

ENERGY EFFICIENT MOBILITY SYSTEMS (EEMS)

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Argonne
NATIONAL LABORATORY

INL
Idaho National Laboratory

NREL
National Renewable Energy Laboratory

Los Alamos
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SRNL
Sandia National Laboratories

OAK
RIDGE
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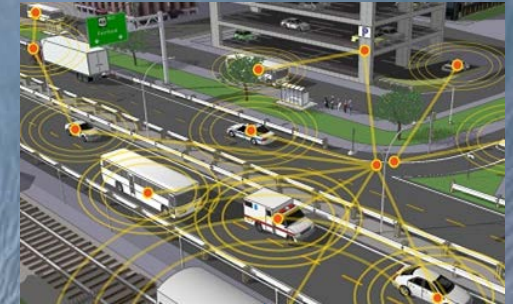
BERKELEY LAB
Lawrence Berkeley National Laboratory

IMAGINE...

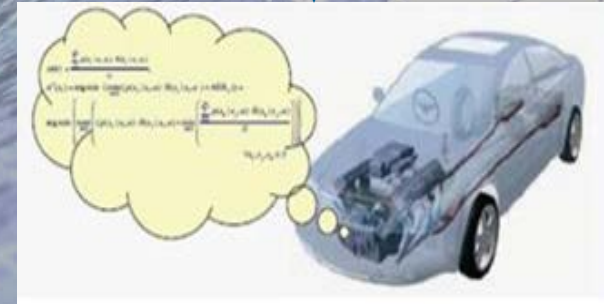


Worlds are colliding...what future worlds may emerge?

THE OPPORTUNITY AND PROBLEM....

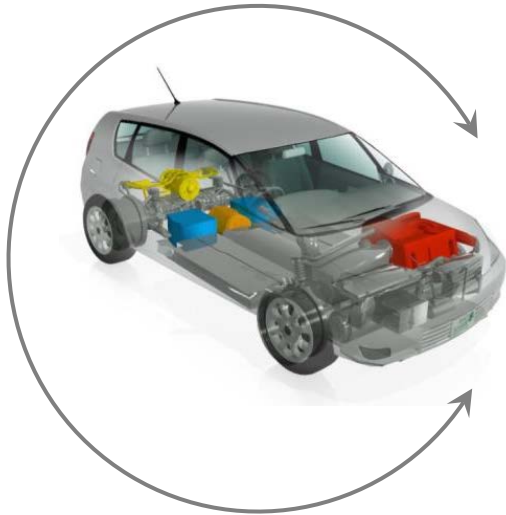


Massive wave of changes hitting our transportation system

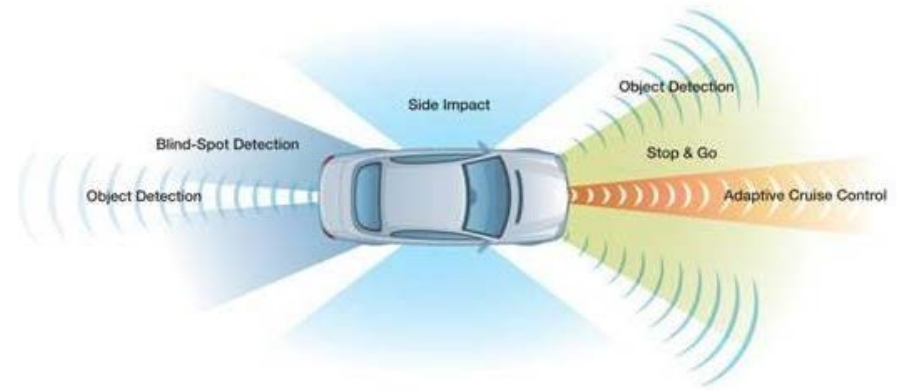


Which factors will dominate? What scenarios will play out?

TODAY....ADVANCED VEHICLES IN A SUB-OPTIMAL SYSTEM



Efficient vehicles enter an inefficient system



CAVs technology targeting safety is hitting the market.

Designing for the nexus of safety, energy, and mobility

TRANSPORTATION-AS-A-SYSTEM

Explore untapped system-level efficiencies at planning and operations timescales



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

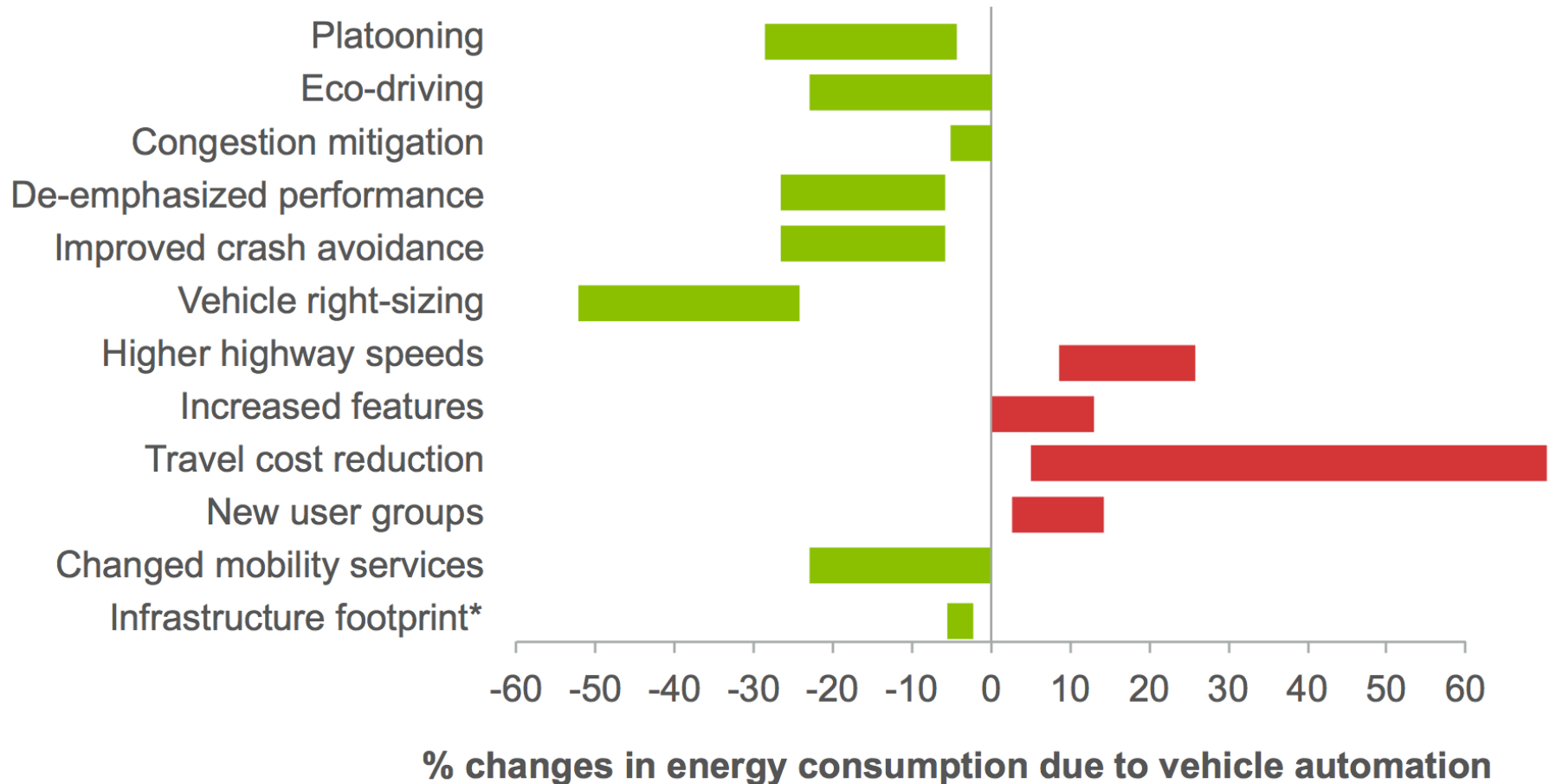
- Tomorrow:
 - System-level focus
 - Connected
 - Automated
 - In concert
 - Across modes
 - Managed behaviors & decisions

THE WAVE....CAVs AND MAAS, BETTER OR WORSE GHG?

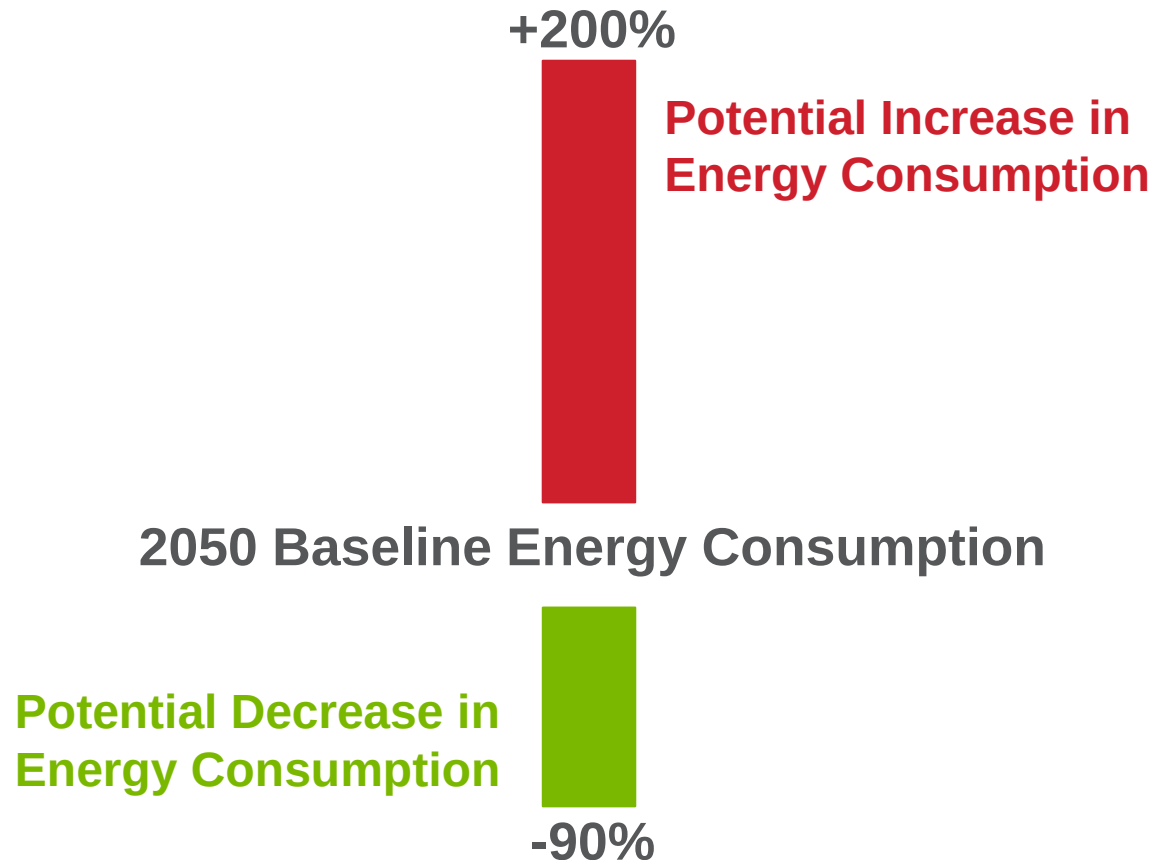
- Maturation of Alt-Vehicles and MAAS (Mobility as a Service)
- Maturation of CAVs

Combination

Substantial reduction or increase of GHG?



LARGE ENERGY AND GHG EMISSIONS IMPLICATIONS



Vast range of energy implications ... more research required

TABLE STAKES ARE IN THE TRILLIONS OF \$'S

Travel More
Travel Faster
Travel by Underserved
Modal Shifting*
Ship More Goods*

+200%



Potential Increase in
Energy Consumption

2050 Baseline Energy Consumption

Potential Decrease in
Energy Consumption



-90%

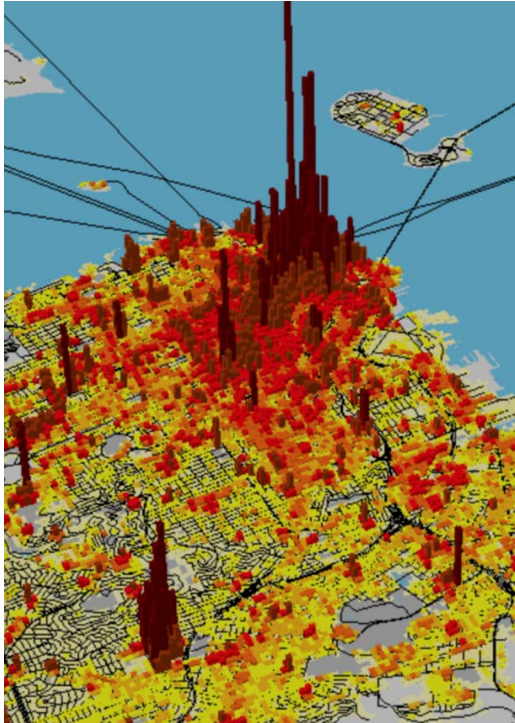
Reduce Congestion
Smooth Traffic Flow
Operate More Efficiently
Adopt More ZEVs*

* Not accounted for in these projections

Will new value creation drive unbridled consumption?

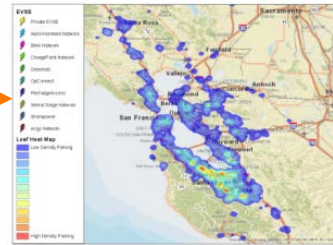
INCREASINGLY COMPLEX DECISION ENVIRONMENT

Cities and Regions



Decisions

Charging/Fueling
Infrastructure

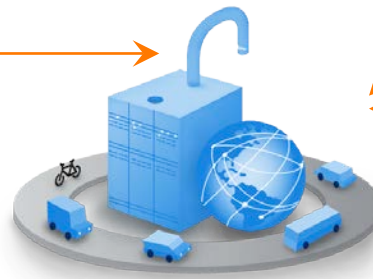


Connected
Travelers



Image by NREL

Data Management



Energy Infrastructure



More
Decisions

Transforming complexity into clarity for decision makers?

CONNECTED & AUTOMATED VEHICLES (CAVs)

- Quantify the energy impacts
- Identify CAV-enabled opportunities
- Inform policy/research on CAVs
- Address the barriers to CAVs



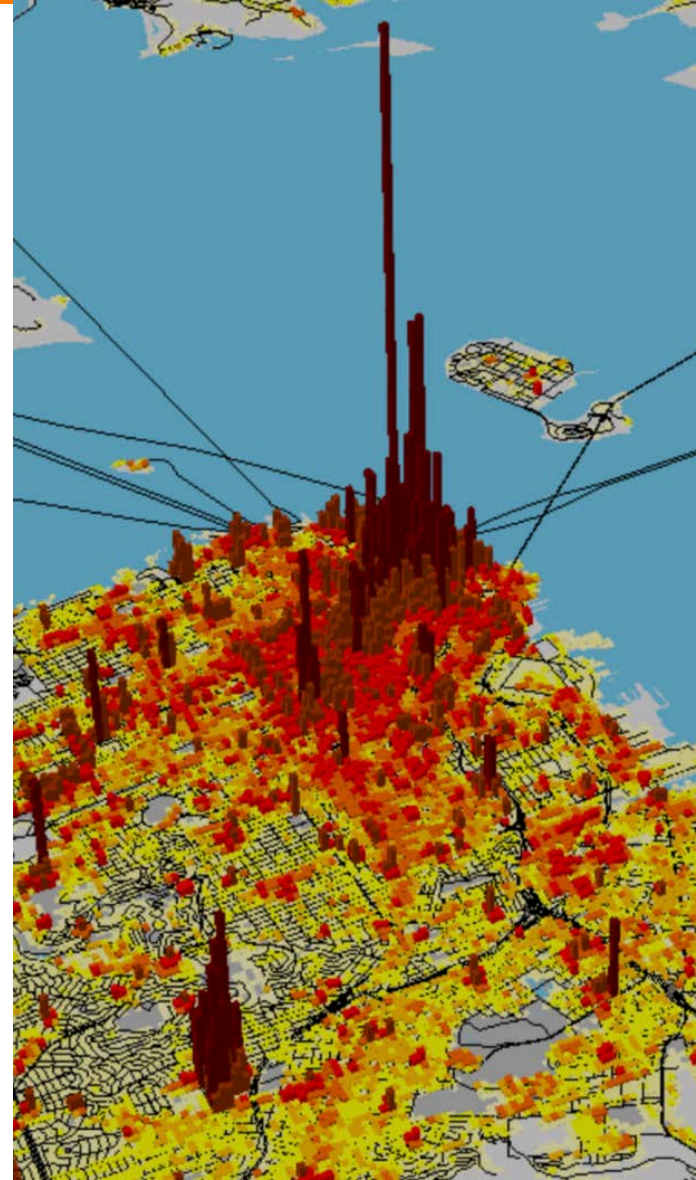
EERE Incubator Award
(U of M, ANL, INL)
500 Vehicle Fleet

Improving our ability to predict the energy impact of CAV's

URBAN MOBILITY SCIENCE

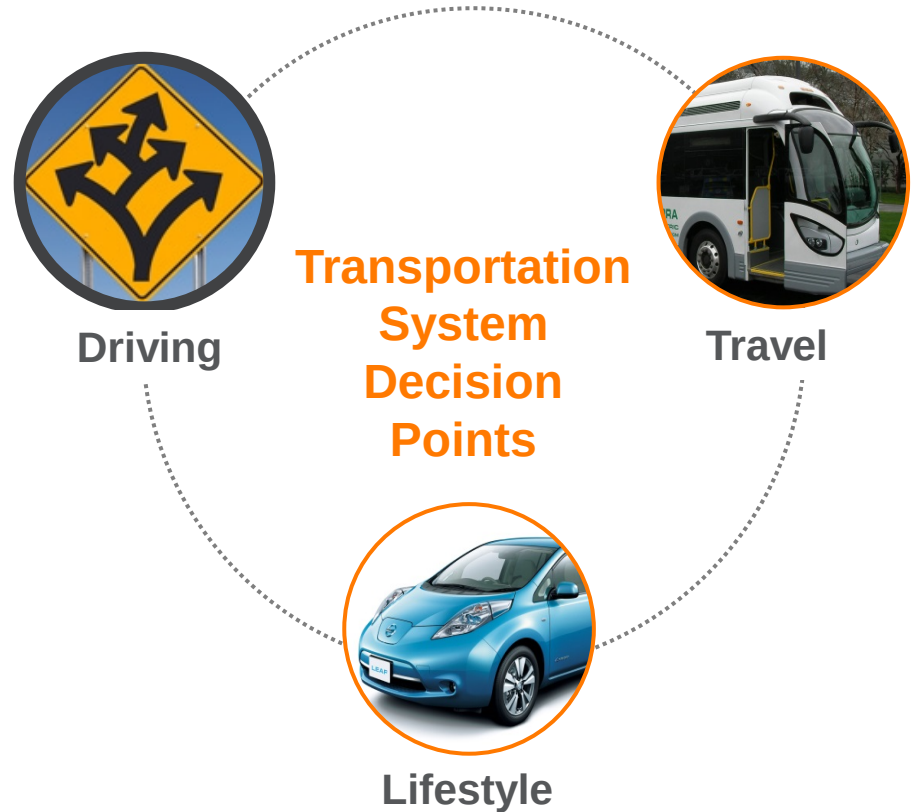
- A new class of data science
- City-scale computational mobility models
- Revealing the previously unknown

Providing scientific support to decision makers



MOBILITY DECISION SCIENCE

- A science of decision making
- Increasingly complex decision environment
- Convergence of ICT, IOT, Shared Economy



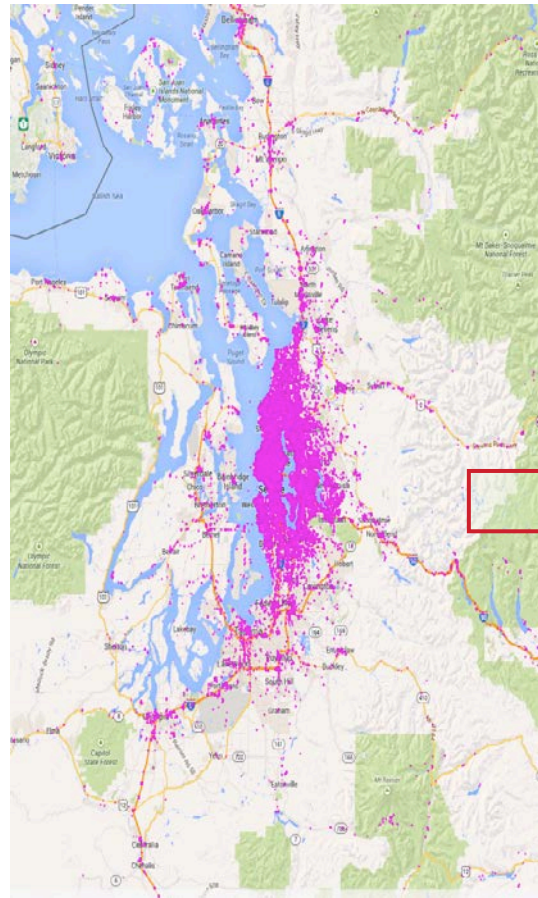
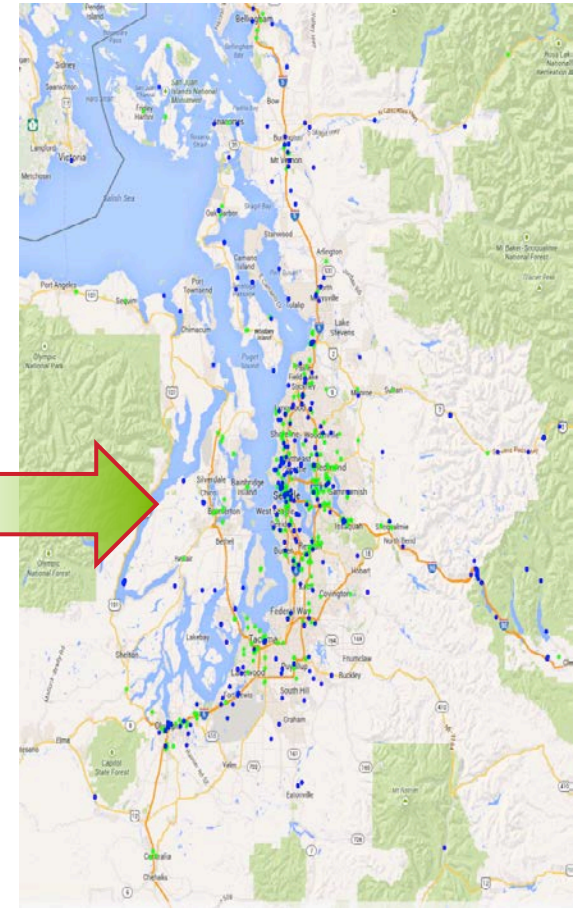
Technology and policy that anticipate how decisions are made

VEHICLES AND INFRASTRUCTURE

- Fueling Station Location Dynamics
- Best outcomes for infrastructure for consumers and investors
- Wireless charging as an enabler? Dynamic?

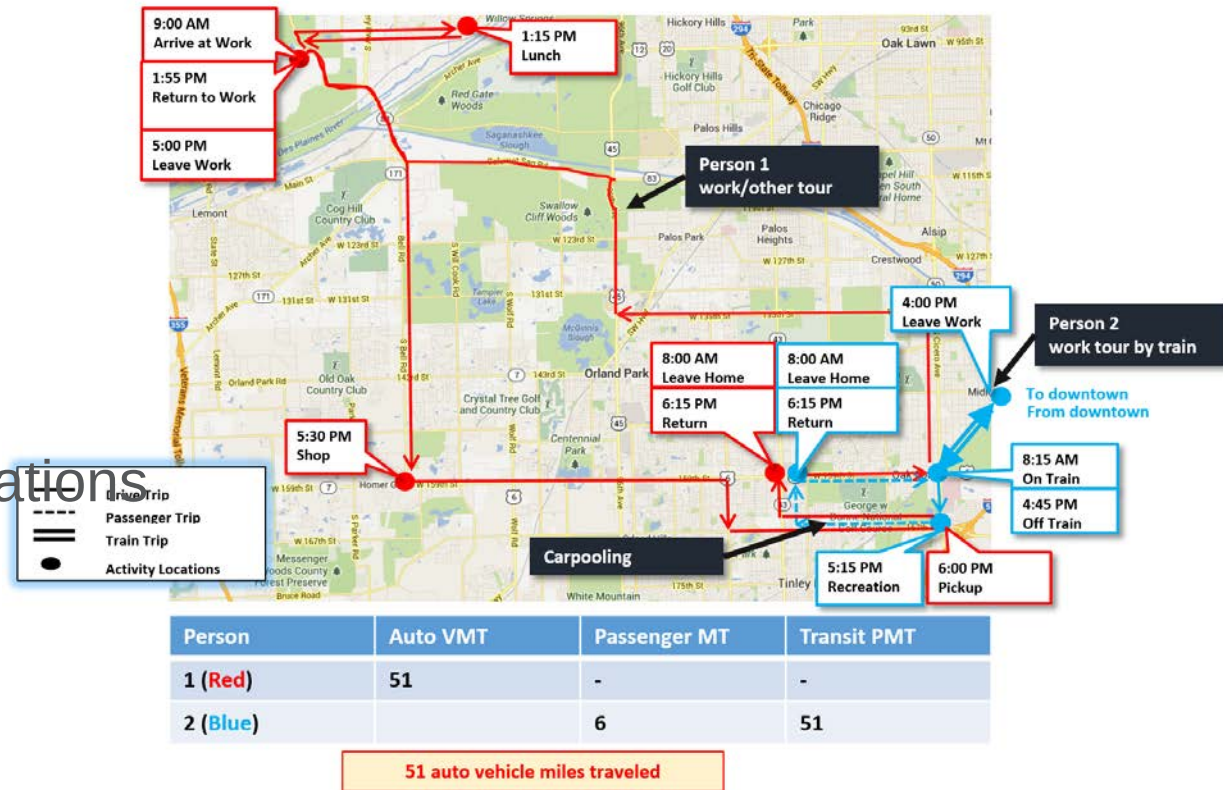
Informed infrastructure investments that drive consumer adoption

Reduced EVSE Locations from 18,000+ to 281 in Seattle



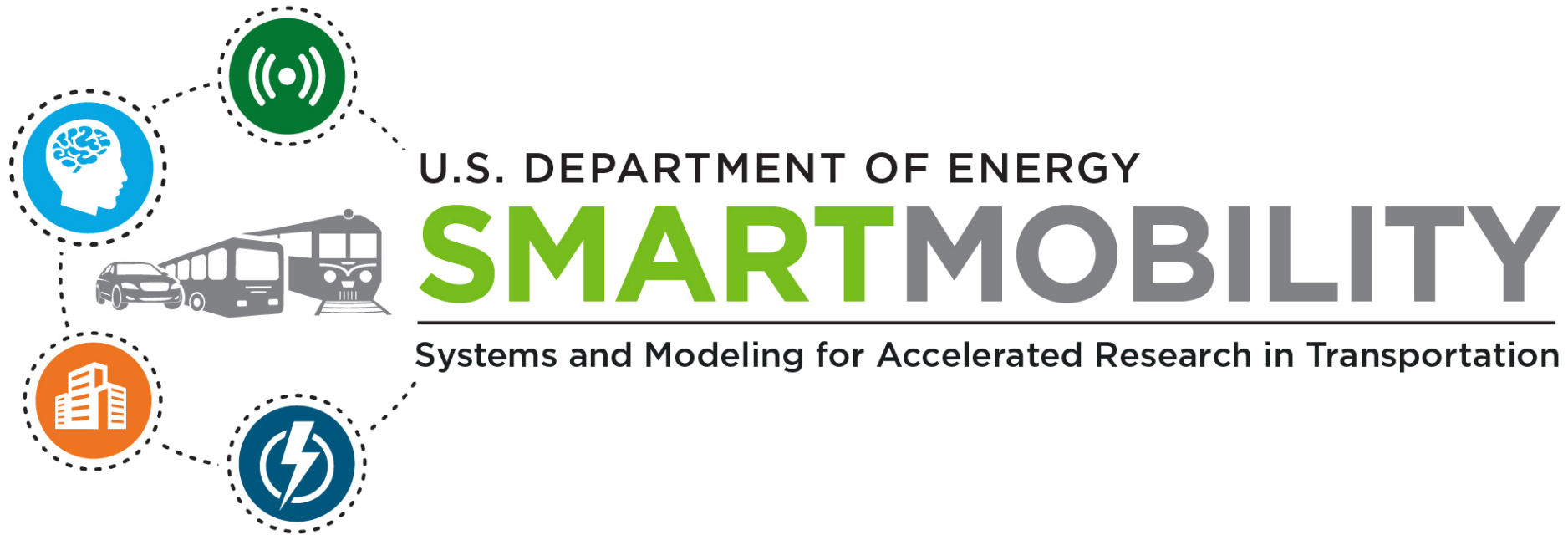
MULTI-MODAL

- People and Goods
- Integrated solutions
- Optimal modal combinations for energy
- MaaS



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

DOE SMART MOBILITY



Multi-lab consortia exploring the nexus of energy and future mobility paradigms

SMART MOBILITY- WHAT ARE WE GOING TO LEARN?

Urban Science



Interaction with the Built Environment & Urban Data

Mobility Decision Science



How Consumers Make Transportation Decisions

Connectivity and Automation



Impacts of CAV's on Energy

Vehicles & Infrastructure



Alternative Fuel
Vehicle-Infrastructure Systems

Multimodal



New Modes, Tradeoffs,
Interface Between Modes

SMART MOBILITY – KEY QUESTIONS

- Will SMART mobility reduce energy intensity of transportation?



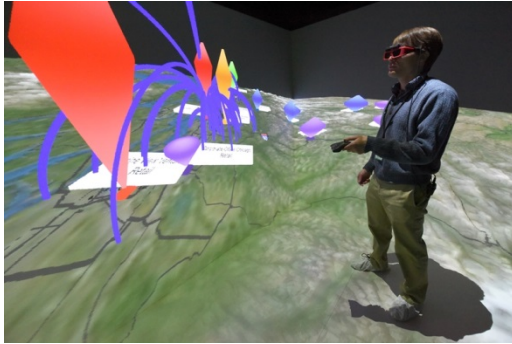
- Will SMART mobility enable greater use of low carbon energy sources?



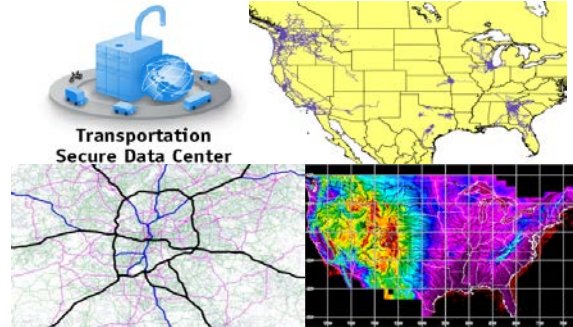
- Will SMART mobility have an impact on VMT?



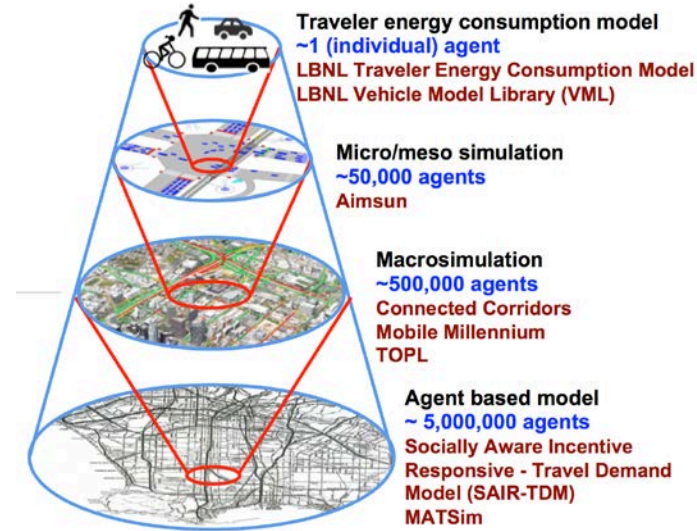
WORLD CLASS LABORATORY RESOURCES



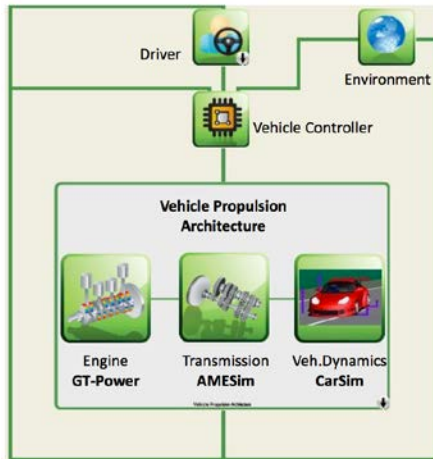
Automation tools



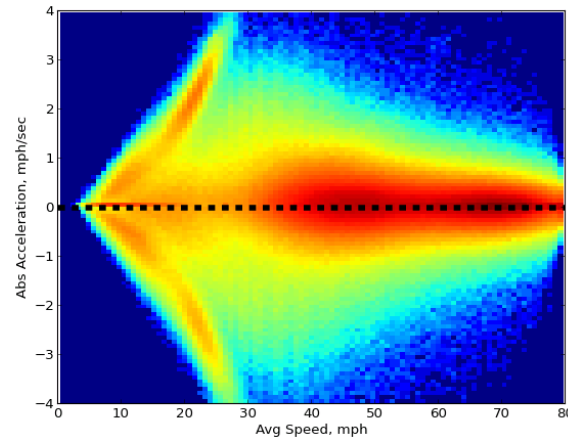
Massive data feeds



Multi-scale mobility models



Propulsion / powertrain
Modeling systems

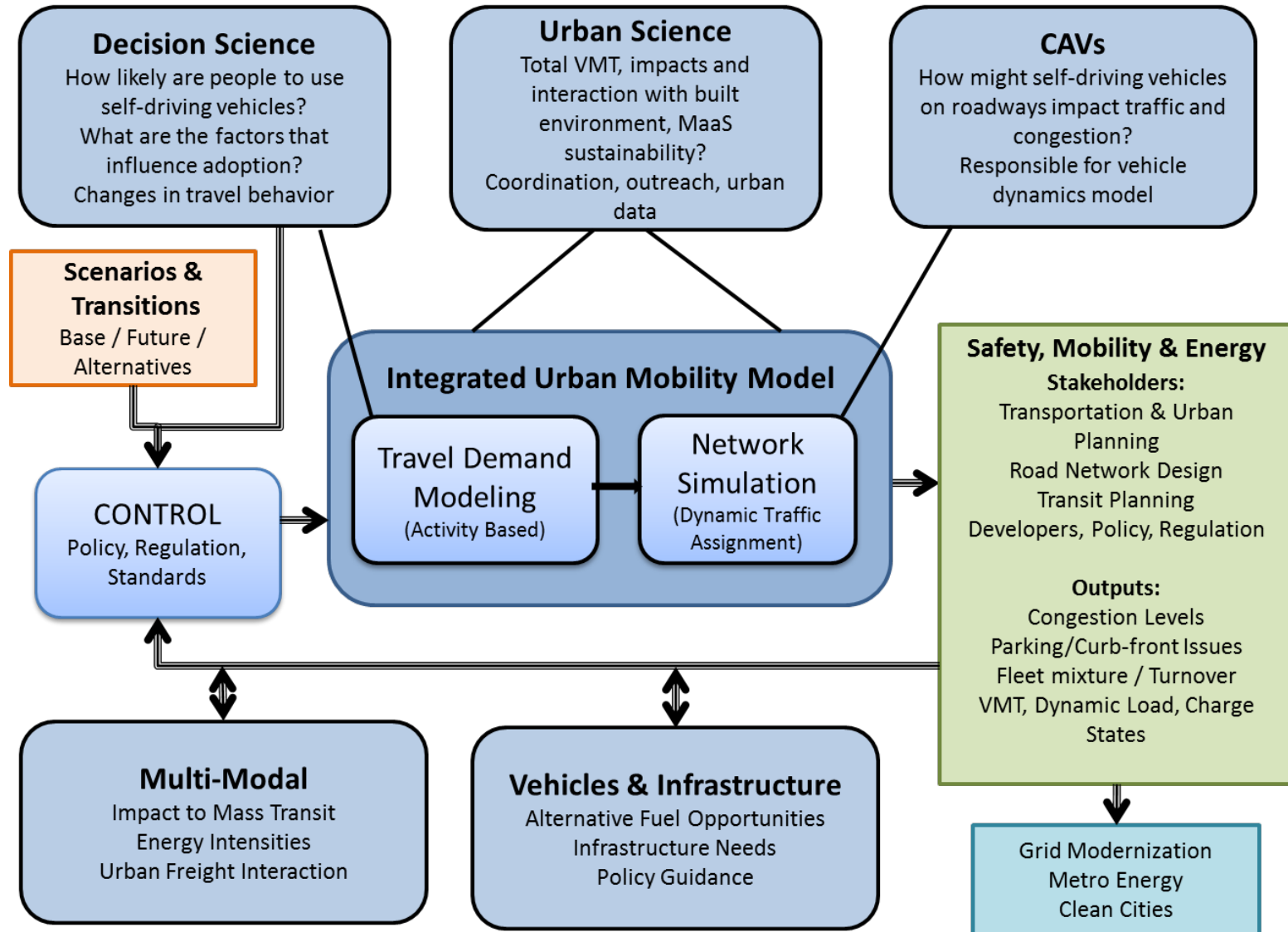


HPC architecture and systems



Land use models and regional models

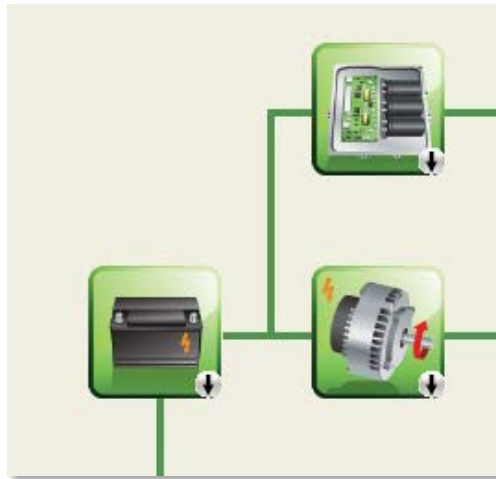
INTEGRATED URBAN MOBILITY MODEL



R&D OPPORTUNITY SPACE STILL EMERGING



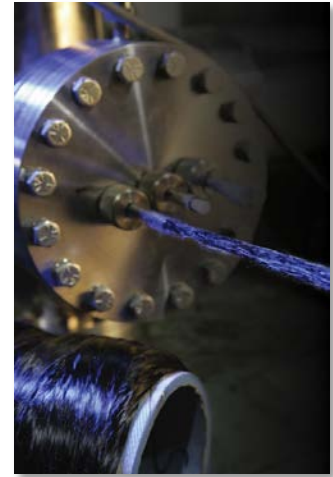
Big Data



Control Systems



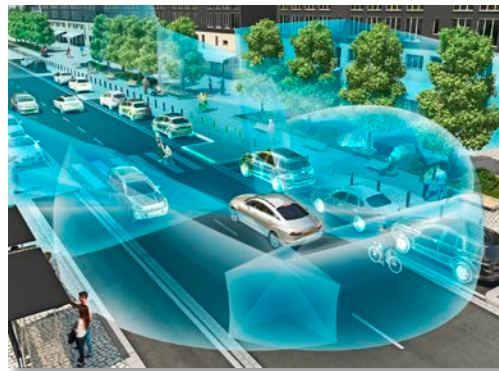
Vehicle Design



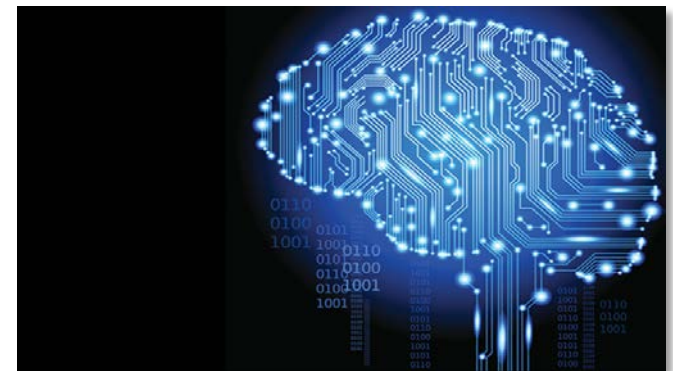
Lightweighting



Powertrain Optimization



Advanced Sensors



AI/Machine Learning