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The Connected Traveler

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THE MARKET OPPORTUNITY

American travel time increased by **6.9 billion hours**

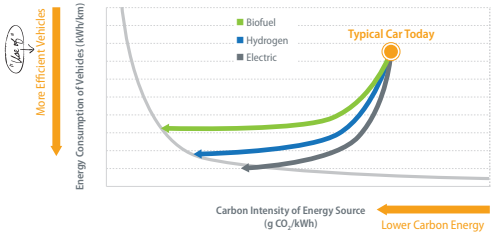
. . . increasing gasoline consumption by **3.1 billion gallons**

. . . resulting in a congestion cost of **160 billion dollars**

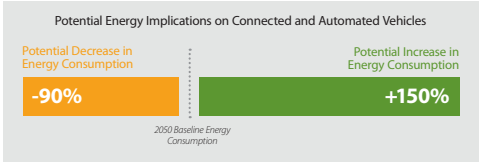
Source: Texas A&M Transportation Institute 2015 Urban Mobility Scorecard

GETTING THE CO_2 OUT—PATHWAYS TO 2050

Transportation system efficiencies represent a substantial and complementary benefit to current efforts to reduce vehicle energy consumption and the carbon intensity of fuels.



CONNECTIVITY/AUTOMATION WILL TRANSFORM TRANSPORTATION



Source: Brown, A., Gonder, J., Repac, B. (2014). "An Analysis of Possible Energy Impacts of Automated Vehicles." Springer Book Chapter.

- Vehicle connectivity and automation can substantially impact the effectiveness of investments in increased fuel economy and low-carbon fuels.
- Huge business around increasing utilization and right-sizing of mobility technologies.
- Increased pressure for transportation infrastructure managers to do more with less.

THE PROJECT

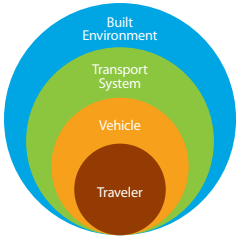
CONNECTED TRAVELER PROJECT OVERVIEW

- Multi-disciplinary undertaking will seek to validate potential for transformative transportation system energy savings by incentivizing efficient traveler behavior.
- Control architecture will be developed that incorporates adaptive learning, and refined incentive and control strategies to provide high certainty of adoption.
- Metropia platform will allow for real-world validation of traveler behavior and assist in refining incentives and control strategies.
- NREL's Transportation Secure Data Center and related tools will be used to determine individual energy consumption.
- Individual energy impacts will be extrapolated to estimate transportation system energy consumption.*

**Additional system model development may be required to refine this to a margin of error that can be used by transportation practitioners.*

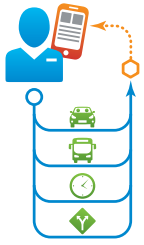
STARTING WITH THE TRAVELER

We need to approach sustainable transportation as a network of travelers, services, and decision points connected by communication technology and decision-making tools—rather than just by vehicles and roads—to significantly reduce related energy consumption.



UNDERSTANDING TRAVELER BEHAVIOR AND DECISION MAKING

Control Architecture



Control Strategies

- Change in Departure Time
- Mode Choice
- Carpooling
- Alternate Routing
- Alternate Destinations
- Elimination of Need for Trips

Framing and Refining Control Strategies

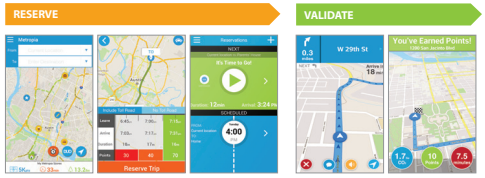
Framing the effects of incentives and benefits will be investigated and refined. Additional control strategies will be investigated to allow for additional savings opportunities and incorporation of new mobility opportunities.

Phase I
- Change in Departure Time
- Alternate Routing
- Alternate Destinations

Phase II
- Mode Choice
- Carpooling
- Elimination of Trips

VALIDATING AND OPTIMIZING TRAVELER BEHAVIOR

- Adaptive learning will be applied to refine control strategies based on energy savings potential and likelihood of adoption by traveler.
- Project will leverage Metropia platform to validate incentive effectiveness and hone control strategies.



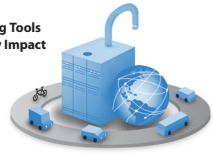
ITERATING A BASELINE FOR ENERGY CONSUMPTION

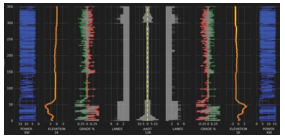
Accessing Diverse Transportation Data Sets

NREL's Transportation Secure Data Center houses data from travel surveys and studies conducted using GPS devices. It features millions of data points—second-by-second GPS readings, vehicle characteristics (if applicable), and demographics—for all modes of travel.

Leveraging Existing Tools to Estimate Energy Impact

- DRIVE
- FASTSim
- Fleet DNA





Example of TSDC Analysis

Integration of TomTom infrastructure details with road load equation to estimate instantaneous power demand (blue) for a Chevy Volt at a constant speed given instantaneous grade. Average annual daily traffic is visualized in the center indicating vehicle count.

PROJECT TIMELINE – KEY MILESTONES

YEAR 1	
Q1	• Tech-to-Market Plan completed • Target city identified • Phase I control architecture development begins
Q4	• Energy estimation for Phase I control strategies completed
YEAR 2	
Q5	• Initial control strategies implemented in Metropia app • Phase II control architecture development begins
Q6	• Sensitivity analysis for control strategies completed
Q7	• Integrate Phase I/II control strategies and incentives into Metropia app • Energy estimation of all control strategies complete • System energy estimation performs within 10% accuracy
Q8	Development of learning algorithm completed
YEAR 3	
Q9	Updated Metropia application deployed to mobile app markets (e.g., iOS app store)
Q10	Project closeout

PROJECT TEAM

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