Estimation of Benefits for Automated Vehicle Systems

Workshop on Connected and Automated Driving Systems

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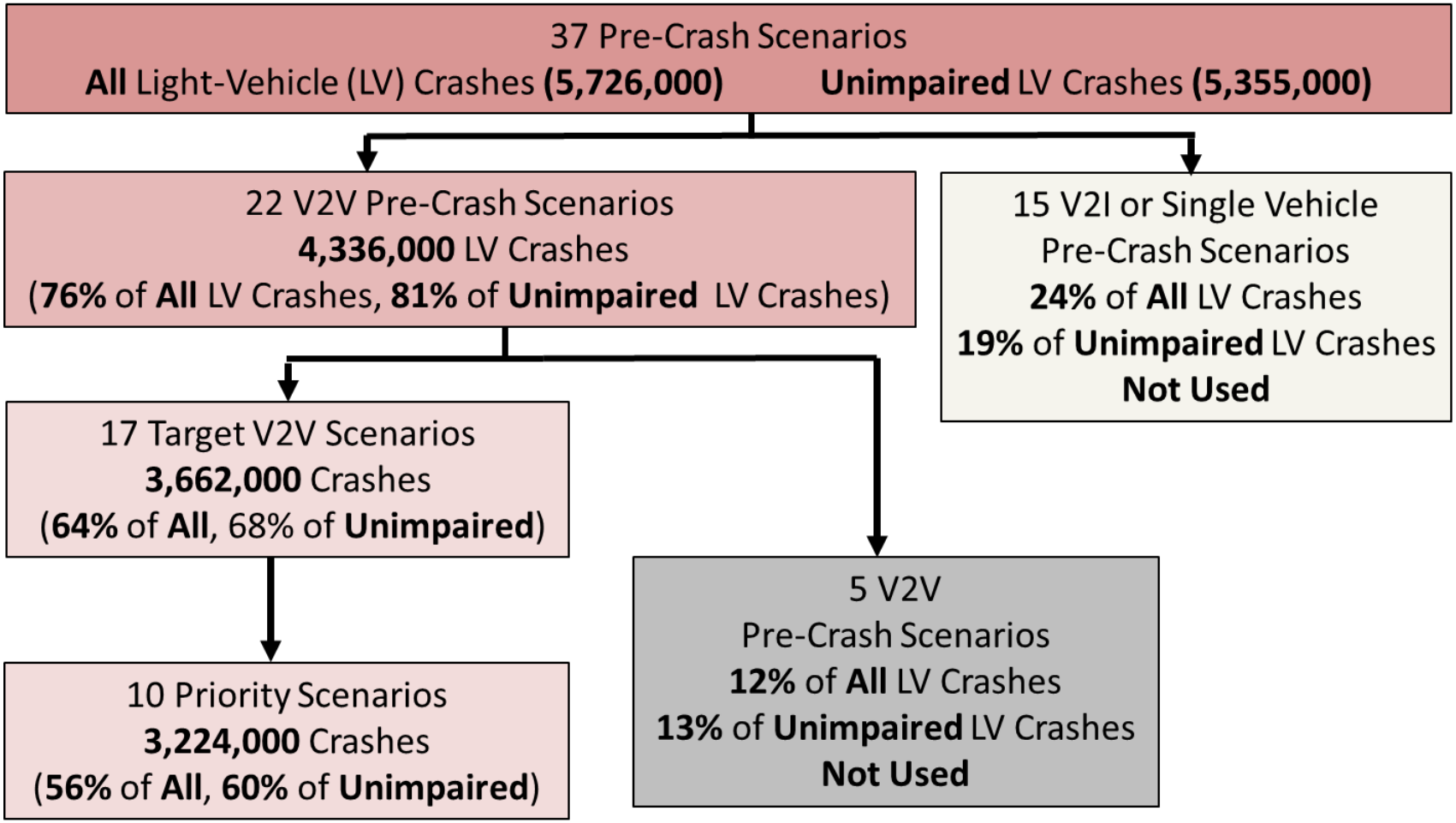
CONNECTED VEHICLE SYSTEMS: BENEFITS & COSTS

“Connected vehicles have the potential to address approximately 80% of vehicle crash scenarios involving unimpaired drivers.”



Source: "Vehicle to Vehicle Communications: Readiness of V2V Technology for Applications"

Preliminary Estimates of Benefit & Costs

- Preliminary Cost Estimates of V2V Equipment
  - $341 to $350 / vehicle in 2020
  - $209 to $235 / vehicle in 2058

- Annual Benefits of IMA & LTA V2V Applications at full deployment
  - Crashes avoided = 400,000 to 600,000
  - Injuries avoided = 190,000 to 270,000
  - Lives saved = 780 to 1,080

Source: “Vehicle to Vehicle Communications: Readiness of V2V Technology for Applications”

AUTOMATED VEHICLE SYSTEMS – BENEFITS

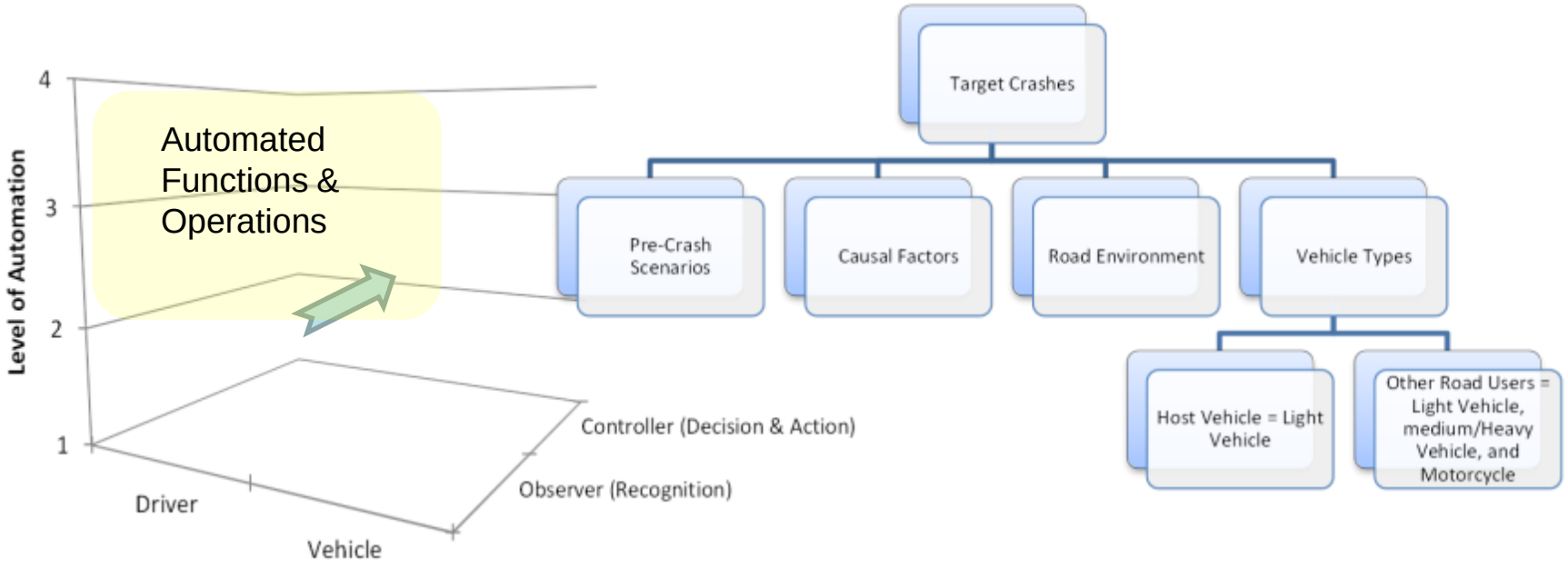
Steven M. Johnson

AV Target Crash Population Research

- Goal
  - Estimate potential safety benefits that could be gained from automated vehicles at automation levels 2-4
- Objectives
  - Map known automated vehicle functions and operations to crash information
  - Query national crash databases (GES and FARS) to estimate the target crash population that could benefit from automated vehicles
- Focus
  - Automated light vehicles
  - Baseline crashes *with* and *without* crash-imminent avoidance applications

Identification of Target Crashes

- Map automated functions & operations to appropriate crash scenarios, causes, & contributing factors
- Identify relevant variables and codes in GES/FARS



AV Multimodal Benefits Framework

- Develop a framework to estimate the potential safety, mobility, energy and environmental benefits of technologies contributing to the automation of the nation's surface transportation system

- Objectives
  - Identify metrics
  - Develop a framework for quantifying impacts
  - Provide a high order assessment of the state of knowledge
  - Incorporate current research by other parties.

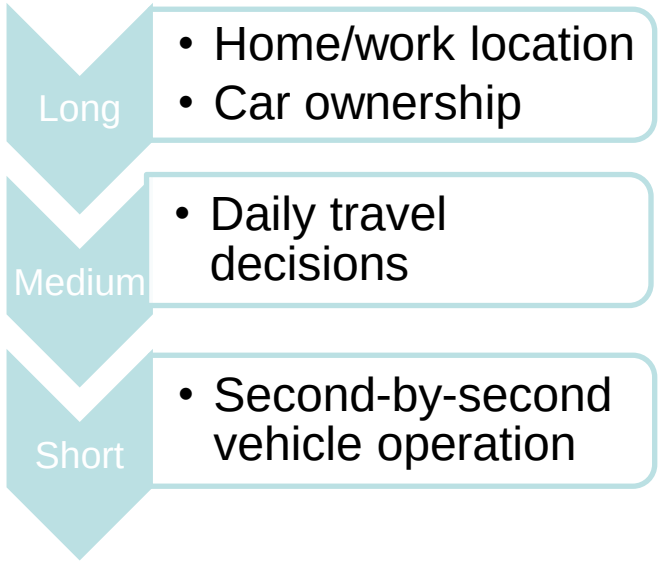
The goal during this first year is to build a framework. Quantitative analysis of expected benefits will come later.

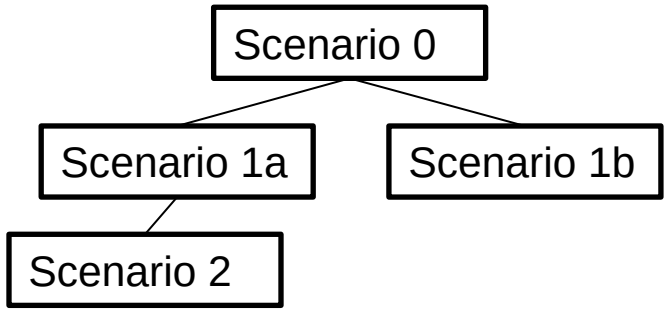
Challenges in Building a Modeling Framework

- Data
  - Performance of the automation application compared to a driver
  - Scaling benefits to a national level
- What is the baseline?
  - **Not** current vehicles
- Risk areas
  - Performance of the automation application in unusual situations
  - Changes in driver / vehicle interaction (more distracted driving behavior?)
- Modeling
  - Need consistent models for driver / vehicle / road performance with and without the automation application
  - Model detail must be sensitive to the impacts of the application
  - Overlapping benefits from multiple applications
- Many possible future scenarios
  - Levels of automation
  - Market penetration
  - Vehicle sharing

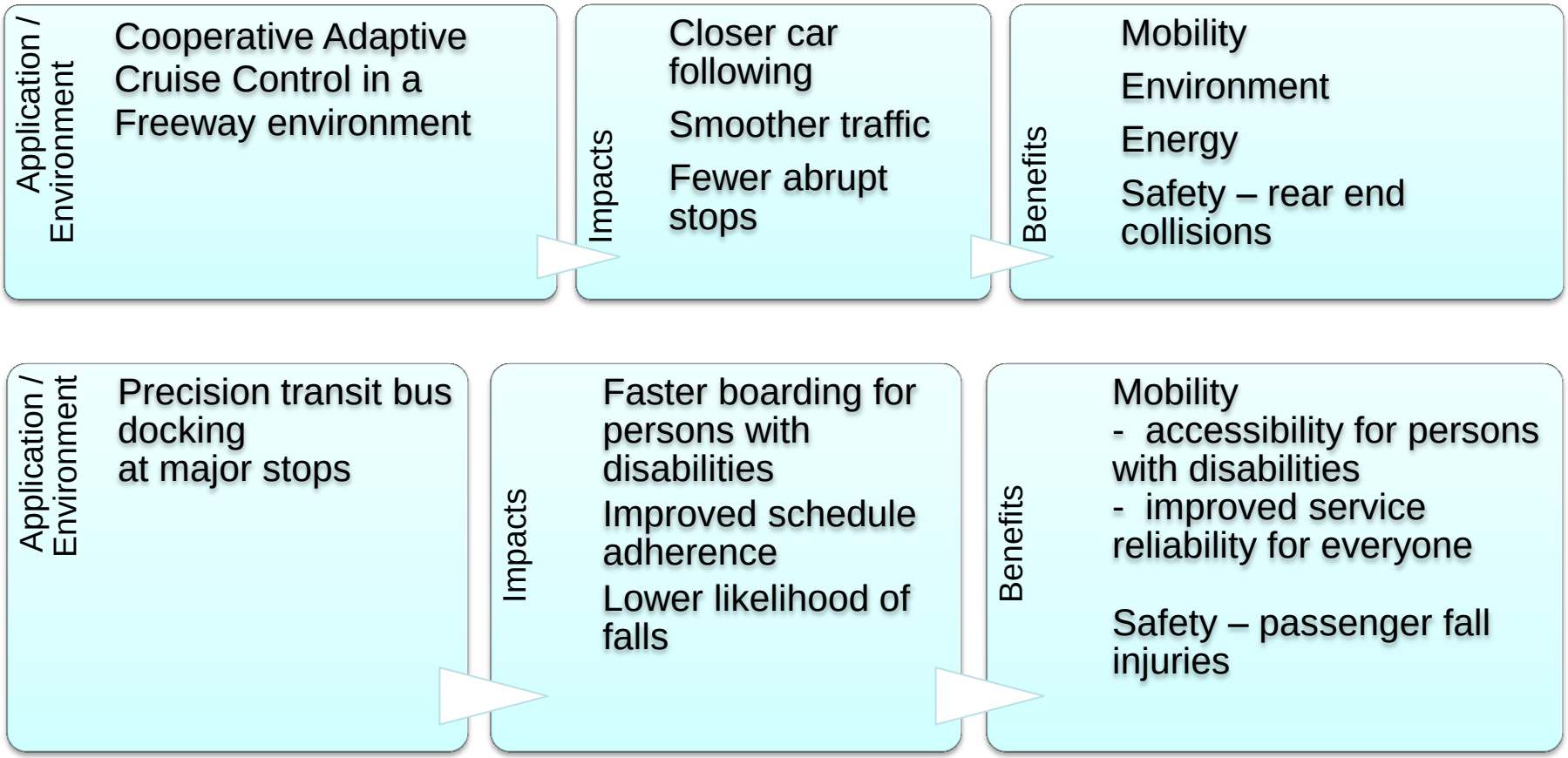
Approach

- Divide and conquer
  - Several layers to the framework, with well-defined interfaces
  - Well defined scenarios (e.g., lead vehicle stopped, car following, etc.)
- Consistent methods for modeling "with" and "without" automation
- Use existing tools and methods as appropriate
  - Safety impact methodology
  - Car-following and traffic microsimulation
  - Emissions / energy estimation (MOVES)
- Flexibility to accommodate several visions of the future world (e.g., state of infrastructure, amount of ride sharing)

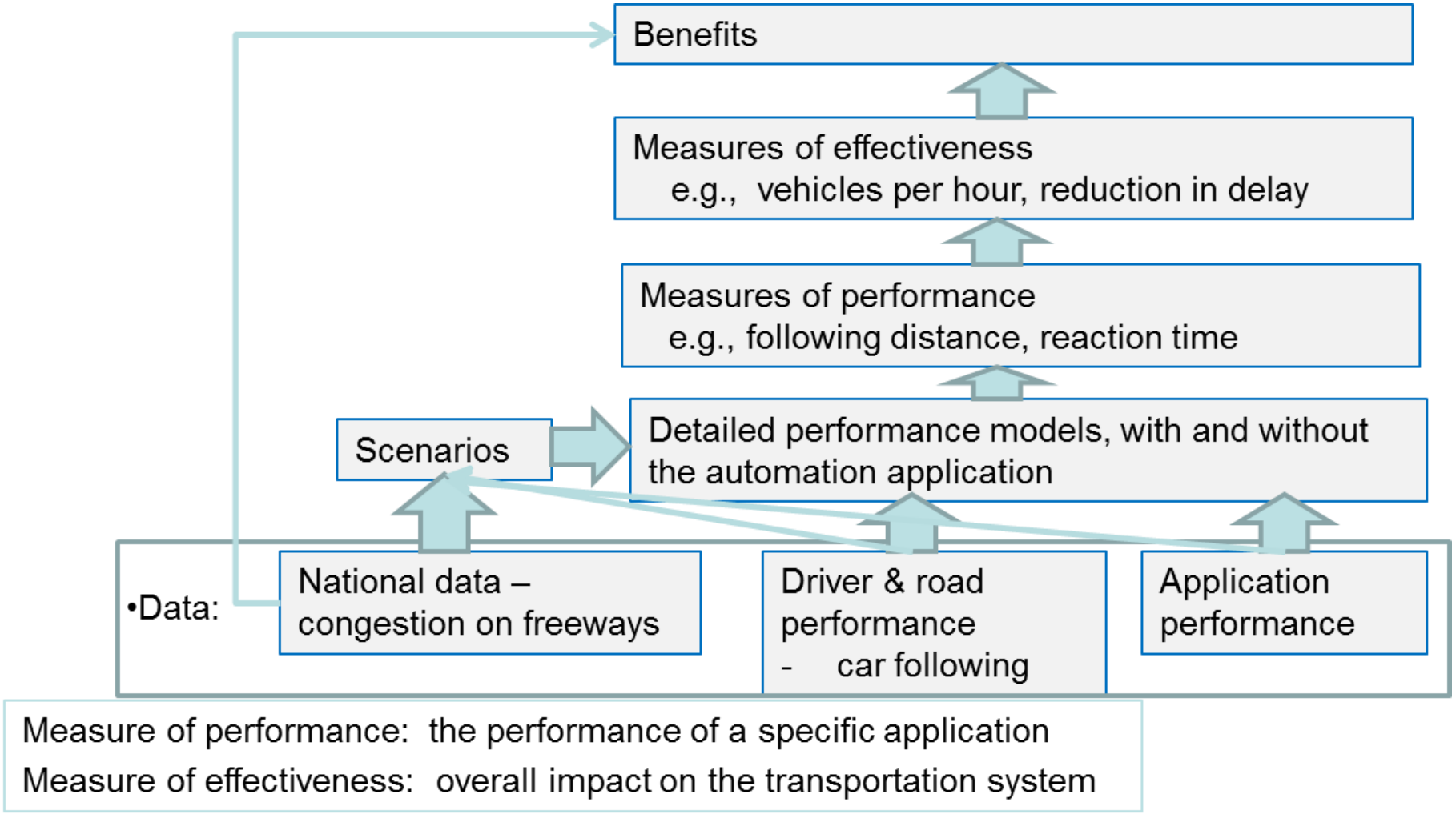




Applications => Impacts => Benefits



Framework Example: Mobility impacts of CACC on a Freeway (1 of 2)



Measure of performance: the performance of a specific application

Measure of effectiveness: overall impact on the transportation system

Mobility Impacts of CACC on a Freeway (2 of 2)

- Local / short term impacts
  - Greater lane capacity from closer following distances
  - Some safety improvement
- Medium term impacts
  - Traffic shift to the freeway from other congested roads
  - Changes in energy consumption and emissions
  - Improved accessibility to points reached by the freeway
- Long term impacts
  - More development on land that is accessible via the freeway

Next Steps

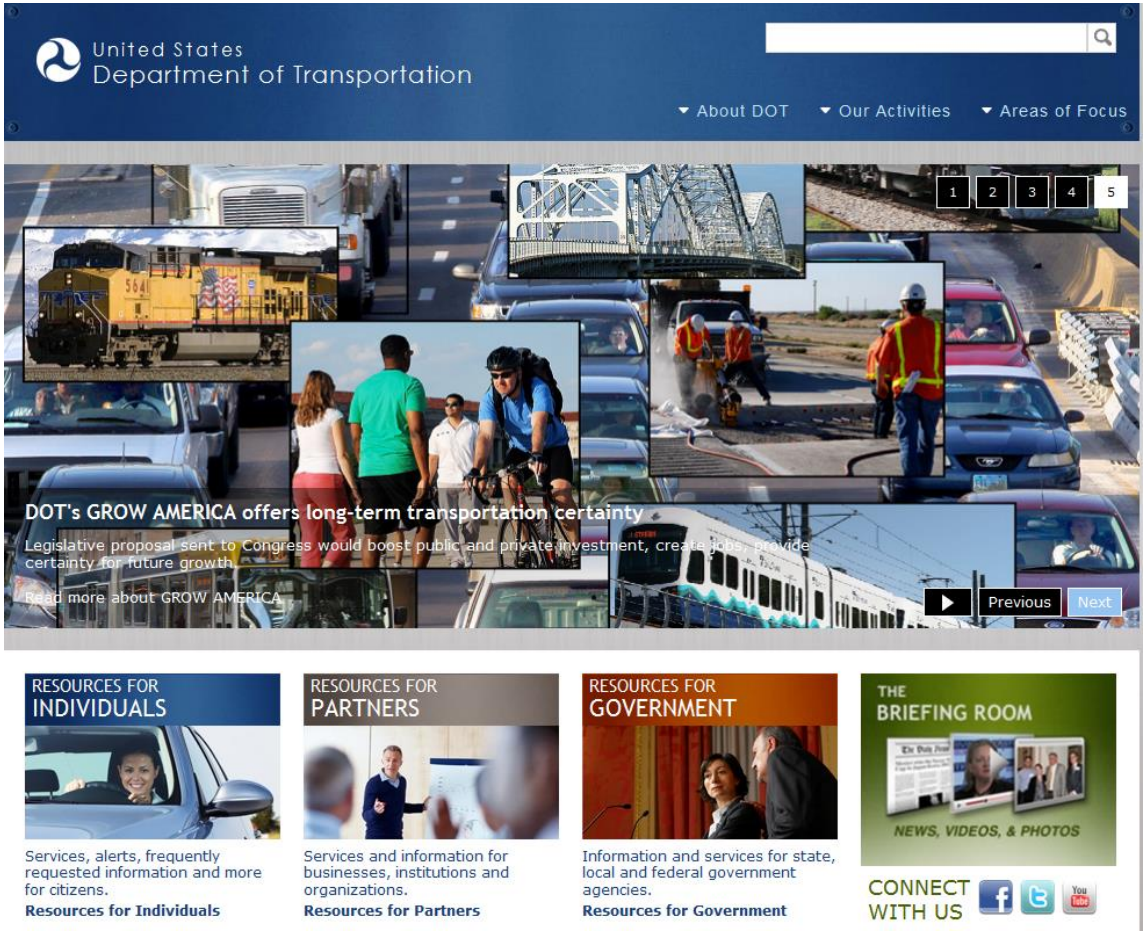
CY 2014 – 2015

- Develop a modeling framework
  - Conceptual description, including assumptions and boundaries
  - Scenarios to be modeled
  - Existing models and gaps
  - Proposal for prototype model development

CY 2015 – 2016

- Develop and validate a working proof-of-concept benefits model

For More Information



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