



## Annual Merit Review and Peer Evaluation Meeting

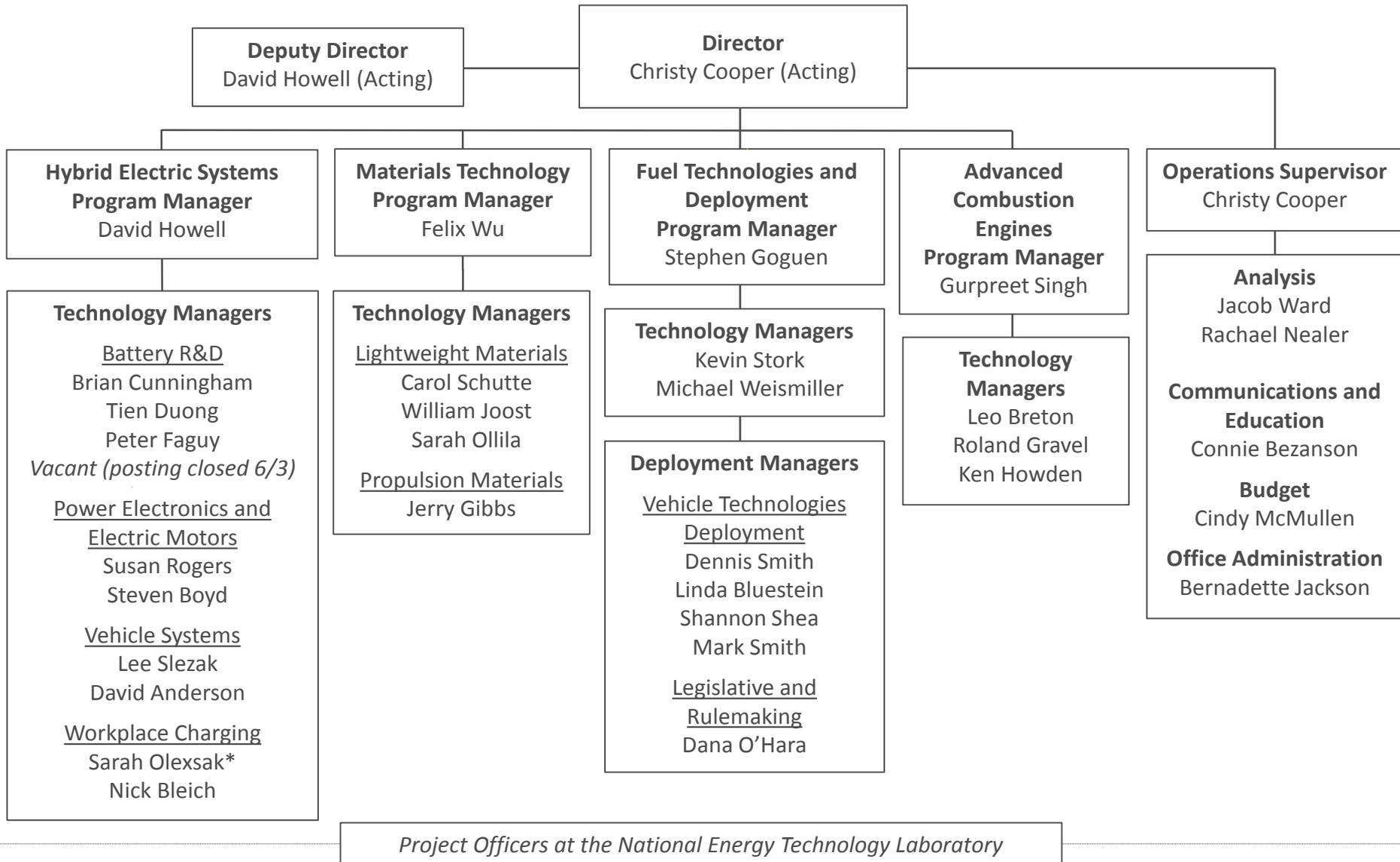
June 6, 2016

Christy Cooper  
Acting Director  
Vehicle Technologies Office

# Today:

- **What's new in VTO**
- **Priorities and Initiatives**
- **Hot Off the Press!**

# Vehicle Technologies Office Federal Staff



\*On detail to WH Council on Environmental Quality

# New VTO Staff



**Felix Wu**

Program Manager, Materials



**Sarah Ollila**

Technology Manager, Materials



**Mike Weismiller**

Technology Manager,  
Fuel and Lubricant Technologies



**Nick Bleich**

Presidential Management Fellow  
Workplace Charging Challenge



**Dave Gohlke**

AAAS Fellow, Analysis



**Rachael Nealer**

Technology Manager, Analysis

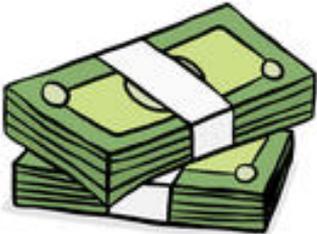
# Sustainable Transportation Drivers

**2/3** of total U.S. petroleum usage is for transportation



On-road vehicles account for **85%** of transportation petroleum usage

Transportation is the **2<sup>nd</sup>** most expensive spending category after housing



Transportation accounts for **~1/3** of U.S. carbon pollution

# Vehicle Technologies Portfolio

## *Advanced Technologies for Clean, High Efficiency Vehicles*

### **Batteries and Electric Drive**

- Advanced batteries
- Advanced electric drive technologies

### **Vehicle Systems**

- Grid integration
- Validation
- Aerodynamics, rolling resistance, and accessory loads
- Modeling
- Codes and standards
- Connected and autonomous vehicles

### **Materials Technology**

- Lightweight low cost structural composites
- Lightweight metals improved properties, processing, cost
- Predictive tools
- Multimaterial enabling: joining, corrosion
- Materials enabling higher efficiency propulsion systems

### **Advanced Combustion Engines**

- Combustion R&D (low temperature combustion, lean-burn, direct injection)
- Emission controls and aftertreatment
- Light- and heavy-duty engine efficiency

### **Fuels and Lubricants**

- Drop-in biofuels
- Clean/efficient combustion fuel characteristics
- Improve use of natural gas in vehicles
- Advanced lubricants

### **Outreach, Deployment, and Analysis**

- Deployment – Clean Cities
- EPA rulemaking
- Student competitions
- Analysis

# Vehicle Technologies Budget (\$K)

| Subprogram/Key Activity                 | FY 2016 Enacted  | FY 2017 Request  | Cross-Cutting Initiatives                               |
|---|------------------|------------------|---|
| <b>Vehicle Technologies</b>             | <b>\$310,000</b> | <b>\$468,500</b> |   |
| Batteries & Electric Drive Technologies | \$141,100        | -                |   |
| Battery Technology R&D*                 | -                | \$130,000        | <i>EV Everywhere, CEMI</i>                              |
| Electric Drive Technologies R&D*        | -                | \$39,000         | <i>EV Everywhere</i>                                    |
| Vehicle Systems                         | \$30,600         | \$90,000         | <i>EV Everywhere, Grid Modernization, SuperTruck II</i> |
| Advanced Combustion Engine R&D          | \$37,141         | \$74,800         | <i>SuperTruck II, Co-Optima</i>                         |
| Materials Technology                    | \$26,959         | \$82,700         |   |
| <i>Lightweight Materials Technology</i> | <i>\$21,636</i>  | <i>\$71,500</i>  | <i>Advanced Materials, EV Everywhere, SuperTruck II</i> |
| <i>Propulsion Materials Technology</i>  | <i>\$5,323</i>   | <i>\$11,200</i>  | <i>SuperTruck II</i>                                    |
| Fuel and Lubricant Technologies         | \$22,500         | \$20,500         | <i>Co-Optima</i>  |
| Outreach, Deployment, and Analysis      | \$48,400         | \$31,500         |   |
| <i>Vehicle Technologies Deployment</i>  | <i>\$34,000</i>  | <i>\$23,000</i>  |   |
| <i>Advanced Vehicle Competitions</i>    | <i>\$2,500</i>   | <i>\$2,500</i>   |   |
| <i>Legislative and Rulemaking</i>       | <i>\$1,500</i>   | <i>\$1,500</i>   |   |
| <i>Analysis</i>                         | <i>\$10,400</i>  | <i>\$4,500</i>   |   |
| NREL Site-Wide Facility Support         | \$3,300          | -                |   |

FY17 House Mark for Vehicle Technologies: \$268M; FY17 Senate Mark for Vehicle Technologies: \$308M

\* Battery Technology R&D and Electric Drive Technologies R&D proposed as separate subprograms in FY 2017 Request.

# Industry Partnerships: U.S. DRIVE

## Recent Highlights:

- ✓ **Completed Cradle-to-Grave Analysis:** Cross-cutting, consensus-based study of full lifecycle petroleum/GHG reduction potential of multiple pathways (**published June 1!**)
- ✓ **2015 Highlights of Technical Accomplishments Report**

## Look Ahead:

New 2025 Partnership research targets  
(June 2016)



<http://energy.gov/eere/vehicles/vehicle-technologies-office-us-drive>

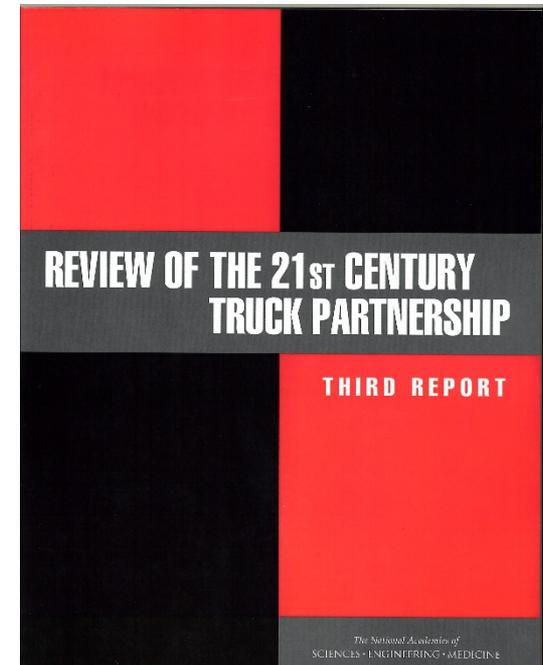
# Industry Partnerships: 21<sup>st</sup> Century Truck

## Recent Highlights:

- ✓ Completed third NAS review of 21CTP – with favorable results
- ✓ Expanded scope of hybrid team to encompass advanced adaptive transmission and axle technologies
- ✓ Held first joint meeting of 21CTP (manufacturers) and National Clean Fleets Partnership (user community)

## Look Ahead:

Working on extensive revisions to 21CTP roadmap



# Major Interagency Collaborations

- **Department of Defense**

- **Advanced Vehicle Powertrain Technology Alliance**
- Collaboration, coordination, and co-funded projects; do more together than either could do separately



- **Department of Transportation**

- Longstanding coordination across RDD&D portfolio
- **NEW: MOU formalizes collaboration on innovative smart transportation systems and alternative fuel technologies**



- **Environmental Protection Agency**

- Longstanding coordination across RDD&D portfolio
- Jointly sponsorship of [www.fueleconomy.gov](http://www.fueleconomy.gov) and **Green Racing**



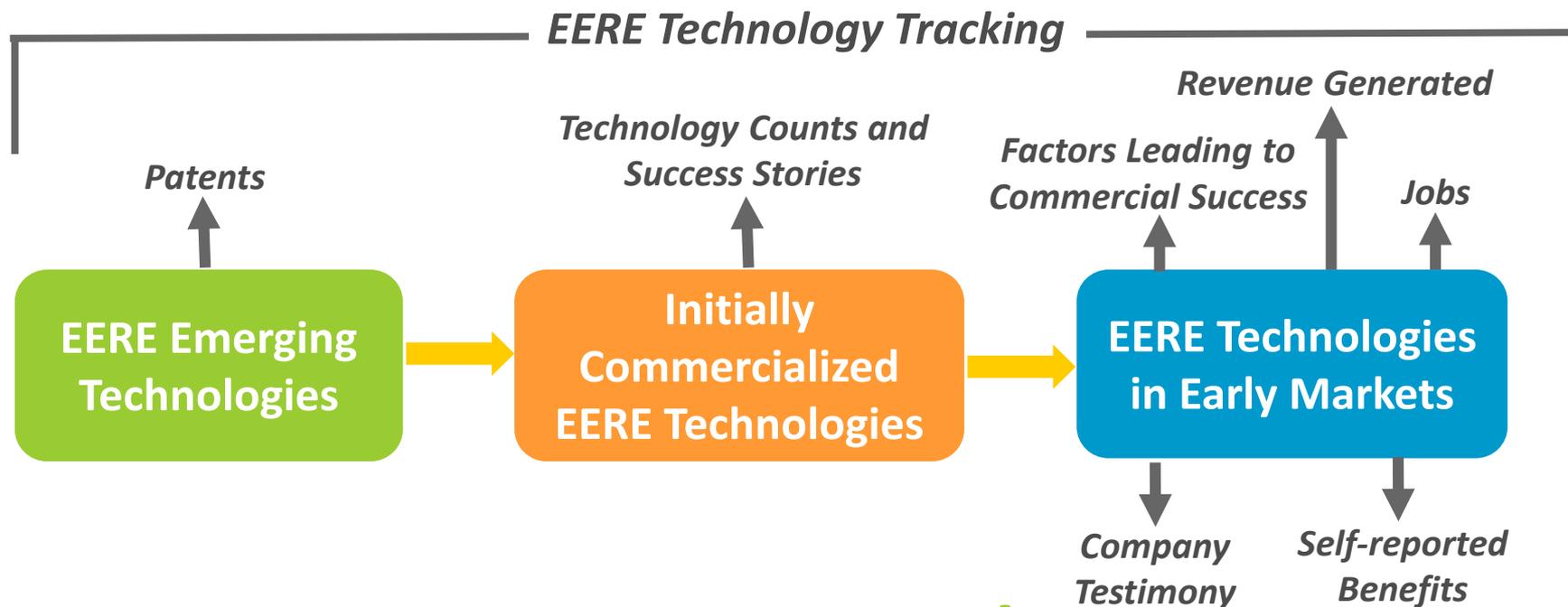
- **Department of Interior**

- Competitively-selected projects to showcase clean, alternative fuel technologies in **highly-visible demonstrations** at National Parks



# Measuring Progress: EERE Technology Tracking Activity

- New this year; led by PNNL
- “Technology” is defined as a process, technique, design, widget, machine, tool, material, or software that...
  - was funded, at least in part, by an EERE program
  - has resulted in domestic manufacturing, sales, or deployment



**VTO PIs: PNNL may contact you!**

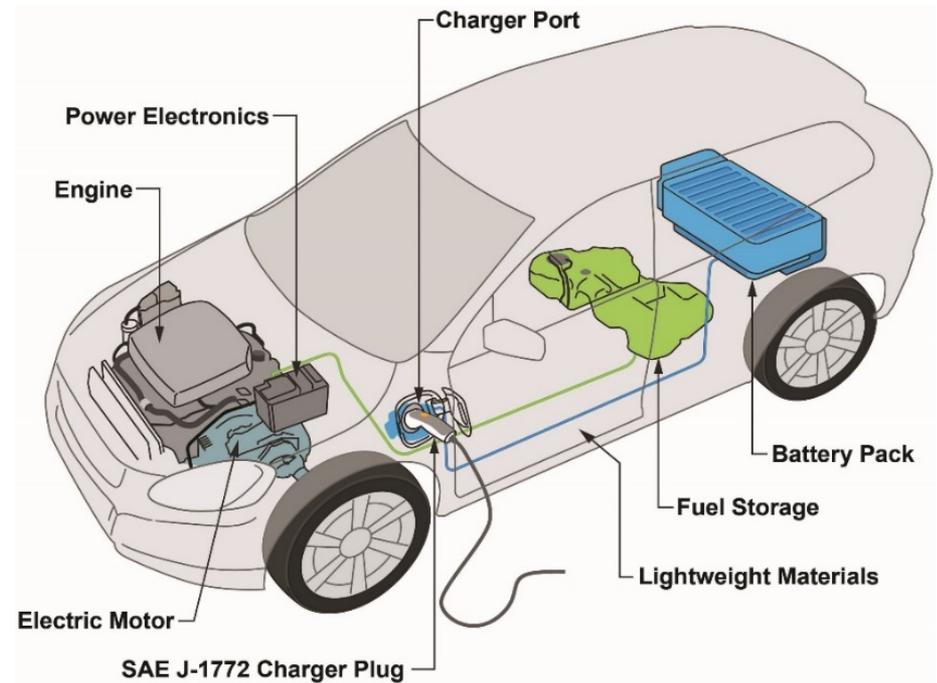
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# Priorities and Initiatives

# EV Everywhere Grand Challenge

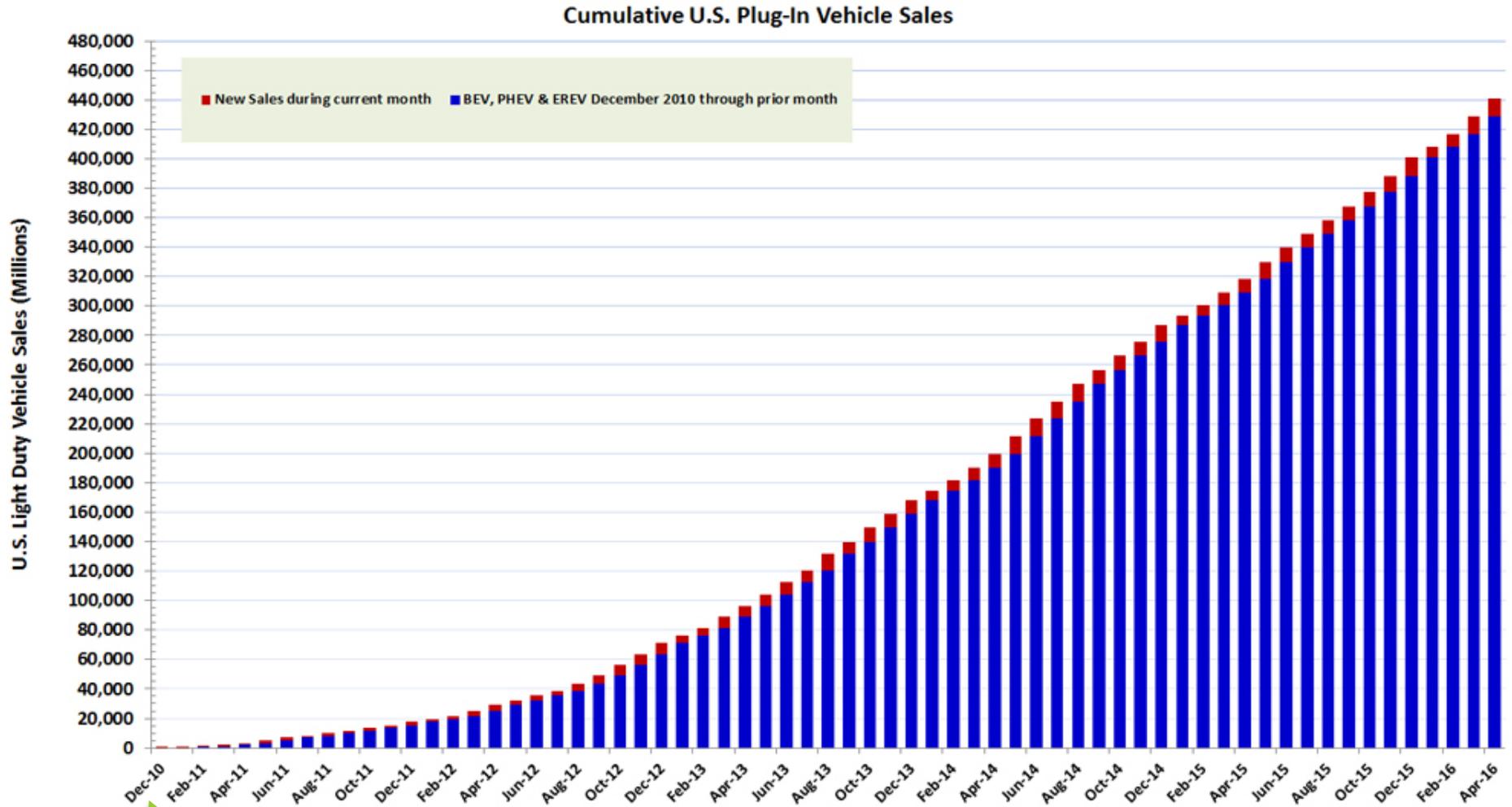
## Goal:

Enable plug-in electric vehicles to be as affordable and convenient for the American family as conventional gasoline-powered vehicles by 2022



[energy.gov/everywhere](https://energy.gov/everywhere)

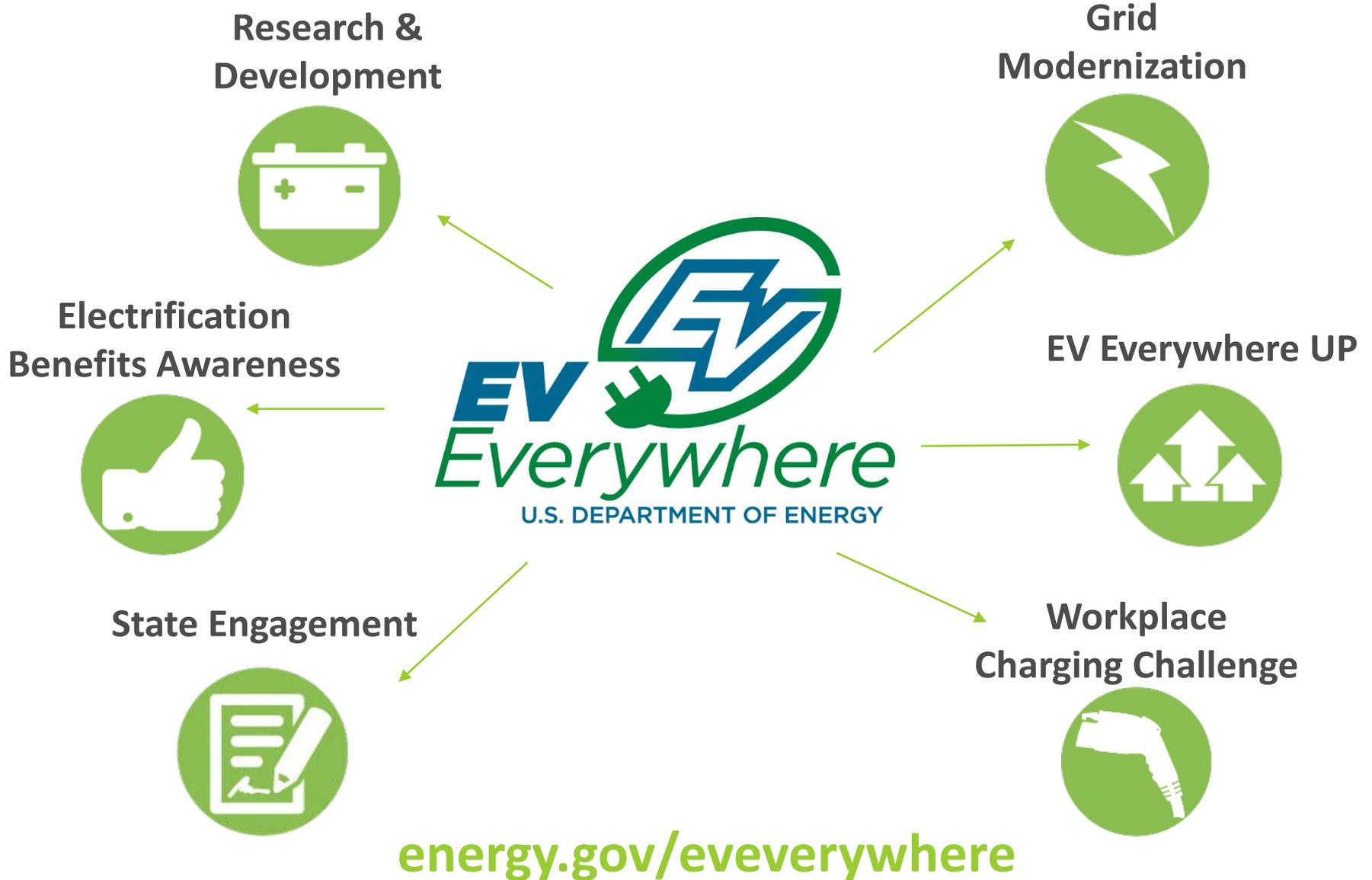
# Plug-in Electric Vehicle Market Growth



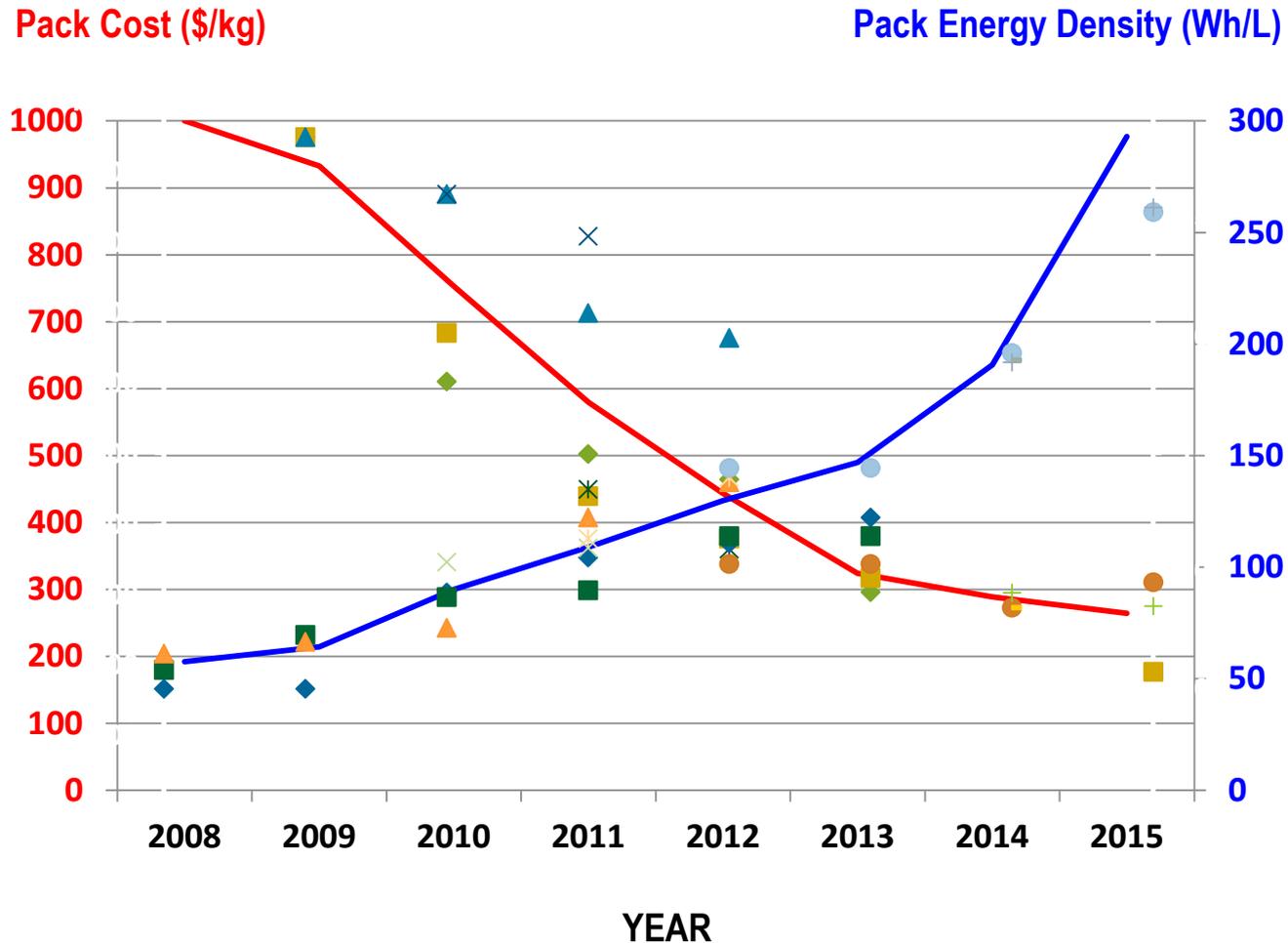
Volt and LEAF  
release (Dec 2010)

440,000+ PEVs on  
U.S. roads (Apr 2016)

# EV Everywhere and Market Acceleration



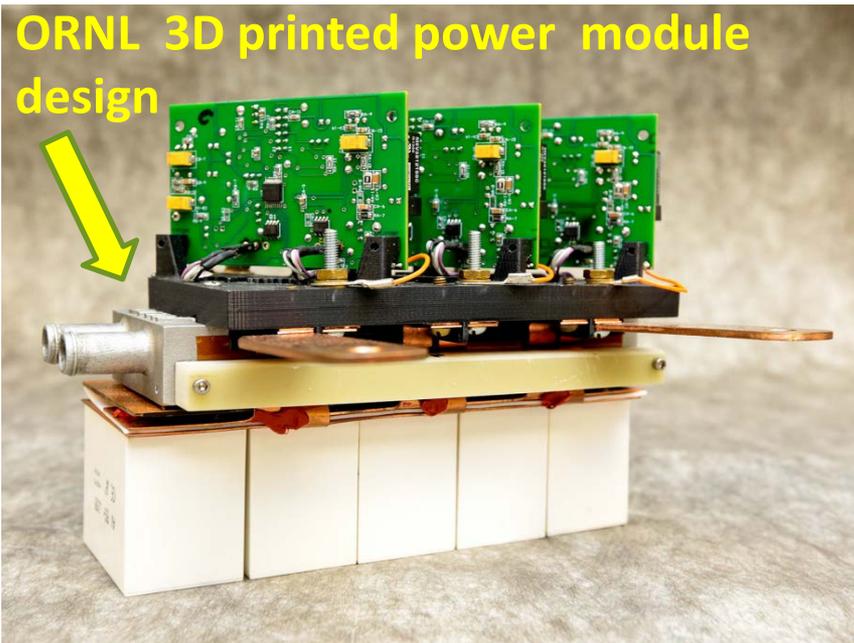
# R&D Highlights: Batteries



VTO R&D has lowered the cost of batteries to **\$268/kWh;**  
**~70%** reduction since 2008

# R&D Highlights: Electric Drive/Systems

ORNL 3D printed power module design



## Worlds' First 3D Printed Inverter

- Innovative cooling technique for high and low temperature components
- Design approach possible only with 3D printing techniques

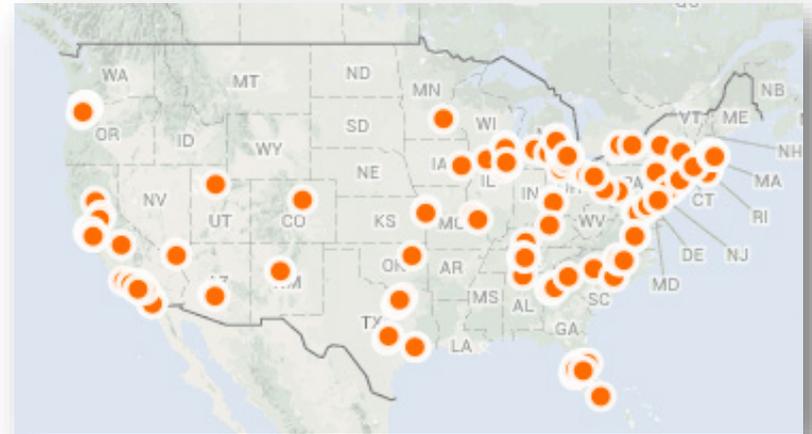
## Wireless Charging System Demonstration

>90% grid-to-battery efficiency while in-motion wireless charging system achieves charge-sustaining energy transfer



# Workplace Charging Challenge

Goal: Increase the number of employers offering charging by 10x by 2018

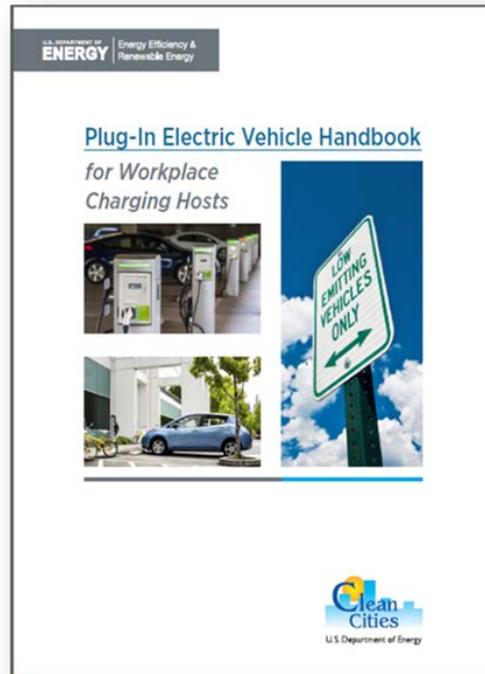


- ~300 Partner employers committing to provide EVSE for employees
- 5,500+ EVSE installed or planned for installation
- 18 Ambassadors promoting and supporting workplace charging

## Resources:

<http://energy.gov/eere/vehicles/workplace-charging-challenge-install-and-manage-pev-charging-work>

# Join the Challenge!



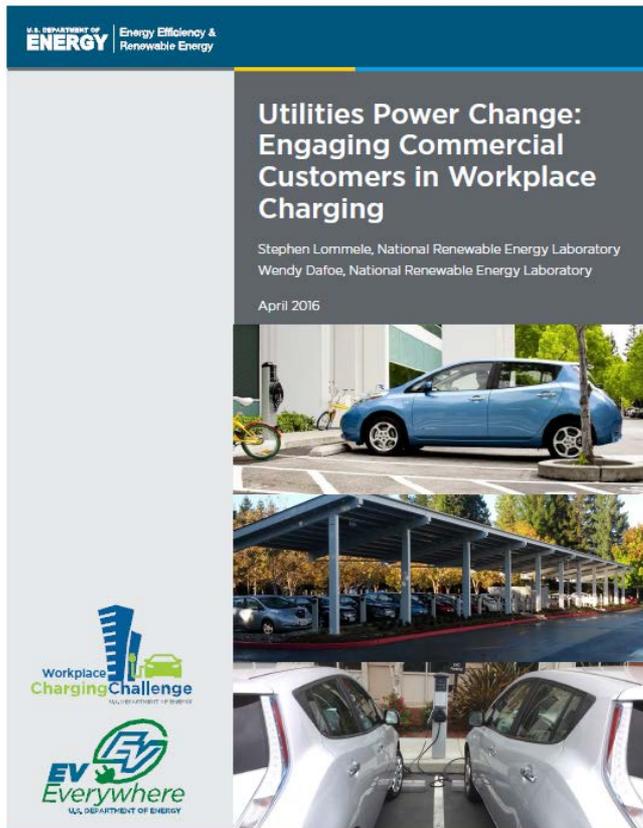
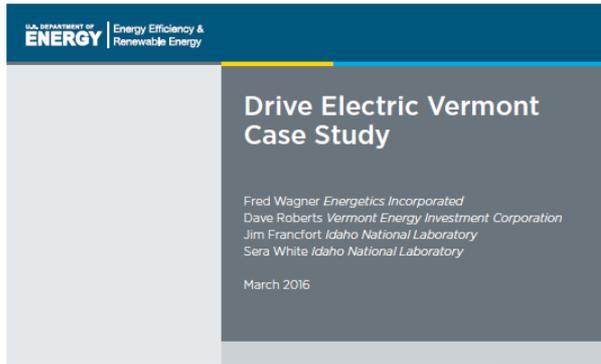
- EV 101
- Employer Resources
- Employee Outreach Toolkit
- Case Studies
- Webinars
- Workshops
- Quarterly Newsletters
- One-on-One Technical Assistance

Take the Pledge  
Join the Challenge



For more information or to  
join the Workplace Charging  
Challenge, contact  
[Nicholas.Bleich@ee.doe.gov](mailto:Nicholas.Bleich@ee.doe.gov)

# EV Everywhere *Solution Center*



## *Find:*

- Drive Electric Vermont Case Study
- Workplace Charging Utility Case Studies
- National Economic Value Assessment
- Consumer Behavioral Analysis
- Infrastructure Analysis
- Fleet Gap Analysis
- ...and more!

[energy.gov/everywhere](http://energy.gov/everywhere)

# Awareness Campaign: Best.Drive.EVer – Go Electric!

TAGLINE LOCKUP

Best. Drive. **EVer.**

For drivers of **ELECTRIC VEHICLES,**  
it adds up.



COLOR PALETTE

FONT

**GOTHAM**

abcdefghijklmnopqrstuvwxyz

ABCDEFGHIJKLMNOPQRSTUVWXYZ

0123456789(!@#%&.,?;:)

**CAMPAIGN FLEXIBILITY**

Campaign design and  
content easily translate to:

**PRINT AD**

**POSTER**

**FLYER**

**BILLBOARD**

**TRANSIT AD**

**WEB BANNER AD**

**SOCIAL MEDIA POST**

**electricity + car =**  
**POWER**

For drivers of  
**ELECTRIC VEHICLES,**  
it adds up.

Best.  
Drive.  
**EVer.**

WEBSITE.COM #BestDriveEVer

Contact: [Robert.Graham@ee.doe.gov](mailto:Robert.Graham@ee.doe.gov)

# Grid Modernization

**Mitigating adverse effects** of EV deployment and **leveraging existing synergy** between EVs and the grid, building energy management systems, distributed renewables, and other smart grid assets

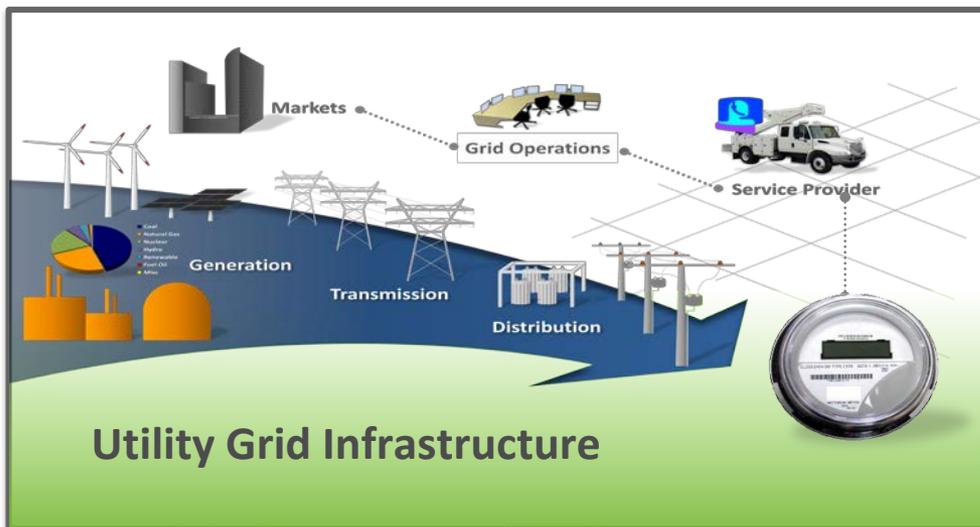
## Smart Building Systems



## Distributed Renewables



## Intelligent Charging & Grid Services



# Transportation as a System (TaaS)

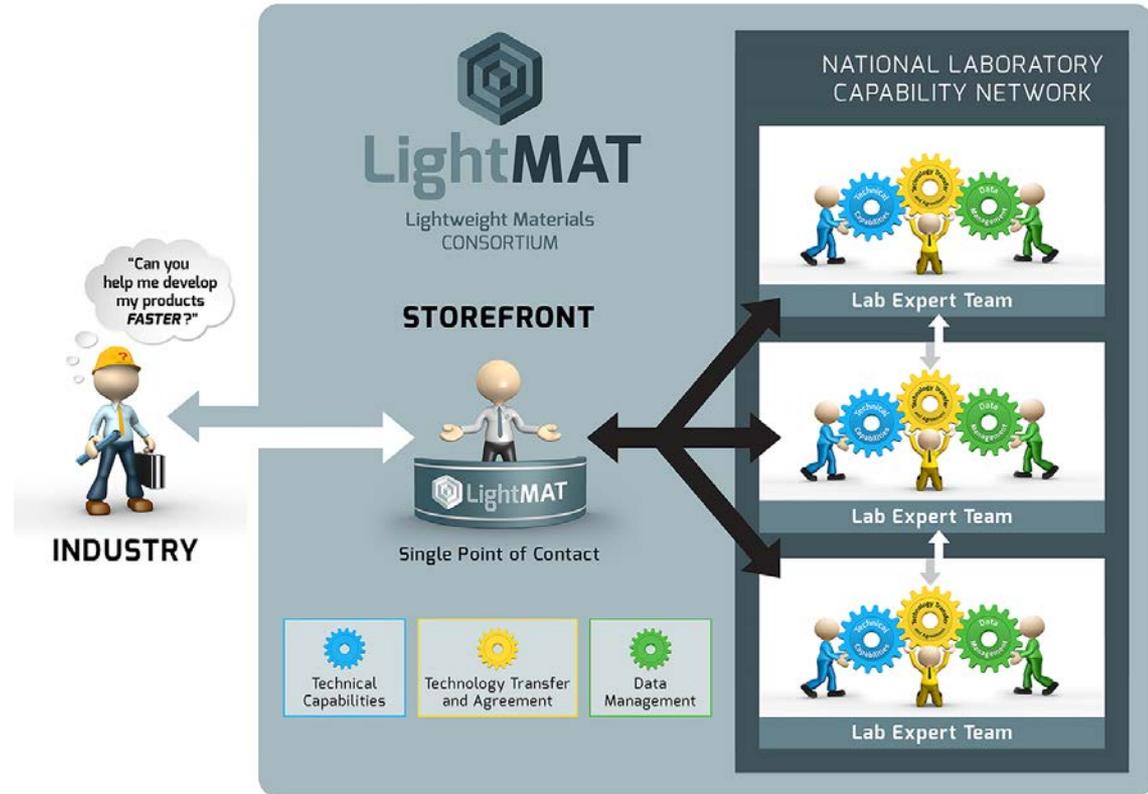
- Radically reshaping the nation's transportation energy footprint by **exploring untapped system-level efficiencies**
- Combines expertise of national labs, industry, and federal, state and local efforts



# Energy Materials Network: LightMat

*Facilitating connections between industry and the National Labs by:*

- Building a network of **unique National Lab resources**
- Providing a **single point of contact** and concierge
- Managing materials **data and tools**
- **Streamlining** the agreements process



<http://LightMAT.org>

# Co-Optimization of Fuels and Engines (“Co-Optima”)



- Joint VTO/BETO effort; nine-lab consortium with industry board
- **Focus:** Develop new fuels and engines that have better performance; can be produced affordably, sustainably, and at scale; and reduce GHG emissions
- **Goal:** Reduce per-vehicle petroleum consumption by 30% vs. 2030 base case
  - **Additional 7-15%** reduction in engine fuel consumption
  - **20% reduction** in fuel well-to-tank emissions
  - GHG emissions reduction of the light-duty vehicle fleet by **9-14%** relative to business-as-usual within 10 years of market introduction



# SuperTruck II

## Will demonstrate Class 8 truck that:

- Achieves **>100% freight efficiency improvement** (2009 baseline)
- Achieves **>55% engine brake thermal efficiency**
- **Cost effectiveness** emphasis: 18-36 month payback period
- Comparable **performance**

## Technologies expected:

- Engine efficiency, emission control, waste heat recovery
- Advanced transmission & hybridization
- Auxiliary power unit to reduce idling
- Improved aerodynamics
- Tire rolling resistance
- Lightweight materials
- Others...



# VT Deployment: Tools, Resources and Technical Assistance

The screenshot shows the homepage of the Alternative Fuels Data Center (AFDC). The header includes the U.S. Department of Energy logo and navigation links for "Fuels & Vehicles", "Conserve Fuel", "Local Stations", and "Laws & Incentives". The main content area features a "Fuels & Vehicles" section with icons for Biodiesel, Electricity, Ethanol, Hydrogen, Natural Gas, and Propane. Below this is a "10 ways to get started" banner with a yellow van. To the right, there are sections for "Maps & Data" (listing "Alternative Fueling Stations by Fuel Type" and "Alternative Fuel Vehicles by Use") and "Tools" (listing "Laws & Incentives", "Vehicle Cost Calculator", "Light Duty Vehicle Search", "Heavy-Duty Vehicle Search", and "TransitBikes"). A "Station Locator" tool is also visible.

*AFDC: 20,000+ entries in Station Locator; 17 other interactive tools; nearly 200 case studies*

The screenshot shows the homepage of FuelEconomy.gov. The header includes the U.S. Department of Energy logo and navigation links for "Find a Car", "Save Money & Fuel", "Benefits", "My MPG", "Advanced Cars & Fuels", "About EPA Ratings", and "More...". The main content area features a large banner with the text "Want to know more about hybrid and electric car options? We can help." Below this are several sections: "Find & Compare Cars" (with a "Compare Side-by-Side" tool), "My MPG" (with a "Calculate or Share Your MPG" tool), "Save Money" (with a "Gas Mileage Tip" and "Fuel Cost Calculator" tool), and "Hybrids & Electrics" (with a "Hybrids Plug-in Hybrids All-Electric Vehicles" tool). There are also sections for "Calculators and Other Tools", "New on fueleconomy.gov...", "Quick Picks", and "Related Links".

*FuelEconomy.gov: Find-a-Car tool has 30+ years of vehicle data; 300M users*

# Clean Cities: Leveraging Local Networks

~100 coalitions with 1000s of stakeholders in nearly every major city in the country



**Look Ahead:** Leveraging boots-on-the-ground **expertise** to build out **Transportation as a System** and **smart mobility** efforts

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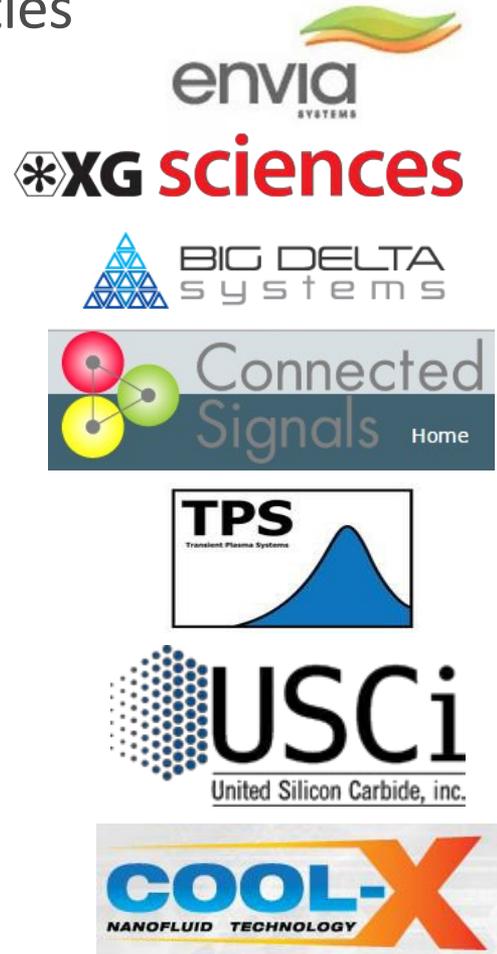
# Hot off the Press!

# Hot Off the Press: Small Business Vouchers Pilot

Supports EERE's **Lab Impact Initiative** to increase and **enhance lab-private sector relationships**, and increase and **streamline access** to national lab capabilities

- Cuts across all EERE R&D programs
- VTO SBV pilot funding: \$2.45M
- Lead Labs: ORNL, LBNL; multiple others participating
- 3 Rounds this year
  - Round 1: Complete
  - Round 2: Selection process ongoing
  - Round 3: Coming soon

<https://www.sbv.org/>



## Enabling Next- Generation Engines

Developed low-cost, high-performance aluminum alloy with a 25% increase in strength at temperatures up to 300°C



- Low-cost, easy-casting, high-performance Al alloy to enable next-generation high-efficiency automotive engines with **rapid tech-to-market transition potential**
- FCA/ORNL collaboration – **leveraged multiple capabilities unique to lab** (e.g., high performance computing, Spallation Neutron Source)
- **Significantly accelerated development time**

# Hot Off the Press: EcoCAR 3 Year 2

## Focus:

- Hands-on vehicle work
- Dynamic events: vehicle safety tech inspections, on-road safety, energy consumption
- Technical, project management, communications presentations

## Competition Results:

1. The Ohio State University
2. Virginia Tech
3. Embry Riddle



**16,000+ Students**

have participated in the DOE Advanced Vehicle Technology Competition Series!

# Hot Off the Press: Sustainable Transportation Summit

## Sustainable TRANSPORTATION



Office of Energy Efficiency and Renewable Energy  
U.S. Department of Energy

**July 11-12**  
**Washington, D.C.**

<http://energy.gov/eere/2016-sustainable-transportation-summit>

### July 11, noon-6pm

- Deep Decarbonization in the U.S. Transportation Sector
- Consumer Adoption of New Vehicle Technologies
- Net-Zero Carbon Fuels
- The Future of Mobility

### July 12, 8am-noon

- Track 1: EV Everywhere EV Market Acceleration
- Track 2: Workplace Charging Challenge
- Track 3: Clean Cities & Smart Mobility
- Track 4: Co-Optima
- Track 5. Hydrogen Fuels and Infrastructure
- Track 6. Synthetic Biology Foundry

*\*Federal and Lab attendance must be coordinated through BETO, FCTO, and VTO*

# Thank You

**Christy Cooper**

**Acting Director**

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**[www.vehicles.energy.gov](http://www.vehicles.energy.gov)**