TRANSPORTATION-AS-A-SYSTEM (TAAS)
IMAGINE...
BIG IDEA
Radically reshape the transportation energy footprint of the nation
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Radically reshape the transportation energy footprint of the nation:

- Develop policy decision support systems for emerging energy mobility paradigms
- Leverage existing and establish new and necessary expertise at DOE in transportation energy systems
THE IMPACT?

10s of billions
gallons of fuel annually
Massive wave of changes hitting our transportation system

Megatrends
Shared Mobility
MaaS
GPS/Map Services
E-Retailing

Master the wave or get washed out on GHG emissions
TODAY….ADVANCED VEHICLES IN A “SUB-ADVANCED” SYSTEM

Efficient vehicles enter an inefficient system – potentially negating efficiency gains

CAVs technology targeting safety is hitting the market.

Leveraging advances in safety to hit energy and emissions goals while improving overall mobility
Our Proposal:
Explore untapped system-level efficiencies at planning and operations timescales

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

- Tomorrow:
  - System-level focus
  - Connected
  - Automated
  - In concert
  - Across modes
  - Managed behaviors & decisions
  - Agencies working together (energy, safety, mobility)
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THE WAVE….CAVs AND MAAS, BETTER OR WORSE GHG?

- Maturation of Alt-Vehicles and MAAS (Mobility as a Service)
- Maturation of CAVs

Substantial reduction or increase of GHG?

Platooning
Eco-driving
Congestion mitigation
De-emphasized performance
Improved crash avoidance
Vehicle right-sizing
Higher highway speeds
Increased features
Travel cost reduction
New user groups
Changed mobility services
Infrastructure footprint*

% changes in energy consumption due to vehicle automation
Vast range of energy implications

... more research required
UNLOCKING VALUE MAY UNLEASH CONSUMPTION

Potential Increase in Energy Consumption

+200%

Potential Decrease in Energy Consumption

-90%

2050 Baseline Energy Consumption

Travel More
Travel Faster
Modal Shifting*
Ship More Goods*

Reduce Congestion
Smooth Traffic Flow
Operate More Efficiently
Adopt More ZEVs

* Not included in preliminary projections

Will new value creation drive unbridled consumption?
How do we transform increasing complexity into clarity for decision makers?
TECHNICAL APPROACH – BEGINS WITH THE END IN MIND

Decisions

Cities and Regions

Charging/Fueling Infrastructure

Energy Infrastructure

Data Management

CAVs

Connected Travelers

More Decisions
TARGETED RESEARCH PORTFOLIO

Vehicle & Fuel Technology

Multi-modal
Transportation choices for people and freight

Automation & Connectivity
Exploiting data to reduce congestion & vehicle miles traveled, increase safety

Urban Systems
Data, models and controls to manage urban systems

- Market uptake of new technology
- Efficient traffic flow
- Broad selection of low-carbon fuels
- Reduced VMT and increased parking
- Healthy MaaS ecosystem

Behavior & Decision Science
Understanding and influencing consumer choice and travel behavior

Vehicles & Infrastructure
Fuels, roadway, and building support for new technologies
Expected Outcomes:

- Revealing the previously unknown: a new class of data science: urban data science
  - New city-scale computational mobility models
  - Calibrated and validated by large transportation data sets: estimation, inference, system identification

- Frameworks and analytical tools
  - Learn, create, run, optimize composite models of urban components for sustainable transportation
  - Can inform local decisions (policy making)

- **Example:** does MaaS increase or decrease VMT, volatility of travel time, energy efficiency?

**Providing scientific support to decision makers**
Expected Outcomes:

- A science of decision making:
  - Understanding of individual and market behavior: behavioral economics
  - Understanding of future technologies, policies, and transportation systems
  - Understanding of enhanced vehicle adoption and choice models
  - Information of holistic policy decisions, vehicle R&D, and infrastructure investments

- Example: delivery of goods to the store with the customer driving or delivery to the home

Technology and policy that anticipate how decisions are made
Expected Outcomes:

- Integrated modeling of vehicle and fuel technologies with consumer preferences
- Best leverage public and private resources for EV/AFV fueling infrastructure
- **Example:** charging station placement with dynamic usage

Informed infrastructure investments that drive consumer adoption
Energy-efficient, seamless multi-modal transport of people and goods

Expected Outcomes:

- Quantify potential energy savings and GHG reductions
  - Diminished modality barriers
  - Passenger and freight scope

- Counteract projected growth of freight energy consumption (through 2040)
  - Leveraging of disparate modal energy intensities
  - Multiscale approach (rural, intercity, etc.)

- **Example**: Contributions of MaaS to congestion
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- Example: Contributions of MaaS to congestion

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

- Inform policy/research on CAVs
  - Maximize sustainability impacts

- Address the barriers to CAVs
  - Cost, cyber security, bandwidth

- **Example:** platooning and traffic flow smoothing

Designing for the nexus of safety, energy, and mobility
CONNECTED & AUTOMATED VEHICLES (CAVs)

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CAVs - PILOT AND DEMONSTRATIONS

Semi-Automated Platooning (NREL, Peloton, Paccar, Intertek)

3.7 – 6.4% Team Savings

EERE Incubator Award (U of M, ANL, INL)
500 Vehicle Fleet

Improving our ability to predict the energy impact of CAV’s
LABORATORY RESOURCES - COMPLEMENTARITY

Automation tools

Massive data feeds

Multiscale mobility models

Traveler energy consumption model
~1 (individual) agent
LBNL Traveler Energy Consumption Model
LBNL Vehicle Model Library (VML)

Micro/meso simulation
~50,000 agents
Aimsun

Macrosimulation
~500,000 agents
Connected Corridors
Mobile Millennium
TOPL

Agent based model
~5,000,000 agents
Socially Aware Incentive
Responsive - Travel Demand
Model (SAIR-TDM)
MATSim

Propulsion / powertrain
Modeling systems

HPC architecture and systems

Landuse models and regional models
Multi-lab consortia exploring the nexus of energy and future mobility paradigms
WHAT DEFINES SUCCESS?

- New science, data, calibrated models and tools exist for planning and operations, to include energy and support policy decisions
- Consumers, regulators, industry, and policy developers understand the energy impacts of new approaches
- DOE receives vital feedback for its technology portfolio
- Nation is poised to adopt new technologies and policies
- Later benefits (beyond successes): drivers embrace the opportunity of unburdened travel

YEAR 1: Operational Tools and data
YEAR 2: Policy simulations
YEAR 3: Controlled experiments
YEAR 4: Informed decision making
YEAR 5: Best practices
PARTNERSHIPS ARE KEY

- DOT
- DOE-EERE
- Other DOE
- Private sector
- NGOs
- Universities
- Other Federal (EPA, NIST…)
- States and Regional MPOs Cities, etc
ALIGNMENT WITH SMART CITIES

TAAS examines the nexus of energy and mobility for future transportation systems (in collaboration with and support of Smart Cities, where appropriate)

TAAS Consortium

- Combination of existing applications into and development of entirely new systems-based collaborative models
- Focused technology demonstrations
- Collaboration with broader stakeholder network, including state and municipal governments, planners, and data scientists
- Building on and unifying existing foundational efforts exploring transportation as a system
- Planning coordination with the International Energy Agency’s Connected and Automated Vehicles (CAVs) Task

“Smart Cities” harnesses data to continuously improve the collection, aggregation, and use of data to improve the life of their residents

Smart Cities Key Strategies

- Test beds for “Internet of Things” applications and developing new multi-sector collaborative models
- Collaborating with the civic tech movement and forging intercity collaborations
- Leveraging existing Federal activity
- Pursuing international collaboration

Transportation-as-a-System offers a unique opportunity to analyze challenges/opportunities for energy-efficient mobility systems for people and goods.
OUR GREATEST RESOURCE

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Thank you to the team!
Radically reshape the transportation energy footprint of the nation:
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