



**Annual Merit Review and
Peer Evaluation Meeting**

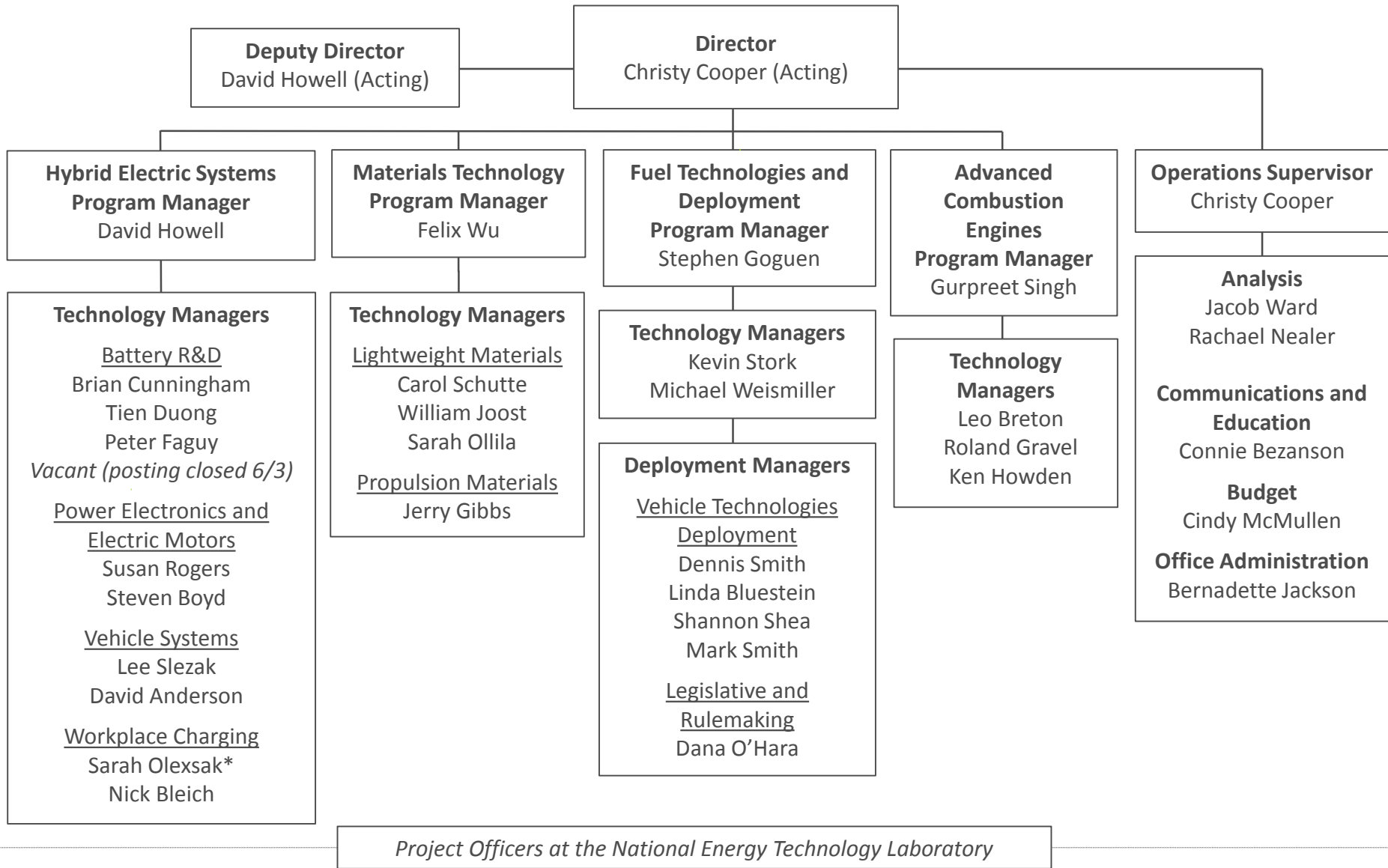
June 6, 2016

**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 **2nd** 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
Vehicle Technologies	\$310,000	\$468,500	
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)

Partners:

- U.S. Department of Energy
- USCAR (United States Council for Automotive Research LLC)
- FCA (Fiat Chrysler Automobiles)
- Ford
- GM
- bp
- Chevron
- ExxonMobil
- Phillips 66
- Shell
- DTE Energy
- Edison
- EPR2 (Electric Power Research Institute)
- Tesla

Associate Members at the Technical Level

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

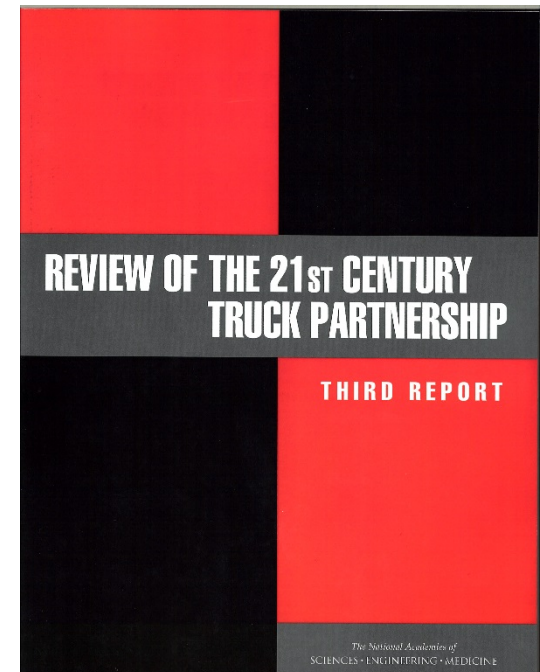
Industry Partnerships: 21st Century Truck

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**



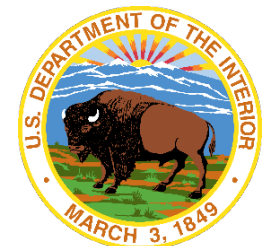
- **Environmental Protection Agency**

- Longstanding coordination across RDD&D portfolio
- Jointly sponsorship of www.fueleconomy.gov and **Green Racing**



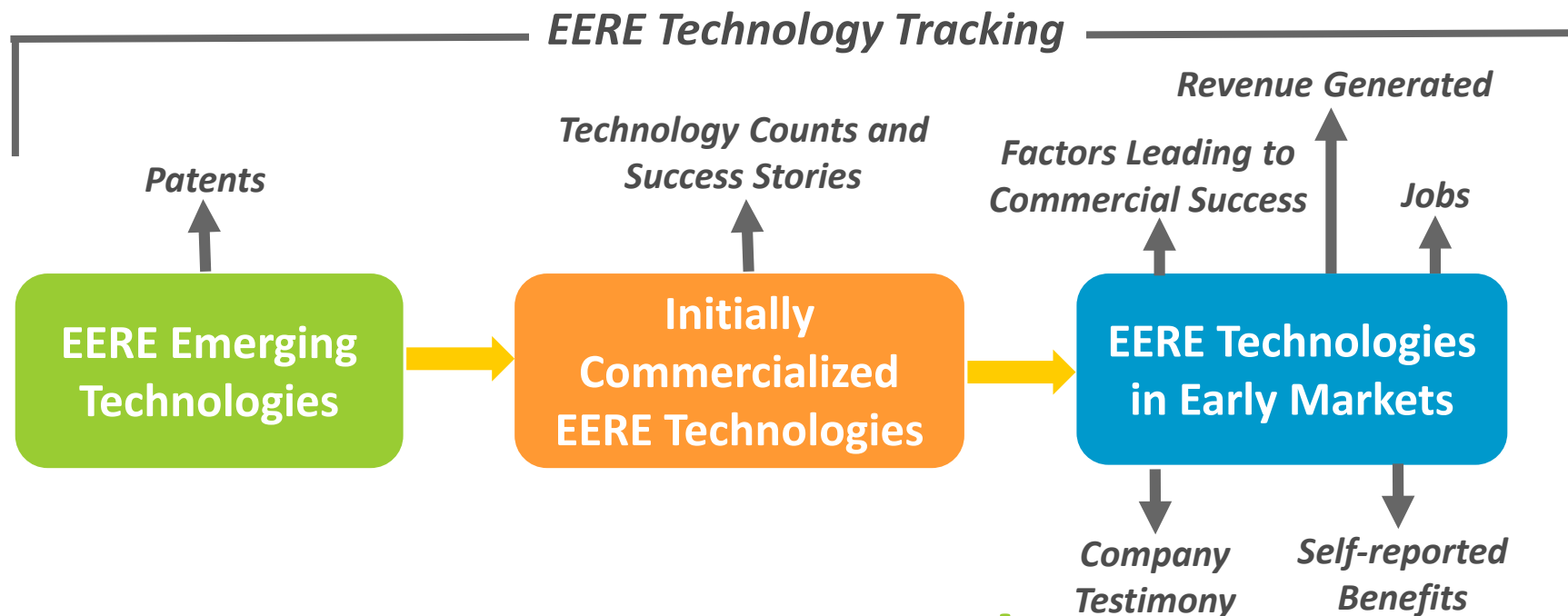
- **Department of Interior**

- 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



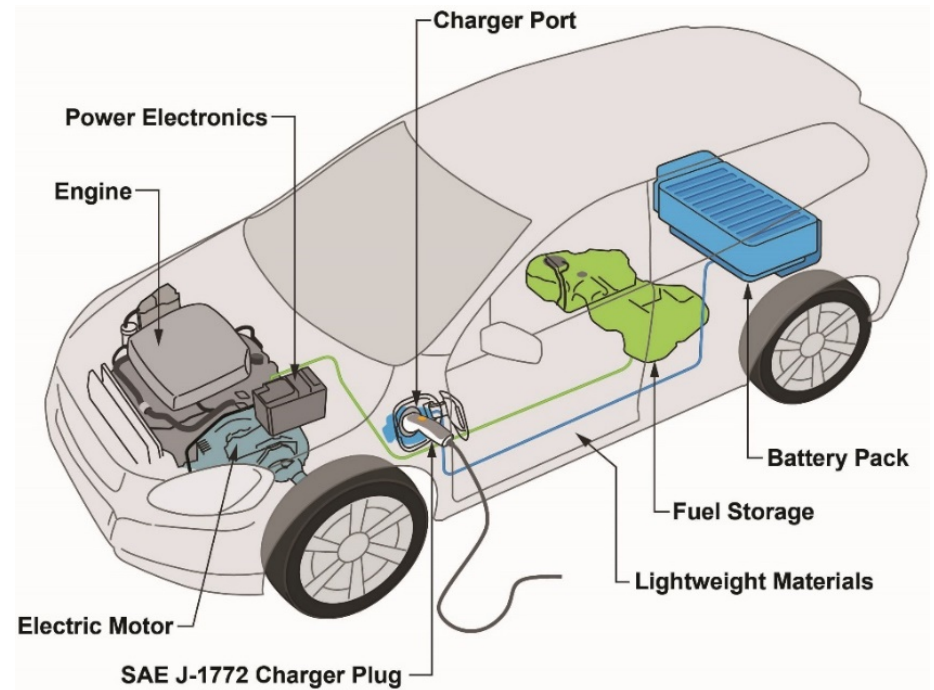
VTO PIs: PNNL may contact you!

Priorities and Initiatives

EV Everywhere Grand Challenge

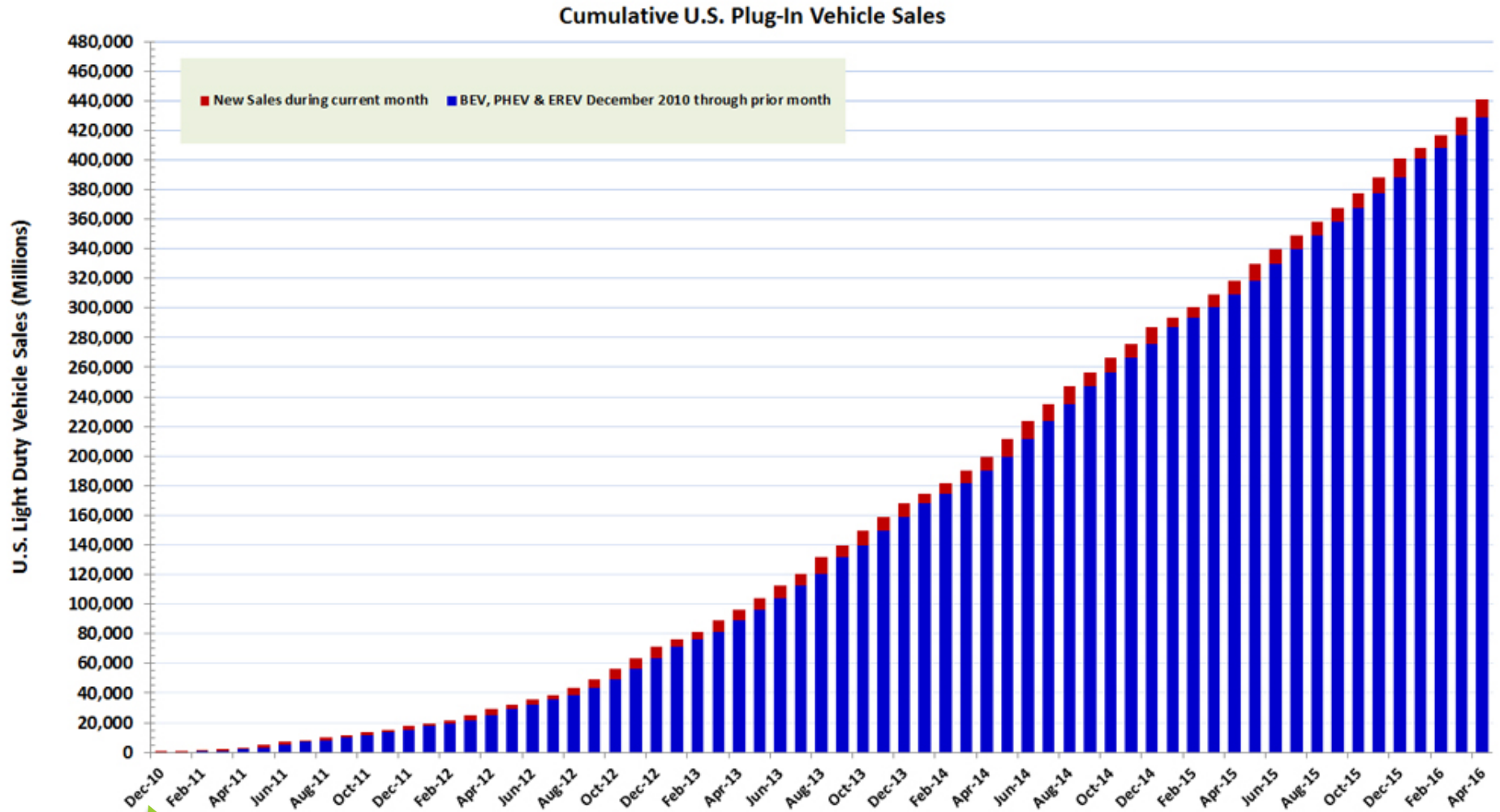
Goal:

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

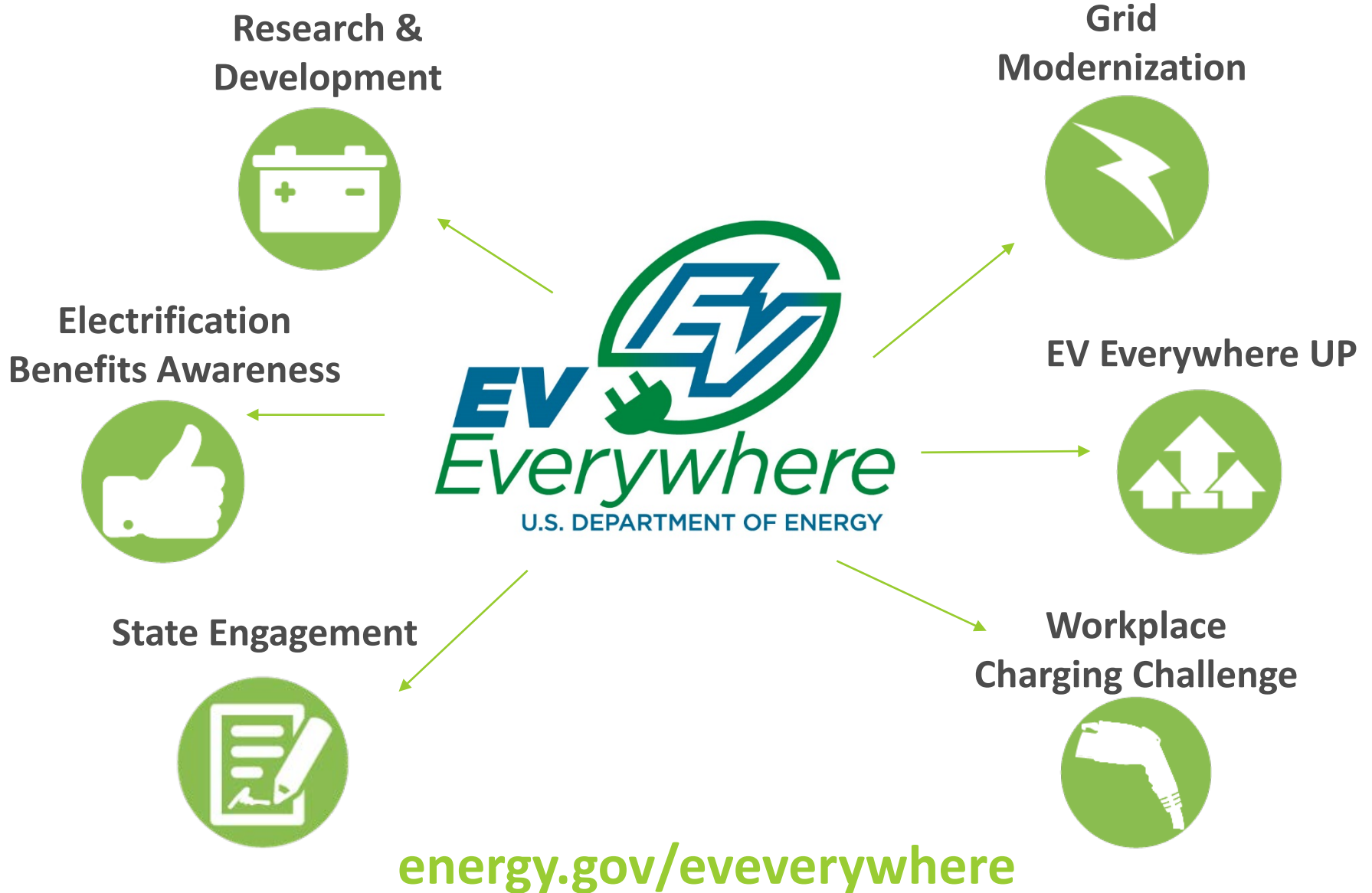
Plug-in Electric Vehicle Market Growth



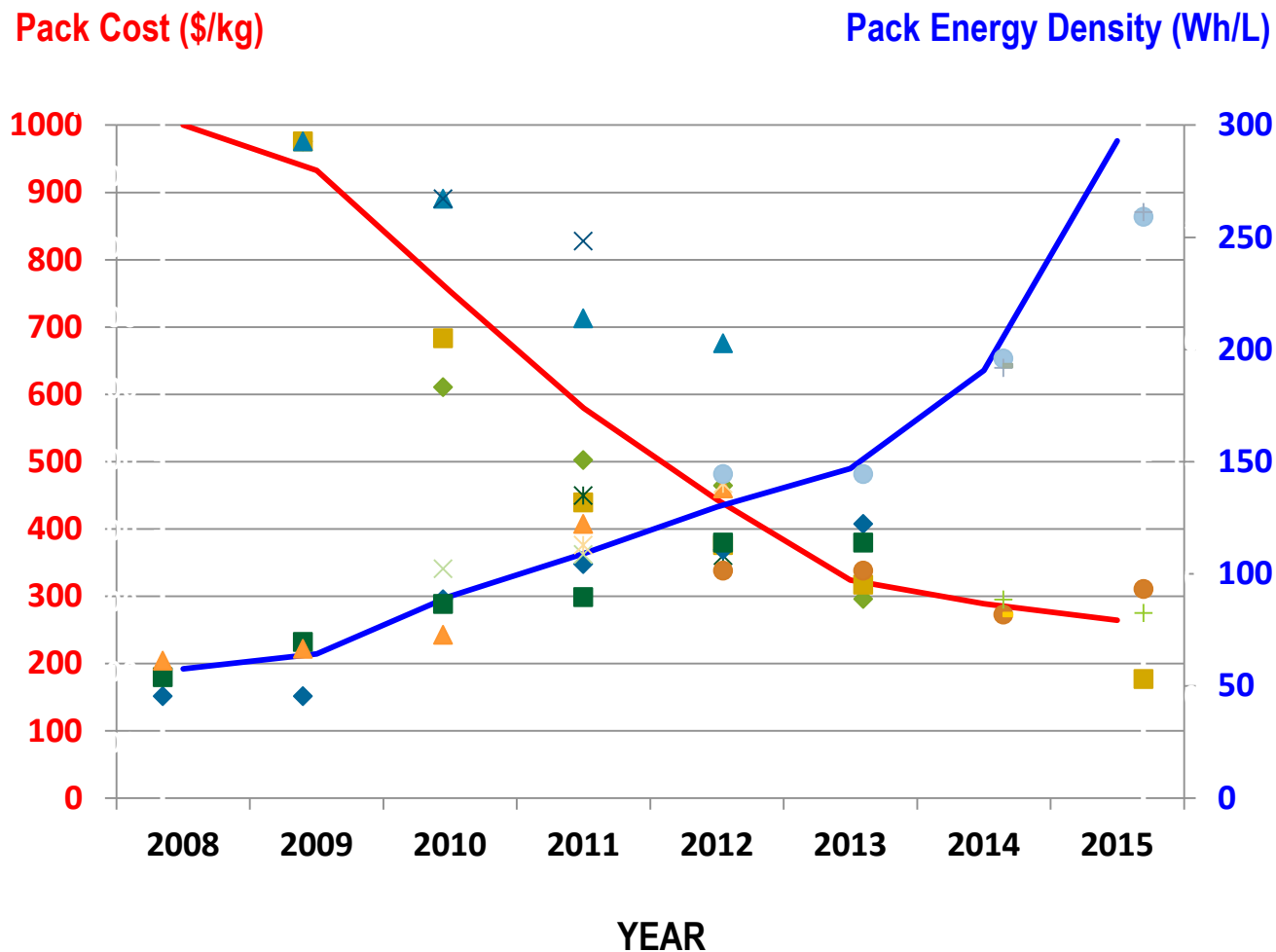
Volt and LEAF
release (Dec 2010)

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

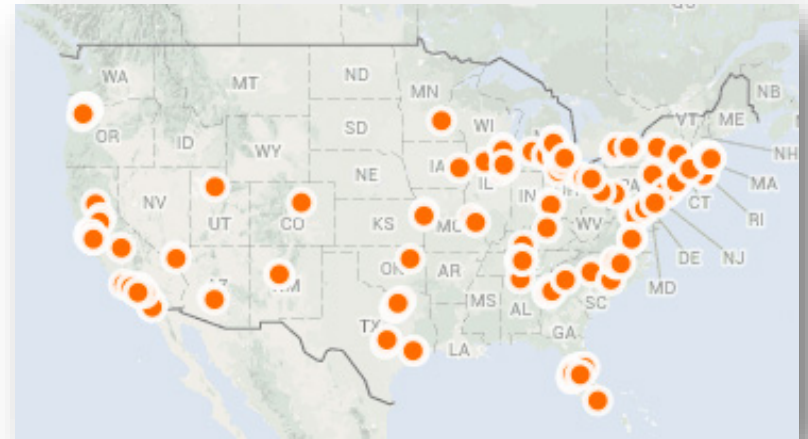
Wireless Charging System Demonstration

>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

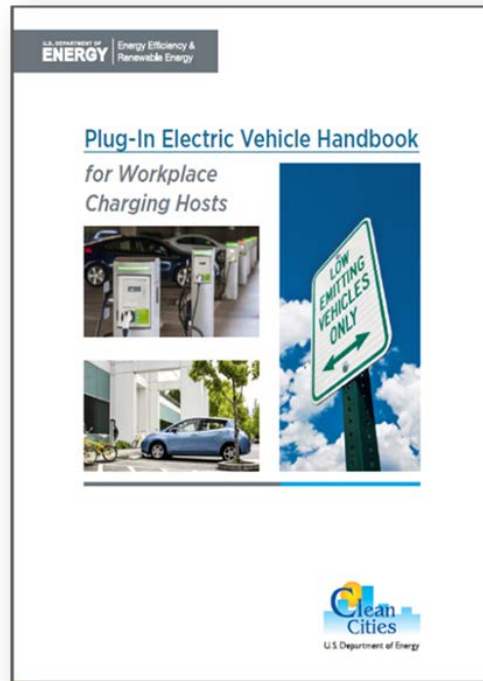


- ~300 Partner employers committing to provide EVSE for employees
- 5,500+ EVSE installed or planned for installation
- 18 Ambassadors promoting and supporting workplace charging

Resources:

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

Join the Challenge!



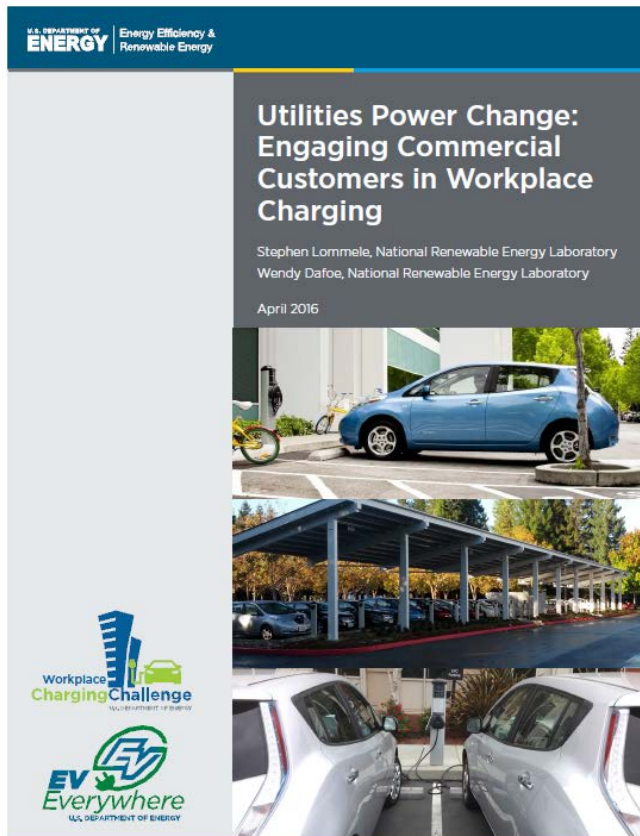
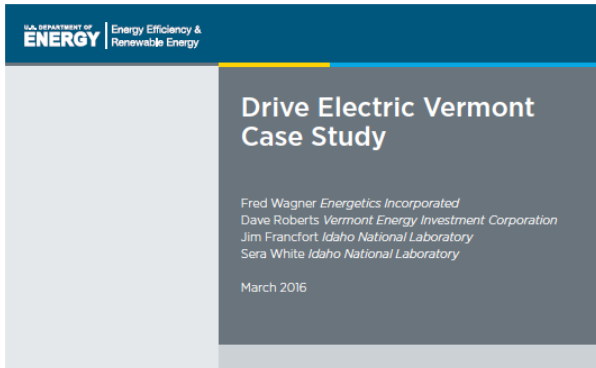
- EV 101
- Employer Resources
- Employee Outreach Toolkit
- Case Studies
- Webinars
- Workshops
- Quarterly Newsletters
- One-on-One Technical Assistance

Take the Pledge
Join the Challenge



For more information or to
join the Workplace Charging
Challenge, contact
Nicholas.Bleich@ee.doe.gov

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

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

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

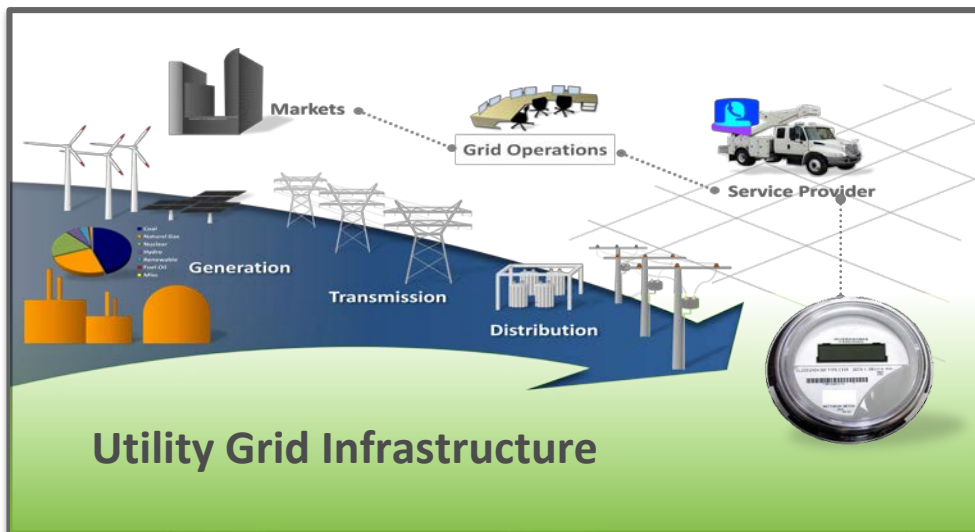
Smart Building Systems



Distributed Renewables



Intelligent Charging & Grid Services



Transportation as a System (TaaS)

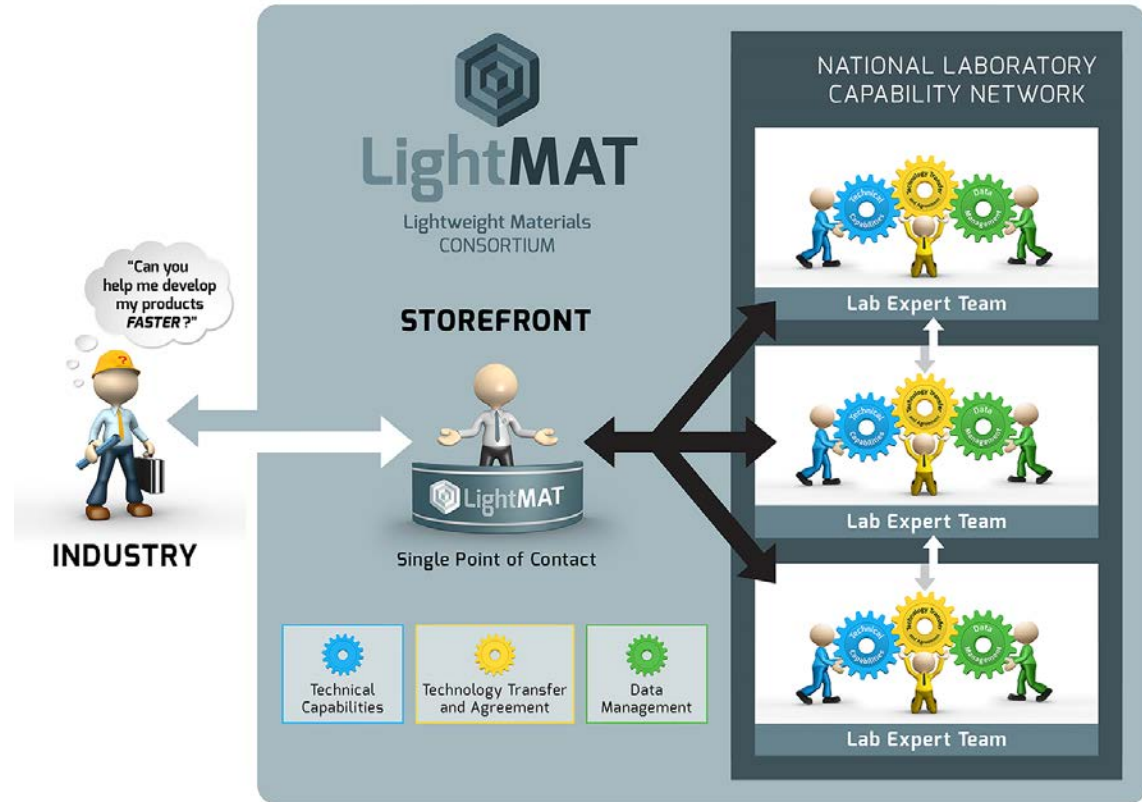
- Radically reshaping the nation's transportation energy footprint by **exploring untapped system-level efficiencies**
- Combines expertise of national labs, industry, and federal, state and local efforts



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 'Alternative Fuels Data Center', 'Search', and 'Tools & Resources'. The main content area is divided into several sections: 'Fuels & Vehicles' with icons for Biodiesel, Electricity, Ethanol, Hydrogen, Natural Gas, and Propane; 'Maps & Data' featuring a 'Fuel Prices' graph and 'Station Locator' tool; and 'Tools' with links to 'Laws & Incentives', 'Vehicle Cost Calculator', and 'Light Duty Vehicle Search'. A large banner at the bottom reads '10 ways to get started' with a yellow van.

*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 'www.fueleconomy.gov', 'Mobile', 'Español', 'Site Map', 'Links', 'FAQ', and 'Videos'. 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 the banner are several tool categories: 'Find & Compare Cars', 'My MPG', 'Save Money', and 'Hybrids & Electrics'. Each category has a representative image and a list of tools or services available.

*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

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

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www.vehicles.energy.gov