INL Advanced Transportation Research and DOE SMART Mobility

John Smart
Group Lead – Advanced Vehicles
INL’s Advanced Transportation Activities

- Attacking the key challenges of cost, consumer acceptance & infrastructure for alt-fuel vehicle mass-adoption

**Performance & Life Testing**
- Cost reduction
- Performance improvements

**Emulation & Simulation**
- Added value hydrogen production

**Energy Storage**

**Vehicles & Transportation Systems**

**H2 & Fuel Cells**

**Bioenergy Feedstock National User Facility**

**Big Data**
- Optimizing consumer experience w/alt-vehicles & infrastructure

**Infrastructure**
- Development of global standards

**Feedstocks**
- Cost reduction
- Quality improvement
- Scale-up and integration
Advanced Transportation Research on the System Level

• Deployment of charging infrastructure that meets driver needs
  – Last September, INL released results from the largest collection of light-duty plug-in electric vehicle and charging infrastructure demonstrations in the world
Advanced Transportation Research on the System Level

• Integration of PEVs with the electric grid
  – Kicking off 3-year vehicle/grid integration projects as part of DOE’s Grid Modernization initiative
Advanced Transportation Research on the System Level

- Understanding the energy impact of connected & autonomous vehicles
  - Two projects began this year to estimate how this quickly emerging field will change driving behavior and resulting energy consumption

Photo courtesy of University of Michigan
Advanced Transportation Research on the System Level

- Taking a holistic view to transportation
  - DOE SMART Mobility Big Idea

**Systems and Modeling for Accelerated Research in Transportation**

Focus on Energy & Mobility
- National Labs
- Federal Agencies
- State & Local Governments
- Universities
- Industry
Transportation as a System

Today:
• Vehicle level focus
• Independent
• Unconnected
• Subject to behaviors & decisions

Tomorrow:
• System level focus
• Connected
• Automated
• In concert
• Across modes
• Managed behaviors & decisions

Exploring the untapped transportation system level efficiencies
Connectivity, Automation and Energy

Research by the National Labs

Potential Increase in Energy Consumption +200%

Potential Decrease in Energy Consumption -90%

2050 Baseline Energy Consumption

Vast range of energy implications … more research required
Expected Outcomes:
- Quantify the energy impact of CAVs
  - Multi-scale
  - Multiple scenarios
  - Different technologies
- Identify CAV-enabled opportunities
  - Vehicle electrification
  - Lightweighting
  - Powertrain optimization
  - Vehicle utilization
  - Reduced VMT’s
- Inform policy/research on CAV’s
  - Maximize sustainability impacts

Designing for the nexus of safety, energy, and mobility
Vehicles and Infrastructure

Expected Outcomes:

• Integrated modeling of vehicle and fuel technologies with consumer preferences

• Best leverage public and private resources for EV/AFV fueling infrastructure

Mapping EV Technology with Travel Patterns
Reduced EVSE Locations from 18,000+ to 281 in Seattle


Informed infrastructure investments that drive consumer adoption
Multi-Modal

Expected Outcomes:

• Quantify potential energy savings and GHG reductions in urban areas
  • Diminished modal barriers
  • Passenger and freight

• Counteract projected growth of freight energy consumption (through 2040)
  • Leveraging of disparate modal energy intensities
    (i.e. streamline transfers, shift to new modes, etc.)

Energy-efficient, seamless multi-modal transport of people and goods
Urban Sciences

Expected Outcomes:

- New city-scale computational models
  - Calibrated and validated by large transportation data sets
  - Can inform local decisions

- Frameworks and analytical tools
  - Build and run composite models of urban components related to sustainable transportation

Aligning urban form with sustainable transportation

Impact of Urban Form on Average Energy Use Per Household

Calthorpe, P. Urbanism in the Age of Climate change. November 2010.
**Behavioral and Decision Science**

**Expected Outcomes:**

- Enhanced vehicle adoption and choice models
  - Inform holistic policy decisions, vehicle R&D, and infrastructure investments
  - Accelerate PEV adoption

- Understanding of individual and market behavior
  - Future technologies, policies, and transportation systems

**Technology & policies that anticipate how decisions are really made**