U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

DOE's Focus on Energy Efficient Mobility Systems

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NASEO Smart Mobility Webinar
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MOBILITY IS FOUNDATIONAL TO OUR WAY OF LIFE

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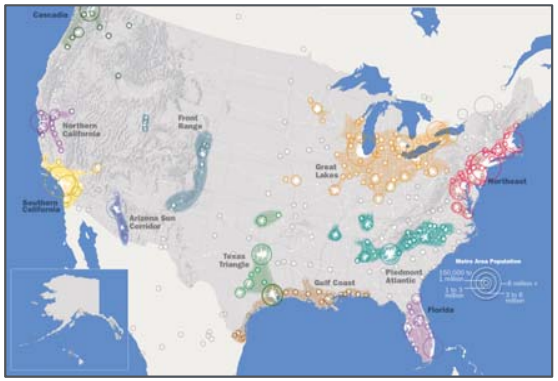
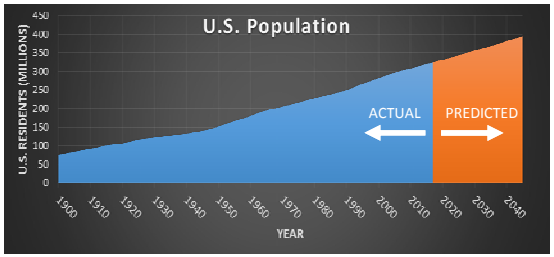
CONVERGING TRENDS ARE SHAPING MOBILITY

Population



75% of population in 11 Megaregions.



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, and they drove 20% fewer miles in 2010 than at the start of the decade.

Technology

- **Integration of Connected & Automated Vehicles**
- **Introduction of Shared Service Platforms**
- **Advancements in Vehicle Powertrain Technology**
- **Deeper Application of Big Data**
- **Faster Processing Speeds at Decreasing Cost**

TRENDS ARE CAUSING A FUNDAMENTAL DISRUPTION

Connectivity

Ride-hailing

New Powertrains

Industry is leading the introduction of disruptive business models & technologies.

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 energy efficiency?

Automation

Car-sharing

New Modes

FUNDAMENTAL DISRUPTION, DRAMATIC ENERGY IMPACTS

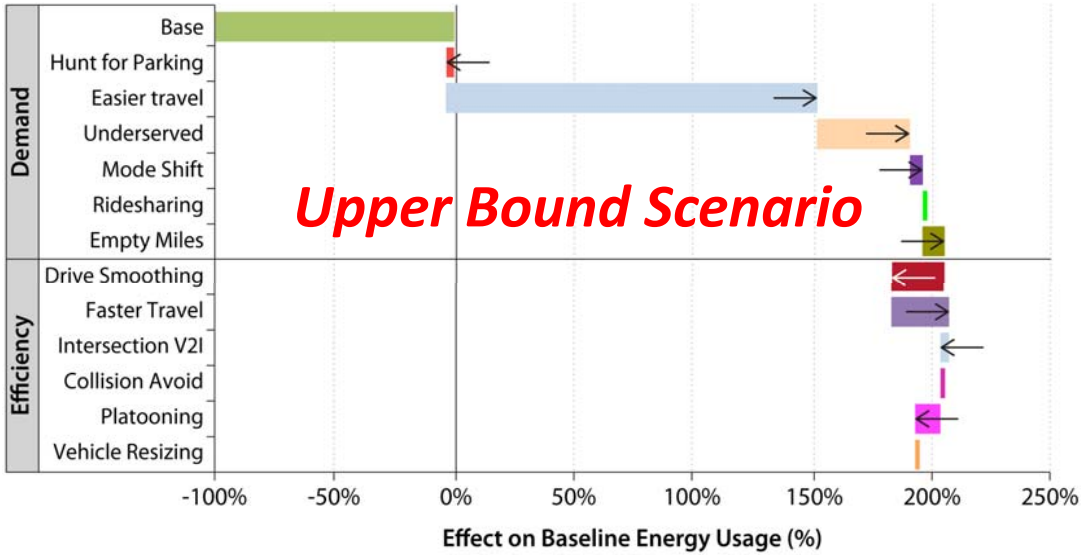
+200%

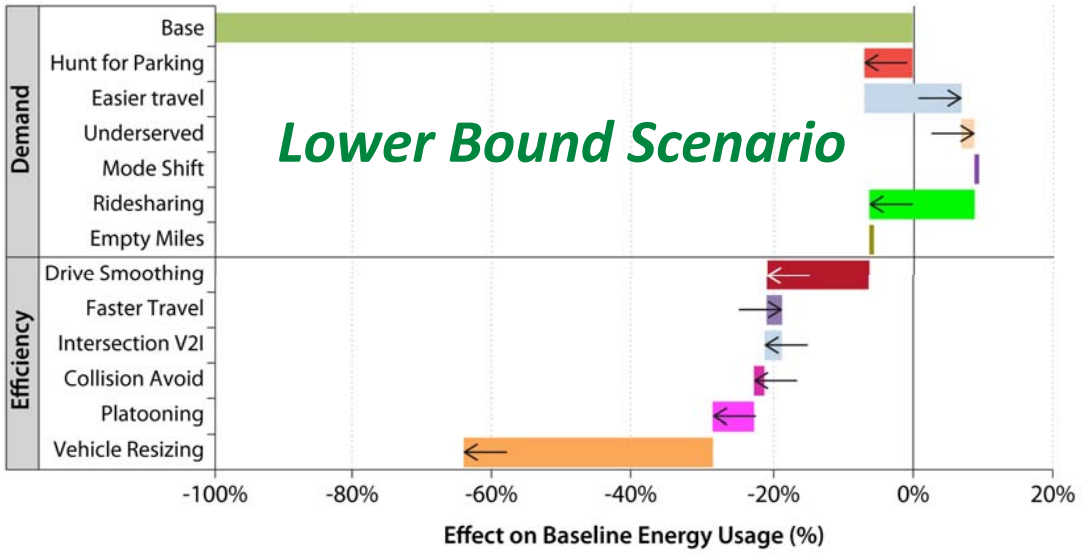
Potential Increase in Energy Consumption

2050 Baseline Energy Consumption

Potential Decrease in Energy Consumption

-60%





Source: Joint study by NREL, ANL, and ORNL
http://www.nrel.gov/docs/fy17osti/67216.pdf

VTO EXPANDING FOCUS TO TRANSPORTATION LEVEL

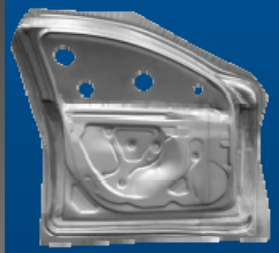
Component **Vehicle** **Transportation System**

EERE'S VEHICLE TECHNOLOGIES OFFICE (VTO)

Vehicle Technologies Office

- **Electrification**

- **Materials Technology**



- **Advanced Combustion Systems & Fuels**

- **Energy Efficient Mobility Systems**

- **Technology Integration**

Clean Cities

- ***Analysis, Comms, & Operations***

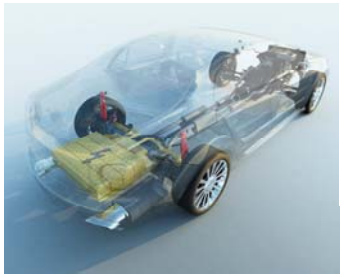
VTO develops advanced transportation technologies that:

- ✓ Improve energy ***efficiency***
- ✓ Increase domestic energy ***security***
- ✓ Reduce operating ***cost*** for consumers & business
- ✓ Improve global ***competitiveness*** of US economy

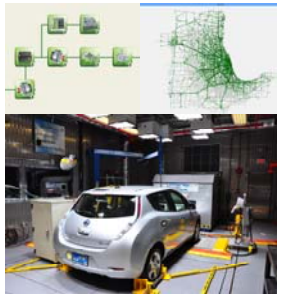
ENERGY EFFICIENT MOBILITY SYSTEMS (EEMS) ACTIVITIES

SMART Mobility Lab Consortium

High-Performance Computing / Big Data Analytics



Advanced R&D Projects



Core VTO Evaluation & Simulation Tools

EEMS Living Labs

SMART MOBILITY LAB CONSORTIUM

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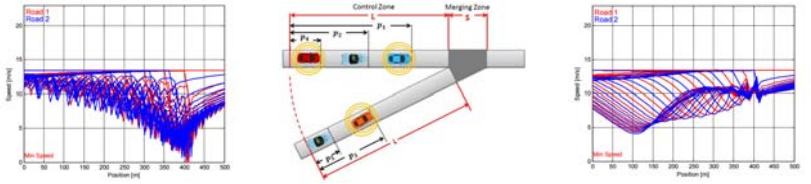
SMARTMOBILITY
Systems and Modeling for Accelerated Research in Transportation

Argonne NATIONAL LABORATORY · INL Idaho National Laboratory · BERKELEY LAB · OAK RIDGE National Laboratory · NREL NATIONAL RENEWABLE ENERGY LABORATORY

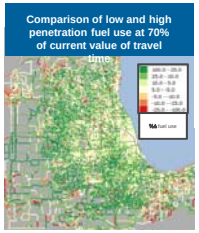
Multi-Lab Consortium creating new knowledge and understanding about the energy implications and opportunities from future mobility.

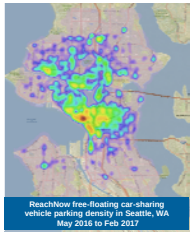
- Connected & Automated Vehicles
- Urban Science
- Mobility Decision Science
- Advanced Fueling Infrastructure
- Multi-modal Transport

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



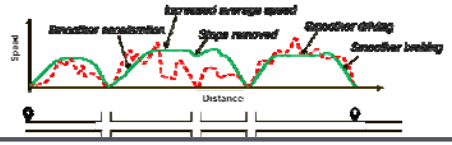
Analyzing regional energy impacts of autonomous driving in Chicago metropolitan area using agent-based transportation simulation (ANL).

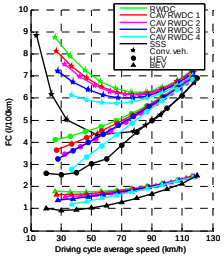




Modeling charging requirements for electrified shared mobility service fleets using spatially-resolved vehicle activity patterns (INL/NREL).

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





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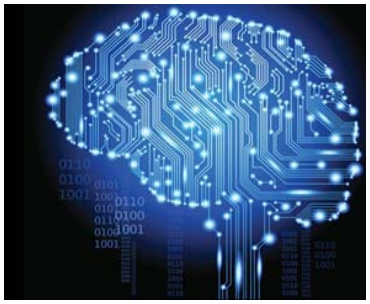
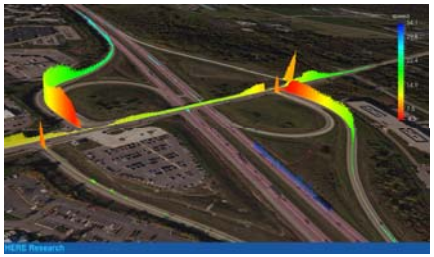
HPC / BIG DATA ANALYTICS


Develop and apply national lab expertise in high-performance computing, machine-learning, and big data science to find solutions to real-world transportation energy challenges.






- **HPC4Mobility**: Small seedling projects to partner specific national lab high-performance computing expertise and resources with cities to create solutions for transportation planning.
  - EXAMPLE: Large-scale simulation to improve metropolitan transportation system design
- **Big Transportation Data Analytics**: National-lab based data-science projects to apply artificial intelligence techniques to emerging large/complex transportation data sets.
  - EXAMPLE: Spatio-temporal deep-learning for mobility applications

ADVANCED R&D PROJECTS

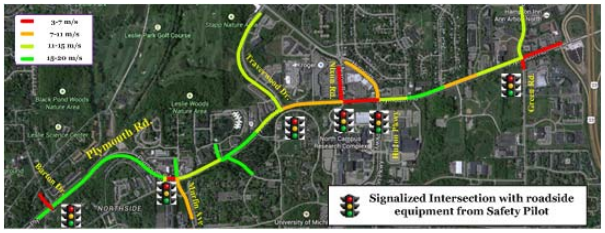


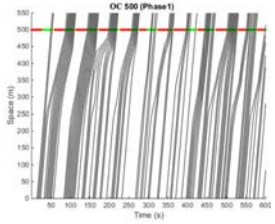
Partner with industry and academia to research and develop mobility technology solutions that lead to energy efficiency savings.

Solutions may include:

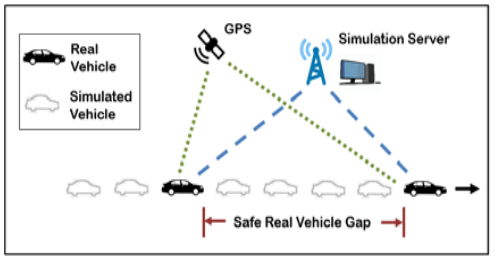
- Hardware devices
- Software solutions
- Control systems
- Advanced sensors
- Powertrain components

Develop an adaptive spatio-temporal intersection control system that reduces fuel use by ~15% while improving travel time (University of Michigan).





Create anticipative/collaborative vehicle control software using connectivity & automation, and demonstrate energy savings through closed-track vehicle-in-the-loop testing (Clemson University).



LIVING LABS



Work with cities and stakeholders for field evaluations and to collect data as new mobility systems are deployed.

- Provides important feedback mechanism to R&D
- Real-world data to test, validate and improve models, simulations, software and hardware
- Understand key energy metrics

Energy Efficient Logistics – Rensselaer Polytechnic Institute

- NYC – Albany Corridor
- Uses Freight Demand Management to manage freight patterns so as to reduce energy use and support energy-efficient goods movement



Evaluating Smart, Shared, and Sustainable Mobility Services – City of Seattle

- Evaluating technical acceptability of electrification in shared mobility applications in four major U.S. markets

MAVEN

ReachNow

UBER

MEMORANDUM OF UNDERSTANDING WITH DOT

MOU signed between DOT/OSTR-R and DOE/EERE to:

- Pursue key collaborative opportunities to accelerate innovative "smart" transportation systems research, development, demonstration, and deployment
- Recognize mutual interest in the economic, environmental, and national security benefits of smart transportation technologies

GOALS

1. Gain mutual benefit from coordination between DOT's Smart City Challenge and VTO's SMART Mobility Lab Consortium.
2. Provide leadership and best practices in the development and analysis of transportation data management.
3. Leverage DOE's expertise in transportation electrification R&D.
4. Leverage DOT's experience with connected and automated vehicles.
5. Utilize and share existing stakeholder networks for institutional knowledge of local resources.
6. Support a Technologist-in-Cities pilot, embedding a mobility energy expert within a Smart City.

CONCLUSION

- ***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 solutions to enable energy efficiency in transportation***

A Maximum-Mobility, Minimum-Energy Future

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