VTO DEVELOPS SOLUTIONS AT ALL LEVELS

Component Vehicle Transportation System
WHAT IS EEMS?

Source: Ford Motor Company
WHAT IS EEMS?

Vehicle Miles Traveled by Ownership Type & Mode

Source: J. Anderson, KPMG
WHAT IS EEMS?
WHAT IS EEMS?

SHARED MICROMOBILITY TRIPS
(NACTO)

Total Trips Taken (Millions)

- Scooter share
- Dockless bike share
- Station-based bike share

2010: 321K
2011: 2.4M
2012: 4.5M
2013: 13M
2014: 18M
2015: 22M
2016: 28M
2017: 35M
2018: 84M
WHAT IS EEMS?
WHAT IS EEMS?

USPS Annual Shipping & Package Volume

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Shipping/Package Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>3.0 billion</td>
</tr>
<tr>
<td>2010</td>
<td>3.2 billion</td>
</tr>
<tr>
<td>2011</td>
<td>3.4 billion</td>
</tr>
<tr>
<td>2012</td>
<td>3.6 billion</td>
</tr>
<tr>
<td>2013</td>
<td>3.8 billion</td>
</tr>
<tr>
<td>2014</td>
<td>4.0 billion</td>
</tr>
<tr>
<td>2015</td>
<td>4.2 billion</td>
</tr>
<tr>
<td>2016</td>
<td>4.4 billion</td>
</tr>
<tr>
<td>2017</td>
<td>4.6 billion</td>
</tr>
<tr>
<td>2018</td>
<td>4.8 billion</td>
</tr>
<tr>
<td>2019</td>
<td>5.0 billion</td>
</tr>
</tbody>
</table>
WHAT IS EEMS?
WHAT IS EEMS?

TNC & Taxi Ridership in the U.S., 1990-2017
Bruce Shaller, Shaller Consulting
WHAT IS EEMS?
WHAT IS EEMS?

THE MOST CONGESTED CITIES IN THE U.S.

- #6 SEATTLE, WA: 138 HRS $1,532
- #10 PORTLAND, OR: 116 HRS $1,625
- #8 SAN FRANCISCO, CA: 116 HRS $1,624
- #5 LOS ANGELES, CA: 128 HRS $1,788
- #3 CHICAGO, IL: 138 HRS $1,920
- #7 PITTSBURGH, PA: 127 HRS $1,776
- #4 NEW YORK, NY: 133 HRS $1,859
- #9 PHILADELPHIA, PA: 112 HRS $1,566
- #2 WASHINGTON, D.C.: 155 HRS $2,161

Source: INRIX
EEMS PROGRAM STRUCTURE

Connected & Automated Technology Development

Simulation & Evaluation
Completed 3+ Year Consortium Effort to Understand Energy & Mobility Implications of Advanced Transportation Systems

EEMS RESULTS

Connected and Automated Vehicles
Mobility Decision Science
Multi-Modal Freight
Urban Science
Advanced Fueling Infrastructure

Argonne National Laboratory
Berkeley Lab
NREL
Oak Ridge National Laboratory
INL

eems085 eems074 eems023 eems057 eems011 eems058 eems030 eems044 eems045 eems020 eems033 eems039 eems081 eems030 eems016 eems059 eems027 eems060 eems034 eems078 eems035
Completed 3+ Year Consortium Effort to Understand Energy & Mobility Implications of Advanced Transportation Systems

COMING SOON!
Completed 3+ Year Consortium Effort to Understand Energy & Mobility Implications of Advanced Transportation Systems

- Faster travel speed (+12%)
- Increased ridesharing
- Increased Transit use

- Faster travel speed (+17%)
- Reduced TNC cost and wait
- Concentrated in transit rich areas

- Lower travel speed in suburbs (-16%)
- In Chicago, higher SAV fleet and transit use
- Does not account for increased productivity during travel
EEMS RESULTS

Demonstrated 18% Energy Reduction Through HPC-Enabled Cyber-
Physical Control of Transportation Infrastructure in Chattanooga

- Created data science algorithms for real-time situational awareness
- Developed “digital twin” to simulate optimization algorithms and interface with signal control hardware
- Implementation/evaluation on Shallowford Road corridor
Commissioned New Connected & Automated Vehicle Environment

- Steerable dynamometer allows vehicle operation in virtual traffic environments

- “Digital Twin” of ACM track environment enables lab-to-track testing of CAV technologies (eems082)

- Co-simulation of vehicle dynamics, traffic, communications and controls
EEMS RESULTS


- Developed anticipative vehicle guidance algorithms
- Tested using traffic microsimulation and vehicle energy consumption models
- Developed communications protocols and experimentally evaluated in vehicle-in-the-loop environment
EEMS: NEW PROJECTS UNDERWAY

Southwest Research Institute (eems084)

Energy Efficient Maneuvering of Connected Automated Vehicles with Situational Awareness at Intersections

- Full preview information at intersections provided through connectivity
- “Intelligent Intersection” infrastructure-based sensing & perception stack
- 15% system-wide energy reduction target

UC Berkeley (eems083)

CIRCLES: Congestion Impact Reduction via CAV-in-the-loop Lagrangian Energy Smoothing

- Mitigates “phantom traffic jams”
- 5% penetration results in 10% system-wide energy reduction
- Large-scale validation on TN public road (100 vehicles out of 2000)
Energy Efficient Mobility Systems

EEMS@EE.DOE.GOV