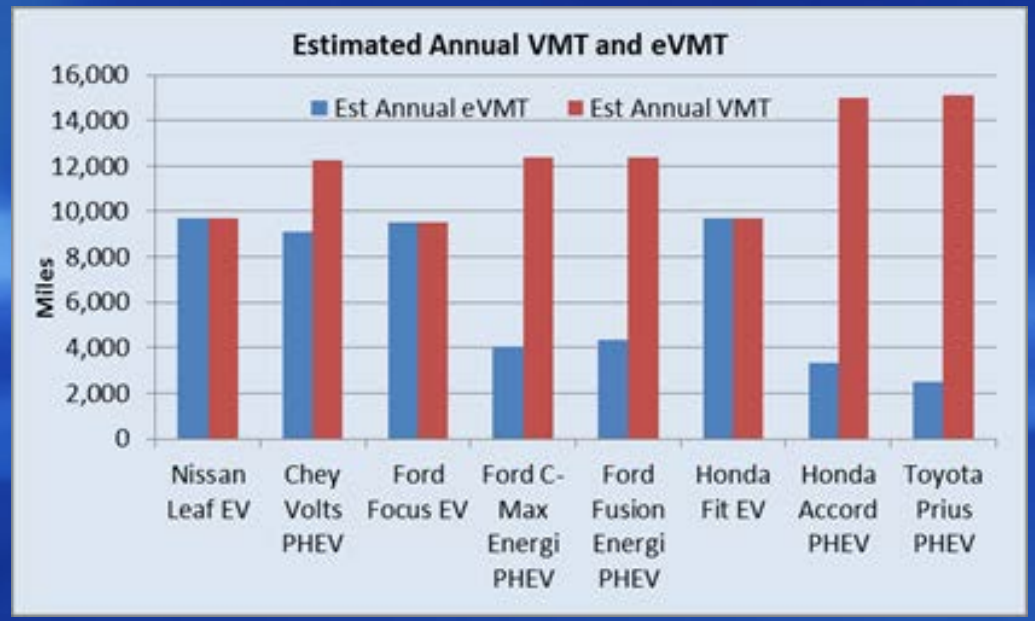
Thank You.

2016 Chevrolet Volt

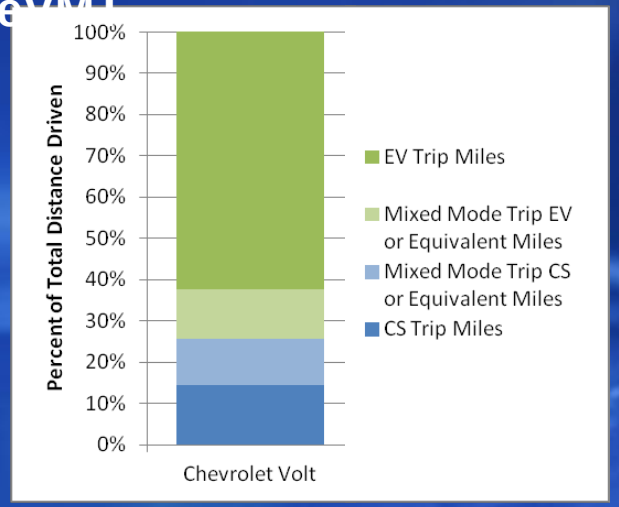
Chevrolet Bolt Concept

Backup

Chevrolet Volt | Impact to Date: INL Analysis



INL Analyses highlights eVMT



Volt is being used as expected:

- Volt Customers are primarily driving electrically

No compromises

- No range anxiety, use full extent of battery range
- May be used on all trips, regardless of length
- May be the household's only vehicle

Chevrolet Volt | Impact to Date: GM Analysis

Presentations at SAE (Feb 2015) / World Congress (Apr 2015):
667 million miles of Volt customer driving has been analyzed

February Presentation Abstract: http://www.sae.org/events/pdf/hybridev/2015_hybridev_guide.pdf
Paper (Published in April): http://papers.sae.org/2015-01-1164/

¶Sample Size

- Data collected from Oct. 2013 through Sept. 2014
- MY11–14 retail vehicles sold in US and Canada with active OnStar accounts

¶Results

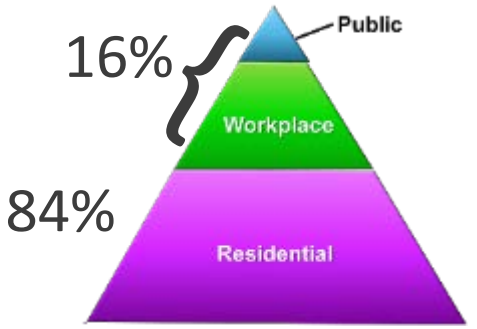
- **Volt drivers traveled 74% of their total miles all-electrically**
  - ➢ Projected to increase to 80% for Second Generation Volt drivers
- Volt initial engine starts were reduced by 70% relative to conventional vehicles
  - ➢ Projected to increase to 77% for the Second Generation Volt
- Daytime charging by Volt drivers contributed to increasing daily all-electric range beyond the EPA label values
- Significantly less real-world production of smog forming emissions from E-REVs vs. a conventional vehicle or PHEV equivalent
  - ➢ Not yet accounted for in the EPA label smog score rating

Home vs. Work vs. Public Charging

DOE's EV Project Data

- EV drivers Overall:

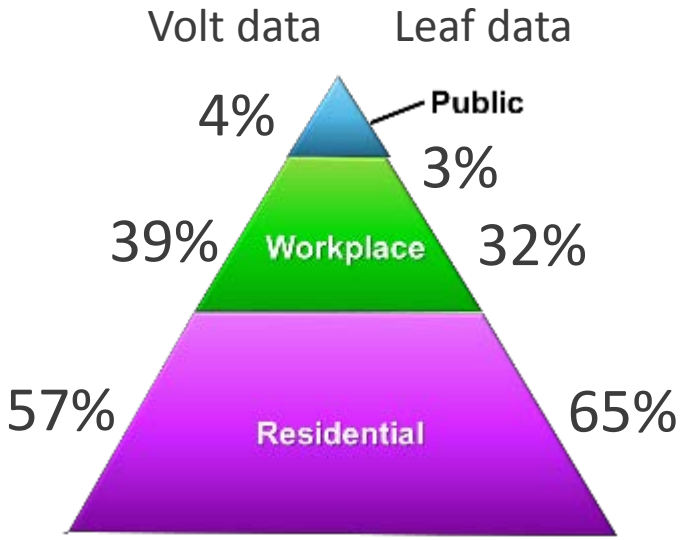
  Study Period 1/1/2012 – 12/31/2013
  - 84% of all charging events are at home
  - 16% not at home



- When workplace charging is available to an EV driver:

  (96 Volts with access to workplace charging Jan '13 – Dec '13)
  - 57% of charging events are at home
  - 39% at work
  - 4% at other locations (e.g. public)

  (707 Leafs with access to workplace charging Jan '12 – Dec '13)
  - 65% of charging events are at home
  - 32% at work
  - 3% at other locations (e.g. public)

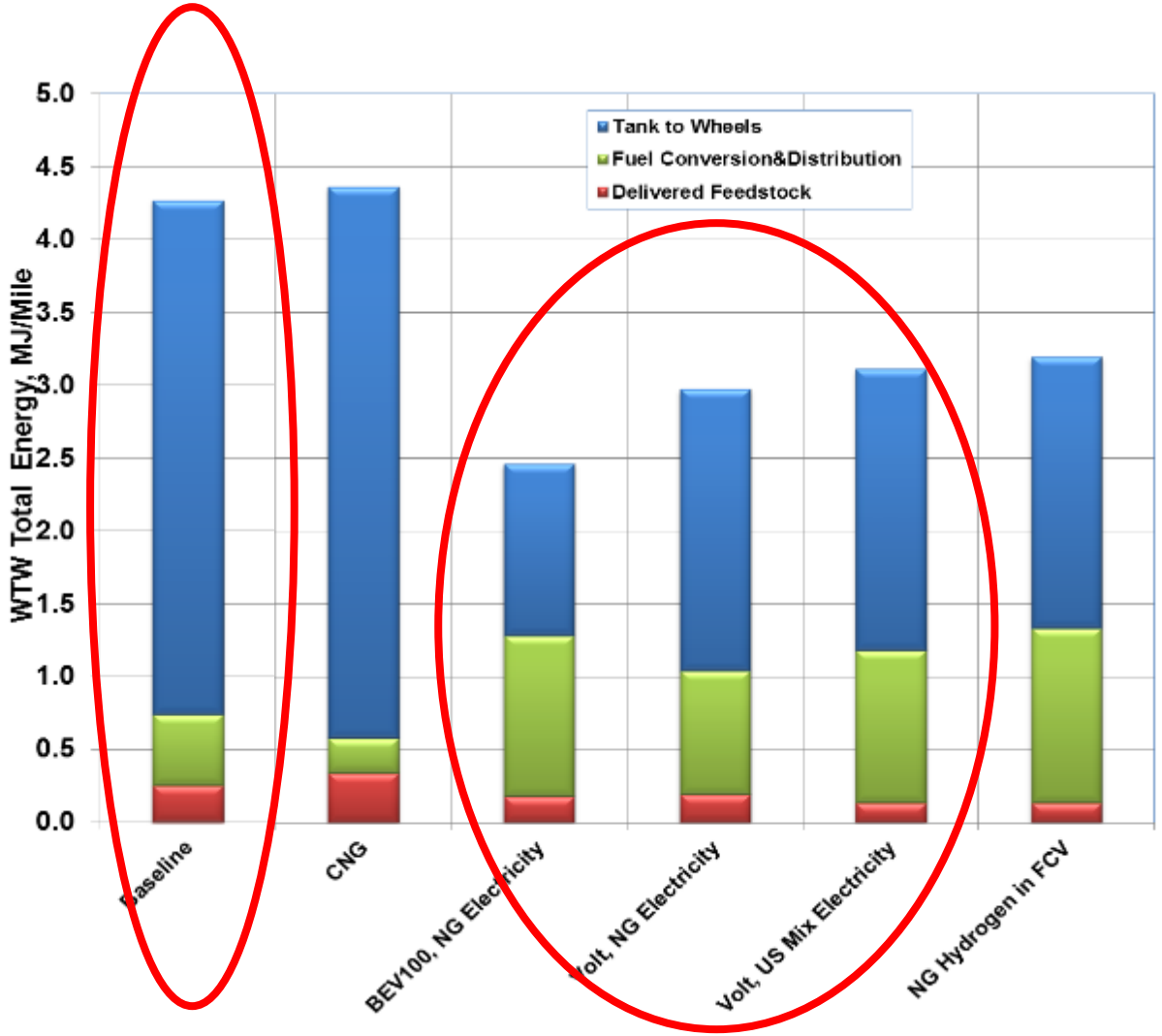


Residential and workplace charging provide the vast majority of all charging.

Source: John Smart, INL, EV Project; Link to all reports = http://avt.inel.gov/librarybydate.shtml

Well-to-Wheels TOTAL ENERGY

- Well-to-Wheels energy analysis accounts for the total energy used across 3 phases from feedstock extraction thru fuel use in a vehicle:
  1. Feedstock extraction and delivery
  2. Fuel conversion and distribution
  3. Fuel use in the vehicle
- 6 fuel pathways compared
- Though more energy is used to produce electricity, the battery (and hydrogen fuel cell) vehicle pathways use less overall energy due to the efficiency of the fuel use on the vehicle.

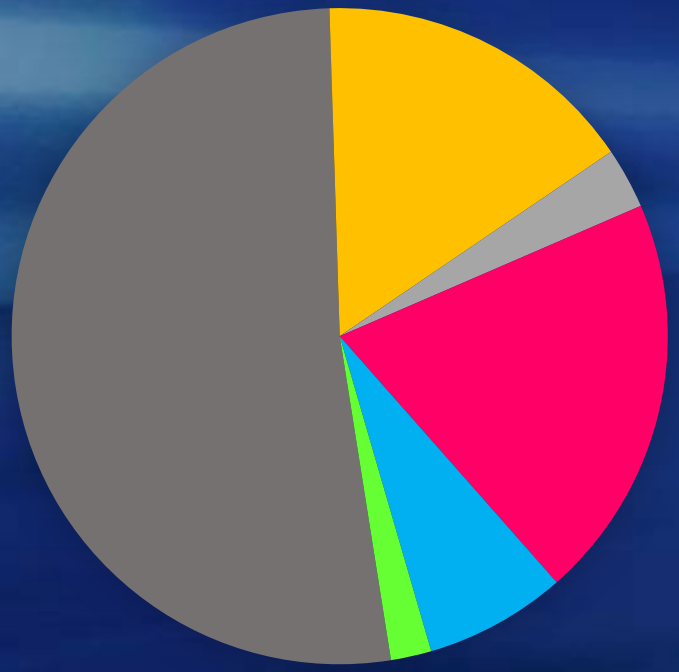


Probably the single most important step a home owner/car owner can take to reduce overall “energy” use.

U.S. Electricity Generation: 2000 to 2014

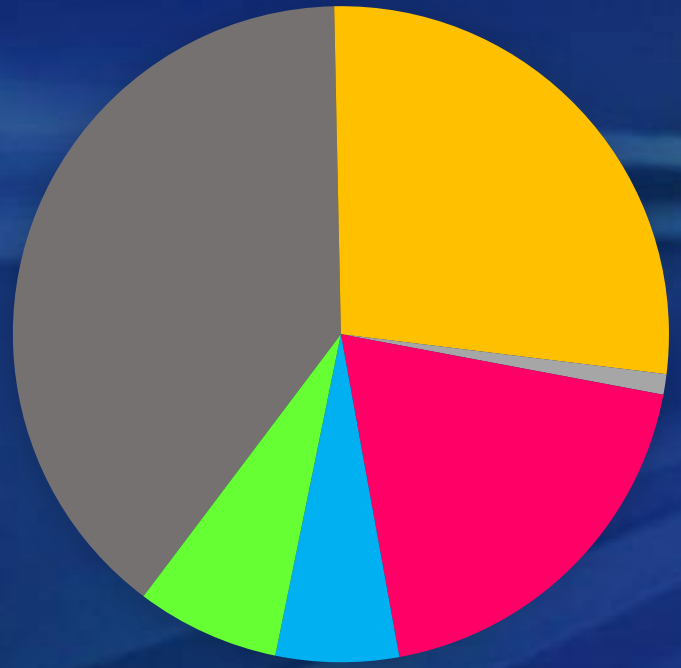
U.S. Average Electricity Fuel Mix

2000



U.S. Average Electricity Fuel Mix

2014



Coal
Natural Gas
Petroleum
Nuclear
Hydro
Renew

The Grid is Getting Cleaner… Since 2000: significant reductions in Coal (52% to 39%); and increases in Natural Gas (16% to 27%) and non-Hydro Renewables (2% to 7%)

Source: EIA, U.S. Energy Information Administration

What is Required of Utilities and Utility Regulators

A growing PEV market benefits everyone

- Individual benefits: fuel savings, quiet and exciting ride & handling
- Society benefits: energy security, environment (local air, climate), and grid reliability
- Utility benefits: a smart load that drives new revenue to keep rates low

Utilities need to be active participants in growing the PEV market

- This is a "learning" transition and requires hands-on experience to shape next steps
- The PEV market will not escape "niche" unless utilities (and regulators) get involved

Active role in home, workplace and DC fast-charging

- PEVs are already very smart and will do most charging at home – utilities will want to ensure good load balancing across the service territory (off-peak EV rates, smart charging)
- Workplace charging is key to growing PEV awareness and corporate relationships are key to utilities - a utility will want to ensure healthy corporate engagement
- A basic network of DC fast-chargers will grow BEV adoption among fence-sitters

Active role in PEV outreach and education

- Utilities are trusted 3rd parties and operate at a local level – key for building awareness

Longer term – pilot projects

- Utilities need to probe the role of PEVs in ancillary services, V2H, V2G, and battery secondary use to address growing issues in renewables, intermittency, storage, outage

THANK YOU