DOE’s Focus on Energy Efficient Mobility Systems

David L. Anderson
Energy Efficient Mobility Systems Program
Vehicle Technologies Office

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MOBILITY IS FOUNDATIONAL TO OUR WAY OF LIFE
MOBILITY IS A LARGE PART OF OUR ENERGY ECONOMY

Transportation is the 2nd largest expense for U.S. households

70% of total U.S. petroleum usage is for transportation

On-road vehicles account for 85% of transportation petroleum usage
CONVERGING TRENDS ARE SHAPING MOBILITY

Population

- Population expected to grow by **70 million** in next **30 years**

Demographics

- **Americans are Living Longer**
  - By 2045, the number of Americans over age 65 will increase by **77%**.
  - About **one-third** have a disability that limits mobility.

- **Millennials are Connected & Influential**
  - There are **73 million** Americans aged 18 to 34.
  - They drove **20%** fewer miles in 2010 than at the start of the decade.

Technology

- **Integration of Connected & Automated Technologies**
- **Introduction of Shared Service Platforms**
- **Advancements in Energy Storage Technology**
- **Deeper Application of Big Data**
- **Faster Processing Speeds at Decreasing Cost**
Industry is leading the introduction of disruptive business models & technologies based on consumer demand.

DOE must understand:
• How will this disruption lead to new energy efficiency opportunities?
• What are the risks to energy use and how can we overcome them?
• What are the most promising innovation levers for a sustainable energy future?
FUNDAMENTAL DISRUPTION, DRAMATIC ENERGY IMPACTS

Potential Increase in Energy Consumption

2050 Baseline Energy Consumption

Potential Decrease in Energy Consumption

Source: Joint study by NREL, ANL, and ORNL (http://www.nrel.gov/docs/fy17osti/67216.pdf)
VTO EXPANDING FOCUS TO TRANSPORTATION LEVEL

Component       Vehicle       Transportation System
VTO develops advanced transportation technologies that:

✓ Improve energy efficiency
✓ Increase domestic energy security
✓ Reduce operating cost for consumers & business
✓ Improve global competitiveness of US economy
ENERGY EFFICIENT MOBILITY SYSTEMS (EEMS)

- SMART Mobility Lab Consortium
- High-Performance Computing / Big Data Analytics
- Advanced R&D Projects
- EEMS Living Labs
- Core VTO Evaluation & Simulation Tools
Multi-Lab Consortium creating new knowledge and understanding about the energy implications and opportunities from future mobility.
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- Connected & Automated Vehicles

**Connected/Automated Vehicles**

- What are the *energy, technology, and usage implications* of connected & autonomous technologies?

- How will these systems *operate in the real world*?

- What are the critical *levers to promote “eco-CAV” solutions*?
Multi-Lab Consortium creating new knowledge and understanding about the energy implications and opportunities from future mobility.

- Connected & Automated Vehicles
- Mobility Decision Science

Mobility Decision Science

- What are the transportation energy impacts of potential lifestyle trajectories?
- How do consumers and companies make travel decisions in the short / medium / long-term?
- What mechanisms are available to influence consumer decisions?
Multi-Lab Consortium creating new knowledge and understanding about the energy implications and opportunities from future mobility.

- Connected & Automated Vehicles
- Mobility Decision Science
- Urban Science

Urban Science

- **How will SMART-enabled mobility impact the urban traveler** in terms of VMT, congestion, vehicle ownership, mobility-as-a-service?
- What are the long-term **impacts on the urban built environment?**
- What are the energy impacts of **optimized signal management and automated mobility districts?**
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- Connected & Automated Vehicles
- Mobility Decision Science
- Urban Science
- Advanced Fueling Infrastructure

Advanced Fueling Infrastructure

- **What infrastructure is required** to support future mobility systems?
- How can next-gen fueling/charging infrastructure enable energy-efficient transportation?
- What are the **costs and benefits**, and where should infrastructure investments be made?

EVSE Location Siting in Seattle

From 18,000 Potential Sites to 281
SMART MOBILITY LAB CONSORTIUM

Multi-Lab Consortium creating new knowledge and understanding about the energy implications and opportunities from future mobility.

- Connected & Automated Vehicles
- Mobility Decision Science
- Urban Science
- Advanced Fueling Infrastructure
- Multi-Modal Transportation

Multi-Modal Transportation

- What are the potential energy benefits of reduced modality interface barriers?
- What are the interactions between mass transit and transportation network companies?
- What opportunities do evolving household spending and commodity flow bring for freight logistics?
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- Connected & Automated Vehicles
- Mobility Decision Science
- Urban Science
- Advanced Fueling Infrastructure
- Multi-Modal Transportation

Quantifying energy savings potential of vehicle connectivity and automation in merging roadway scenario (ORNL).

Quantifying the energy benefits of CAV-enabled drive smoothing for multiple powertrain technologies (ANL).

Modeling charging requirements for electrified shared mobility service fleets using spatially-resolved vehicle activity patterns (INL/NREL).

Analyzing energy impacts of autonomous driving in Chicago metropolitan area using agent-based transportation simulation (ANL).
ADVANCED R&D PROJECTS

Partner with industry and academia to research and develop mobility technology solutions that lead to energy savings.

Solutions may include:
- Hardware devices
- Software solutions
- Control systems
- Advanced sensors
- Powertrain components
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Develop an adaptive spatio-temporal intersection control system that reduces fuel use by ~15% while improving travel time (University of Michigan).
Partner with industry and academia to research and develop mobility technology solutions that lead to energy savings.

Solutions may include:
- Hardware devices
- Software solutions
- Control systems
- Advanced sensors
- Powertrain components

**FOA-0001629 EEMS AWARD SELECTION**

Clemson University: Boosting Energy Efficiency of Heterogeneous Connected Automated Vehicle (CAV) Fleets via Anticipative and Cooperative Vehicle Guidance

- Develop anticipative/collaborative traffic and vehicle control algorithms to achieve 10% energy savings
- High-fidelity transportation and vehicle simulation to quantify energy benefits
- On-track vehicle-in-the-loop testbed to validate results
Partner with industry and academia to research and develop mobility technology solutions that lead to energy savings.

Solutions may include:
- Hardware devices
- Software solutions
- Control systems
- Advanced sensors
- Powertrain components

**FOA-0001629 EEMS AWARD SELECTION**

University of California – Riverside: Evaluating Energy Efficiency Opportunities from Connected and Automated Vehicles (CAVs) coupled with Shared Mobility in California

- Conduct real-world CAV data collection and analysis
- Model impacts on energy intensity (EI) and modal activity (MA)
- Construct statewide energy inventory
Partner with industry and academia to research and develop mobility technology solutions that lead to energy savings.

Solutions may include:
- Hardware devices
- Software solutions
- Control systems
- Advanced sensors
- Powertrain components

**FOA-0001629 EEMS AWARD SELECTION**

Virginia Polytechnic Institute and State University: Developing an ECO-Cooperative Automated Control System (ECO-CAC)

- Develop network-level vehicle-routing and speed-harmonization algorithms
- Develop vehicle-level energy management algorithms
- Integrate network and vehicle algorithms to demonstrate 20% energy savings while improving Level-of-Service (congestion)
- **Major disruption** occurring in transportation
- **Connected & Autonomous Vehicles** (CAVs) are coming
- CAVs & Shared Mobility have **dramatic implications for energy use**
- DOE must understand energy impacts and **develop the knowledge to enable energy efficiency in transportation**