Introduction

**Automated Vehicles**
- Collision avoidance
- Connected V2X
- Autopilot capable
- Self-Driving
- Driverless

**Electrification & Zero-Emission Vehicles**
- Plug-in Electric
- Fuel cell
- Human-powered

**Sharing & Ride Pooling**
- Shared ownership
- “vehicle shedding”
- Shared trips
- Transit

3 Revolutions
3rev.ucdavis.edu • 3rev@ucdavis.edu • @3rev_ITSDavis
Introduction

AVs
Pooling
ZEVs
1. **CONVENE.** bring local, state, regional, national and international stakeholders to the table
2. **RESEARCH.** Policy research enables us to anticipate, rather than react to changes and innovations (when it is often too late).
3. **EDUCATE.** Materials will bring voices and research together to better understand impacts of technological innovations.
4. **AMPLIFY.** Public outreach ensures that our work does not sit on a shelf.
1. CONVENE

✓ 3 Revolutions Conference, Nov 2016, UC Davis
   Partners: California’s Governor Office
✓ Transportation Policy Forum Apr 2017, UC Center Sacramento
   Partners: UC-ITS and NCST

Upcoming Event Alert: Workshop

**Pooling & Pricing: Harnessing the 3 Revolutions to Solve Congestion, Climate Change and Social Equity**
June 30th 2017 10a-4p, at UC Davis ARC Ballroom

Series of events considering Sacramento, Boston? Denver?
Three Revolutions in Urban Transportation: How to achieve the full potential of vehicle electrification, automation and shared mobility in urban transportation systems around the world by 2050

Lew Fulton, Co-Director of STEPs at ITS-Davis
Dominique Meroux, ITS-Davis former researcher (now working at Ford)
Jacob Mason, ITDP
2. RESEARCH
a. Key Questions

- Can modeling utopian and dystopian scenarios provide insights for policy action?
- Are there interactions effects that will create synergies between the three revolutions?
2. RESEARCH
   b. Methodology
2. RESEARCH
b. Methodology

Fulton, Meroux and Mason (2017)

<table>
<thead>
<tr>
<th><strong>Three Revolutions in Urban Transportation</strong></th>
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<tbody>
<tr>
<td><strong>Business-as-Usual Scenario</strong></td>
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<td>Electrification + Automation + Sharing</td>
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</table>
2. RESEARCH

c. Scenarios (1 of 3)

The Benchmark scenario (none are assumed to be most likely)
- Regulatory barriers to automation inhibit market growth
- Neither electrification or energy decarbonization occur
- Little sharing or active mode share
- Car-centric development patterns

*Fulton, Meroux and Mason (2017)*

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**Business-as-Usual Scenario**

**20th Century Technology**

Through 2050, we continue to use vehicles with internal combustion engines at an increased rate, and use transit and shared vehicles at the current rate, as population and income grow over time.
2. RESEARCH
c. scenarios (2 of 3)

(BAU++) population and growth assumptions
- AV supportive policies
- More EV supportive policies both:
  Demand side (consumer)
  Supply side (producer)

Fulton, Meroux and Mason (2017)
2. RESEARCH

c. scenarios (3 of 3)

(BAU+2R+)

- Sharing supportive policies
- Multimodal land use patterns

_Fulton, Meroux Mason (2017)_
Three Revolutions in Urban Transportation

**Business-as-Usual Scenario**

20th Century Technology

Through 2050, we continue to use vehicles with internal combustion engines at an increased rate, and use transit and shared vehicles at the current rate, as population and income grow over time.

**2 Revolutions (2R) Scenario**

Electrification + Automation

We embrace more technology. Electric vehicles become common by 2030, and automated electric vehicles become dominant by 2040. However, we continue our current embrace of single-occupancy vehicles, with even more car travel than in the BAU.

**3 Revolutions (3R) Scenario**

Electrification + Automation + Sharing

We take the embrace of technology in the 2R scenario and then maximize the use of shared vehicle trips. By 2030, there is widespread ride sharing, increased transit performance—with on-demand availability—and strengthened infrastructure for walking and cycling, allowing maximum energy efficiency.

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**Number of Vehicles on the Road by 2050**

- **2.1 billion**
- **2.1 billion**
- **0.5 billion**

**CO2 Emissions by 2050**

- **4,600 megatonnes**
- **1,700 megatonnes**
- **700 megatonnes**

www.ITDP.org
2. RESEARCH

d. Central Finding: Sharing yields the most benefits

“When it comes to cars, what we learned early in life still holds true—sharing makes everything better. All the futuristic automotive technology being developed could make our cities more livable and the air more breathable—but only if we take sharing seriously.”

– Lew Fulton, UC Davis
3. EDUCATE
  a. Existing AV Policy Focus

- NHTSA guidelines released in 2013 and 2016
- Dozens of states have policies enacted related to AVs
- No policy to date addressing AV passenger/emissions.
- Should all EVs be ZEVs?
  - CA – SB802 (Skinner)
  - MA – H3417 (Day) – Status?
3. EDUCATE
b. Policy Briefs: published 2017

February 2017
Capturing the Climate Benefits of Autonomous Vehicles
Author: Don Anair, Union of Concerned Scientists
Contributors:
Patty Monahan, Energy Foundation
Levi Tillemann, Valence Strategic
Matthew Barth, UC Riverside

April 2017
Keeping Vehicle Use and Greenhouse Gas Emissions in Check in a Driverless Vehicle World
Co-Authors:
Giovanni Circella, University of California at Davis
Chris Ganson, Governor's Office of Planning and Research
Caroline Rodier, University of California at Davis
*For identification purposes only
3. EDUCATE
b. Climate-related AV Policy progress and next steps

Demand side:
- Carbon tax or VMT/passenger tax (Feebates- sharing, EV, transit connections)
- Reduction of fossil fuel subsidies and support for smart charging makes EVs more attractive
- Subsidies to transit and shared travel

Supply side:
- Fleet ZEV Mandates
- Fleet CarbonIntensity Performance standards
  (Supply-side may be more effective policy for Canadian EV market Axen 2017)

Policy mechanisms need research to refine scale of impact, ID challenges and opportunities
3. EDUCATE
c. Policy Briefs: published 2017

February 2017 Policy Briefs:

**Active Travel**
Policy Brief: Active Travel in an Era of Sharing, Electrification & Automation
Guest Authored by Susan Handy, National Center for Sustainable Transportation, UC Davis

**Transit**
Policy Brief: Three Transportation Revolutions - Synergies with Transit
Guest Authored by Steven E. Polzin, Center for Urban Transportation Research, University of South Florida

**Equity**
Policy Brief: Can we Advance Social Equity With Shared, Electric & Autonomous Vehicles?
Guest Authored by Stuart Cohen, TransForm and Sahar Shirazi, California Governor’s Office of Planning and Research

**Governance**
Policy Brief: Governance: Who’s in Charge Here?
Guest Authored by David Ory, MTC; Carol Cooper, King County; and Fanta Kamakaté and Peter Slowik, ICCT
3. EDUCATE

c. Land Use Policy

April 2017 Policy Brief

Land Use and Transportation Policies

Co-Authors:
Marco Anderson, Southern California Association of Governments (SCAG)
Nico Larco, University of Oregon
Contributors: Giovanni Circella, University of California at Davis
Lisa Aultman-Hall, University of Vermont

More Info ›
3. Even More EDUCATE to come

- Several Additional Policy Briefs in Development
- EV Infrastructure
- Road User Pricing/ Pooling Pricing
  - Model Policy & Legislative Tracking
  - Provide Expert Briefings

Reach out and ask for what you think would be useful
4. More AMPLIFY
Follow: @3rev_ITSDavis
Thank you.
2. RESEARCH
d. Findings

US LDV – Travel (VKm) by scenario
Fulton, Meroux Mason (2017)
CO₂ Emissions - World

<table>
<thead>
<tr>
<th>Year</th>
<th>BAU 2015</th>
<th>BAU 2030</th>
<th>2R 2030</th>
<th>3R 2030</th>
<th>BAU 2050</th>
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<td>3</td>
<td>3.5</td>
<td>5.0</td>
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<td>2</td>
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</tbody>
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Fulton, Meroux Mason (2017)
US LDV Stock evolution by scenario
Fulton, Meroux Mason (2017)
### Passenger Kilometers - World

<table>
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<tr>
<th>Year</th>
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Legend:
- Walk
- Cycle/e-bike
- Motorcycle
- Rail
- Large bus
- Minibus
- Shared LDV
- Private LDV

Fulton, Meroux Mason (2017)