PROJECT ID: EEMS051

U.S. DEPARTMENT OF ENERGY

SMARTMOBILITY

Systems and Modeling for Accelerated Research in Transportation

SMART Mobility Modeling for Typical Mid-Size City

Andrew Duvall

DOE Vehicle Technologies Office 2018 Annual Merit Review and Peer Evaluation Meeting

June 19, 2018

Argonne NATIONAL LABORATORY

INL Idaho National Laboratory

BERKELEY LAB

OAK RIDGE National Laboratory

NREL NATIONAL RENEWABLE ENERGY LABORATORY

ENERGY EFFICIENT MOBILITY SYSTEMS PROGRAM
INVESTIGATES

MOBILITY ENERGY PRODUCTIVITY

THROUGH FIVE EEMS ACTIVITY AREAS

Advanced R&D Projects

Living Labs

Smart Mobility Lab Consortium

HPC4Mobility & Big Transportation Data Analytics

Core Evaluation & Simulation Tools

Advanced Fueling Infrastructure

Connected & Automated Vehicles

Urban Science

SMART MOBILITY LAB

CONSORTIUM

7 labs, 30+ projects, 65 researchers,
$34M* over 3 years.

Mobility Decision Science

Multi-Modal Transport

*Based on anticipated funding

OVERVIEW

Timeline

- Project start date: 1 Oct 2017
- Project end date: 30 Sep 2019
- Percent complete: 25%

Budget

- Total project funding
  - DOE share: $350k (Base FY18-19)
  - Contractor share: $0
- Funding for FY 2017: $0
- Funding for FY 2018 (if available): $175k

Barriers

- Existing transportation models do not integrate smart technologies
- Foundational modeling data sources are not contemporary; insufficiently flexible to maintain accuracy

Partners

- Texas A&M Transportation Institute (TTI)
- Metropia, Inc.
- Project lead: NREL

RELEVANCE

- **Objectives:**
  - A key objective is to extend existing transportation data and models to include emerging Smart transportation options, in order to better assess affordability, efficiency, safety, and accessibility of mobility
    - Include mobility as a service, ubiquitous communications, and automation
  - Identify how improvements to models to integrate rapidly evolving smart technologies can improve system efficiency
  - Develop recommendations for extension of current models to include emerging travel technologies and practices
- **Impact:**
  - Development of replicable methods to enable existing models to assess energy impacts, and affordability, efficiency, safety, and accessibility of Smart transportation
  - Identify data sources for smart transportation technology and how they may be used to augment models
  - Build on relevant ARPA-E Traveler Response Architecture using Novel Signaling for Network Efficiency in Transportation (TRANSNET) project outcomes

RESOURCES

- **Tools and methods to simulate and estimate emergent mobility options as supported through ARPA-E TRANSNET project**
  - Advanced models created to simulate effects of mobility app at scale
  - Dynamic traffic assignment capabilities within DynusT software
- **Collaborative relationships with key organizations in cities of focus**
  - Strong connections with Smart City group in Austin
  - NREL team member serves as Technologist in Residence for USDOT Smart City Columbus
- **Subcontractors with experience in cities of focus**
  - Austin, TX: Texas A&M Transportation Institute (TTI)
  - Columbus, OH: Metropia, Inc

MILESTONES

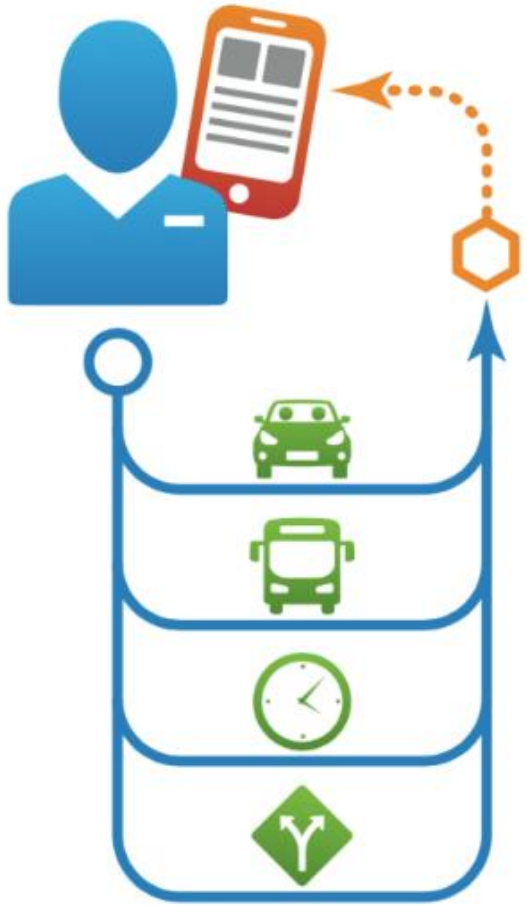
- FY 2018 Q1 – Kickoff meeting in Austin, TX
- FY 2018 Q2 – Report on the transportation modeling maturity/capacity in Columbus, OH (existing and planned models) to reflect SMART technology in comparison/contrast to that of Austin
- FY 2018 Q3 – Recommendation report mapping SMART scenarios and technology of specific interest/concern to Austin within the framework of existing tools and data, and recommendations for implementation
- FY 2018 Q4 – Brief Project Forum Report
- FY 2019 – TBD

APPROACH

- Work directly with city research entities (TTI and Metropia), which have in-depth knowledge of existing Austin, TX, and Columbus, OH, travel-demand models and associated data
- Extend model incrementally to include impacts of Smart Mobility, documenting methods with existing dynamic traffic assignment with conventional trip generation practice
- Estimate mobility and energy impacts of Smart technologies within an existing / established modeling framework as a case study for other cities
- Integrate findings from ARPA-E TRANSNET project to augment modeling capabilities

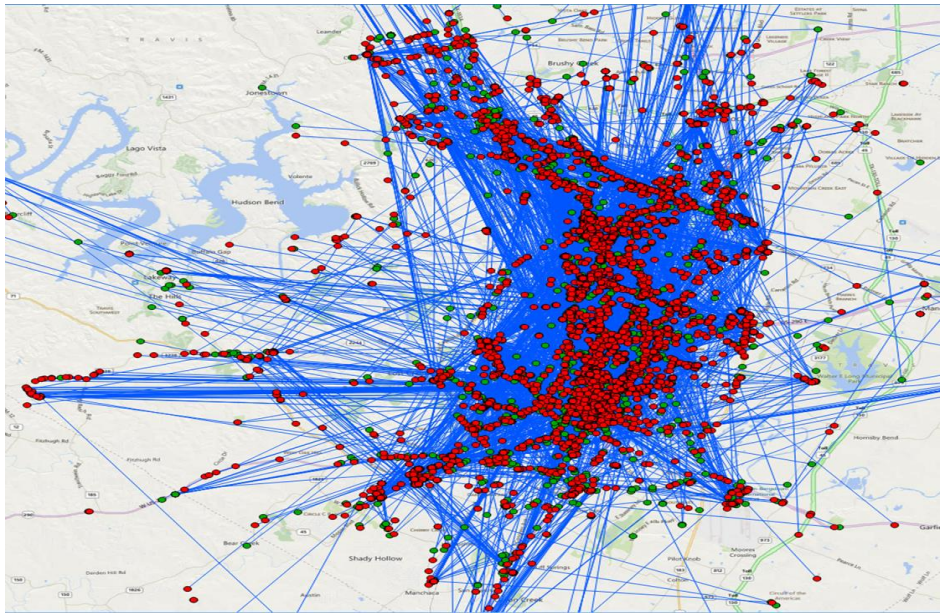
BUILDING ON DOE SUPPORT: ARPA-E TRANSNET PROJECT

- ARPA-E TRANSNET
- Focus on Austin, TX
- Improve existing transportation network and reduce energy use—travel time, mode choice, routing options, vehicle passenger load
- Metropia mobility app leverages incentives, convenience to shift behavior; learns user preferences
- Integrated with Uber POOL



TRANSNET: TTI ESTIMATED IMPACT AT SCALE

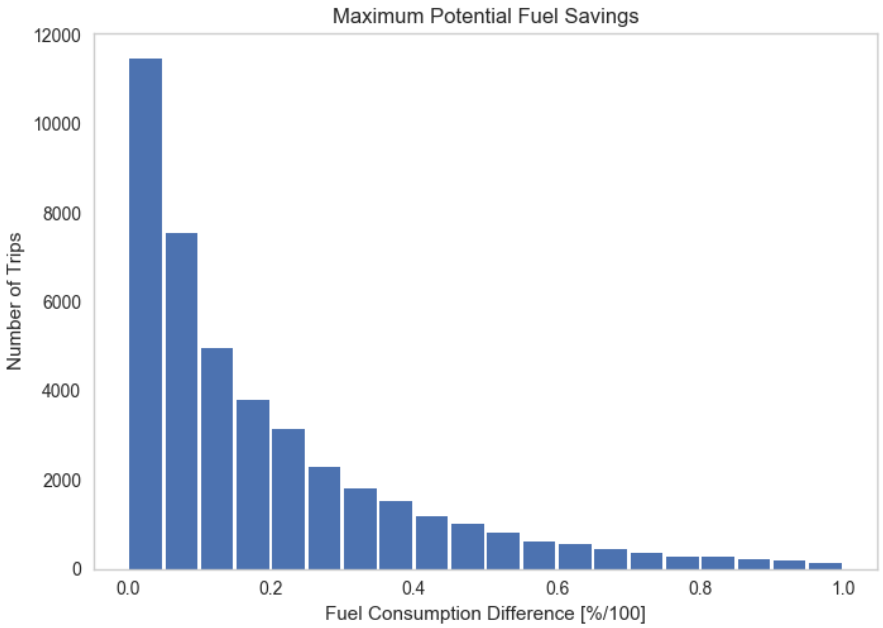
- TTI estimated impact of the Metropia app at scale using simulation models
- Modeling tool:
  - DynusT is a simulation-based dynamic traffic assignment software that can support engineers and planners in addressing emergent transportation planning and operations issues



Simulation images used with permission of Texas A&M Transportation Institute

TRANSNET: NREL ESTIMATED ENERGY OUTCOMES

- NREL developed methods to estimate energy impact of travel options presented through the Metropia app
- The energy units presented to users are tailored to individual preferences
- System-scale energy impacts are estimated from aggregated user data



Total Potential Savings	2039 gal.
Total Relative Savings	4.1%
Trips with Savings	18.1%
Average Relative Savings for Subset of Trips with Savings	17.2%

TECHNICAL ACCOMPLISHMENTS AND PROGRESS

- Deliverable 5.1: Assessment and modeling report for Austin, TX
- Impacts of being the fastest-growing mid-size city in U.S.
  - I-35 through downtown rated worst freeway segment in U.S.
  - Multiple large tech companies are based in Austin area
  - Influx of employees contributing to sprawl, congestion
- Innovations in Austin Smart Mobility Roadmap
  - Two-way open data portal: framework for interactive data flow
  - Connected traveler initiative: real-time data to inform travel decisions
  - ARPA-E TRANSNET project is nucleus for informed traveler choices
- **Key message**: Austin exhibits acute travel challenges but is a leader for novel mitigation approaches

DELIVERABLE 5.1 FINDINGS

- Austin developed a “Smart Mobility Roadmap” document detailing plans to foster shared electric and autonomous vehicle technologies
  - Identifies need for advancement and augmentation of existing models
  - Outlines recommendations, with timeframe, actions, policies, pilots, and programs
  - Ambitious goals include Pecan Street autonomous shuttle, connecting with transit stations

Transportation Costs and Percentage of Income: Travis County, TX

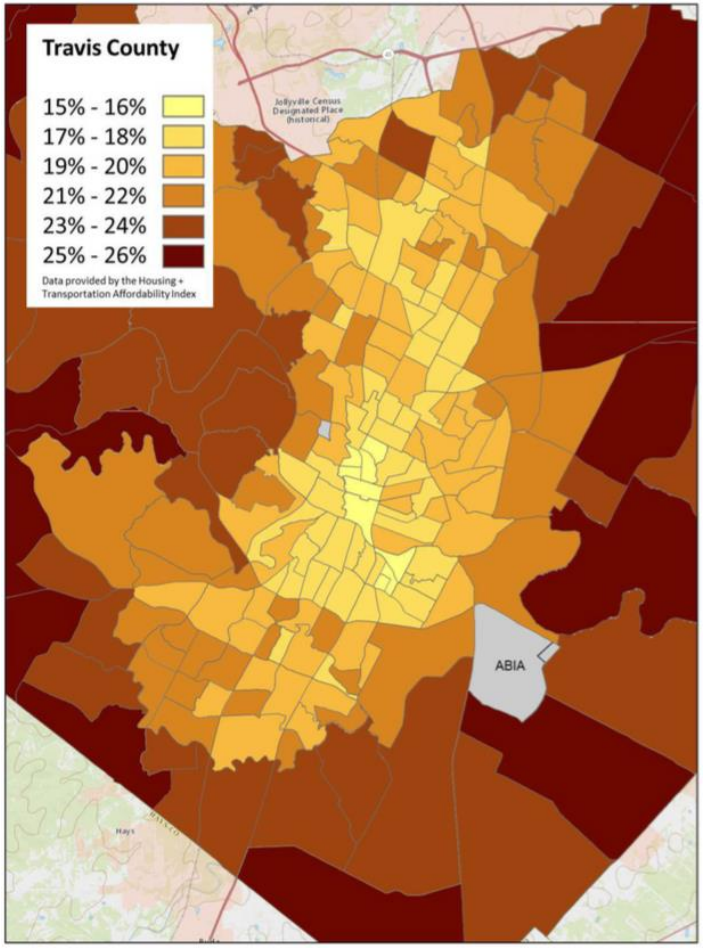


Image used with permission of City of Austin, TX

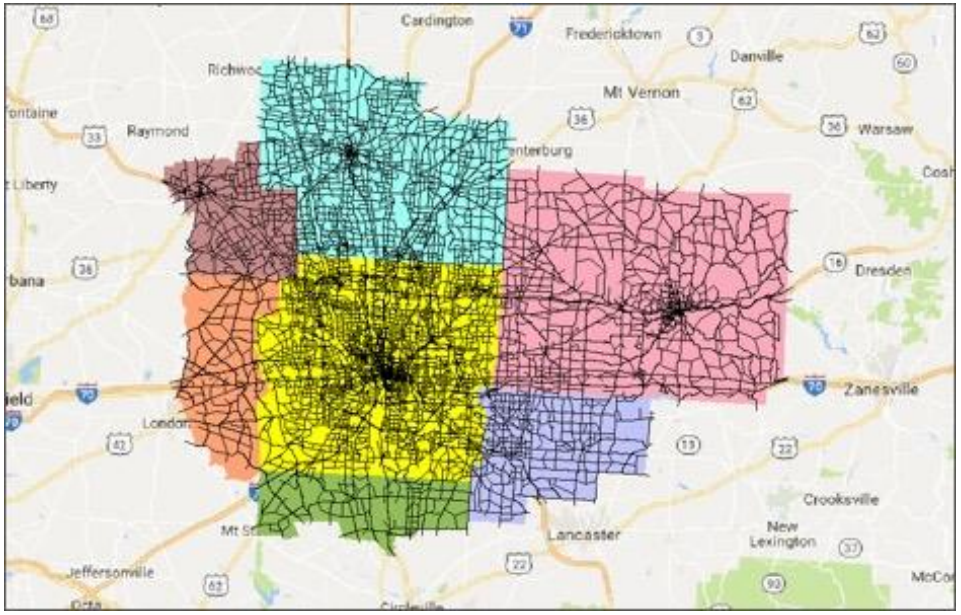
TECHNICAL ACCOMPLISHMENTS AND PROGRESS

- Deliverable 5.1: Assessment and modeling report for Columbus, OH
  - In 2016, Mid-Ohio Regional Planning Commission (MORPC) and Ohio Department of Transportation (ODOT) developed activity-based model (ABM) for forecasting and analysis
  - In 2017, integrated DynusT model for dynamic traffic assignment
  - Enhances analytical capabilities using Active Transportation Demand Management (ATDM) strategies
- US DOT Smart City Columbus efforts underway
- **Key message**: MORPC and ODOT working toward transition to agent-based modeling and simulation(ABMS) framework, capable of incorporating Smart Mobility technologies

DELIVERABLE 5.1 FINDINGS

- ODOT is pushing the envelope of transportation modeling by being one of the pioneering agencies to incorporate advanced demand and dynamic traffic assignment features
- The integrated framework provides the initial step in transitioning to an ABMS framework and could serve as an intermediate assessment platform prototype for other cities exploring new technologies and mobility options

Columbus Area Agent-Based Model and Dynamic Traffic Assignment Modeled Network



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TECHNICAL ACCOMPLISHMENTS AND PROGRESS

- Deliverable 5.2: Recommendation report for Austin, TX
- **Key message**: Replacement of current models or frameworks is not recommended due to high level of effort and cost for a completely new model. Augmenting existing models is viable and cost effective

SUMMARY OF RECOMMENDATIONS FOR USE IN MODELING STRATEGIES WITH CAMPO MODEL

Smart Mobility Strategy Impact	Impact Accounted For Through	CAMPO MODEL COMPONENT			
		Trip Generation	Trip Distribution	Mode Choice	Traffic Assignment
Vehicle Availability	Current Model			✓	
	Recommended Enhancement	✓	✓		
Travel Time	Current Model		✓	✓	
	Recommended Enhancement		✓		
Parking Cost	Current Model			✓	
	Recommended Enhancement		✓		
New Modes	Current Model			✓	
	Recommended Enhancement				
Transit Access/Egress	Current Model			✓	
	Recommended Enhancement		✓	✓	
Roadway Capacity	Current Model				✓
	Recommended Enhancement				✓
ZOV Trips	Current Model				
	Recommended Enhancement	✓	✓		✓

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Image: Texas A&M Transportation Institute

TECHNICAL ACCOMPLISHMENTS AND PROGRESS

- Deliverable 5.2: Recommendations report for Columbus, OH
  - Further develop agent-based modeling and simulation(ABMS) framework for implementation
  - Extend models to include impact of emerging Smart Mobility technologies
    - Automated vehicles, electric vehicles, shared mobility
  - The status of Columbus as U.S. DOT Smart City makes modeling efforts an example for the nation
- **Key message**: It is essential that Columbus develop robust, updatable, next-generation modeling capabilities to reflect emerging transportation technologies.

RESPONSES TO PREVIOUS YEAR REVIEWERS' COMMENTS

- This project was not reviewed last year.

COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS

- Texas A&M Transportation Institute (TTI)
  - University subcontractor, outside Vehicle Technologies (VT) Office
  - Travel modeling expert; provides transportation system evaluation and simulation testing for Smart City Austin, TX
  - ARPA-E TRANSNET partner with NREL
- Metropia, LLC
  - Industry subcontractor, outside VT Office
  - Developer of DynusT modeling software; provides dynamic travel assignment support for Smart City Columbus, OH
  - ARPA-E TRANSNET partner with NREL
- Collaboration between NREL, TTI, and Metropia developed through ARPA-E TRANSNET, building on resources to support current subtask (U.S. 2.1.3)

COLLABORATION AND COORDINATION WITH OTHER INSTITUTIONS

- Additional collaborative and cooperative agencies (all outside VT Office):
  - –The Columbus Partnership
  - –Mid-Ohio Regional Planning Commission
  - –Ohio State University
  - –University of Texas – Center for Transportation Research
  - –City of Austin
  - –Austin Energy
  - –Pecan Street Development (Austin)
  - –Texas Department of Transportation

REMAINING CHALLENGES AND BARRIERS

- The project has identified current transportation models and characteristics of the sample cities, and developed recommendations
  - –The next step is to develop strategies to achieve recommendations for extension of models
- Remaining challenges and barriers
  - –Identify data sources for emerging transportation
  - –Enable production and integration of tools and frameworks to extend existing models in other cities and regions

PROPOSED FUTURE RESEARCH

- FY 2018 Project Plans
  - Q3: Refine recommendations reports, identifying how findings may translate to models for other mid-size cities
  - Q4: Develop brief project forum report
  - Expanded scope FY18 – develop and implement approach for employer-provided mobility, AMD special generator and/or TNC use
- FY 2019 Project Plans
  - To bring new data and modeling methods:
    - Mobility as a Service (TNCs, Car-Sharing, Ride-Sharing & other)
    - Automated vehicles and other emerging mobility choices
    - Extend existing travel demand models and be transferrable to additional cities and regions
  - Estimate mobility and energy impacts of ACES within an existing / established modeling framework as a case study for other cities
- Dealing with future decision points or barriers
  - Integration of Smart Mobility technologies is subject to data availability
  - Recommendations are platform agnostic, so as to be widely applicable

Any proposed future work is subject to change based on funding levels.

SUMMARY

- Existing transportation models do not integrate smart technologies
- Current transportation models in example Smart Cities (Austin and Columbus):
  - Do not accurately account for emerging transportation technologies
  - Are maintained by agencies that are receptive to updating and advancement
- Recommendations highlight importance of better reflecting current transportation trends, future adaptability
  - If applied to other mid-size cites and regions, flexibility for integration into a wide variety of other models is important
  - Open-source tools may be of advantage
- Planned future work is designed to address challenges and barriers to achieve better models

THANK YOU

TECHNICAL BACK-UP SLIDES

- (Include this “divider” slide if you are including back-up technical slides [maximum of five]. These back-up technical slides will be available for your presentation and will be included in the web PDF files released to the public.)

TECHNICAL BACK-UP SLIDES

- **Technical back-up slides WILL be included in the published meeting proceedings but are intended primarily to answer questions or provide supplemental information.**
  - **Maximum five slides**
  - **Must be placed after main presentation and before reviewer-only slides**
- **Technical back-up slides are optional.**