Emerging Transformation of Vehicles, Fuels, and Mobility ...
As seen by an academic, regulator, and policy wonk

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Challenge

How to Build a Sustainable 21\textsuperscript{st} Century Transportation System with 20\textsuperscript{th} Century Institutions and Budgets?

Answer: Lots of innovation (and leadership)!

#3. “…innovation in passenger mobility services and in public-sector infrastructure lags far behind that in the private sector.”

#5. “… transportation exerts large scale, unsustainable impacts on energy, the environment, and climate.”

(Other critical issues: system performance, safety, funding, R&D)
Transportation’s Roots are in Civil Engineering
(priority through 1970)

... not in social and environmental sciences
(new priority)

Education? Job hiring practices? Organizational missions?
Civil Engineering Competencies Facilitated Interstate Highway System of mid-’50s to mid ‘70s ... But This is Last Major Passenger Transport Innovation in US

How to stimulate innovation and change to create a sustainable transportation system?
Outcome: Car-Centric Cities and Lifestyles

Gone Too Far?

Car-Centric LA
I-105 & I-110 with HOV Flyover
Imitated Around the World

Car-Centric Brasilia
Outcome: Transport Monoculture in US

- Solo driving increased
- Carpooling shrank
- Public transport = 3% of PMT (~5% of trips)


- 1980 Census
- 1990 Census
- 2000 Census
- 2012 ACS
Car-Centric Monoculture is Extraordinarily Expensive and Resource-Intensive

- Road Infrastructure Cost
  - Over $100 billion/yr (US)
  - Plus other infrastructure costs to support sprawl

- Personal Cost
  - $9000/year to own and operate a car (US)
  - Total = $1+ trillion/yr (US)

- Oil
  - 70% of oil consumption (USA)
  - $300-$500 billion/yr

- Climate Change
  - 1/3 of GHGs (US)

- Air Pollution
  - Half of urban air pollution
Sustainability Challenges Looking Forward
Global Fossil Energy (Carbon) Budget

Carbon Released Since Industrial Revolution

1400 gigatons

How Much More Can Be Released?

500 gigatons

Remaining Fossil Energy (Carbon) Reserves

2800 gigatons

At current rate of 16 gigatons/year, carbon budget will be used up in 16 years.
How to Reduce Vehicle Use (for many reasons)?

Travel Peaked in Rich (OECD) Countries

Source: IEA, 2012 (ETP 2012)
How to Shift Away from High-Carbon Fossil Fuels?

- Oil Sands
- Arctic Oil
- Shale Oil/Gas

Source: Richard Doctor, Argonne, 2003
Politically Incorrect Facts

• HOV lanes failed
• Demand management policies failed
• Conventional transit performs poorly
  ▪ High cost (60% of metro transport budgets for <10% of trips)
  ▪ Higher GHG/PMT than cars

“We can not solve our problems with the same thinking [and institutions and research] we used when we created them.”
- Albert Einstein
How to Create Transport Systems That Are Cheaper, Better, and More Sustainable?

• Less expensive
• Less resource intensive
• Less carbon intensive
• More accessible

➢ Two Transportation Revolutions
Revolution 1a: Energy Efficiency of Cars Doubling from 2010 to 2025 (US) .... Policy, Automakers, and Consumers??
Auto Industry on Path to 80% Reduction
(assuming policies continue and consumers don’t resist)

ICEVs

4%/yr improvement

PEVs and FCVs
Revolution #1b: Vehicle Electrification .... engaging policy, automakers and consumers!
California and 8 Other States Require ~15% of Vehicle Sales to be “ZEVs” by 2025
Plug-in Electric Vehicle Sales Increasing Around the World

2012

North America

Europe

Asia

2013

North America

Europe

Asia

131,573 PEV sales

213,252 PEV sales

source: http://ev-sales.blogspot.com
Test Question
Revolution #2: Sharing Rides and Vehicles
... engaging policy, industry, and consumers!

“Silicon Valley” transformed how we communicate, do research, buy books, listen to music, and find a date ....

What is it doing for transportation?
Breakthrough: Uber/Lyft  (partly at expense of Taxis)

How to stimulate innovation while protecting consumers and public interest

Need new policy framework that eases excessive regulation on taxis and imposes appropriate regulations on new services.
New Mobility Services Could Capture over 30% of Passenger Travel

✓ Unable to drive
  ▪ Elderly and young; physical disabilities

✓ Prefer not to drive
  ▪ Drinking alcohol
  ▪ Deteriorating driving skills (esp nighttime)

✓ Emergencies
  ▪ Car breakdown or car unavailable

✓ Save money
  ▪ Carpool to work, school, events
  ▪ Access to conventional transit

✓ Use travel time productively
Large Potential Public Benefits of New Mobility Services

- Less vehicle use
  - Result of transforming fixed costs into variable costs
- Improved access by mobility disadvantaged (elderly, handicapped, suburban/rural poor)
  - Perhaps subsidized by gov’t?

Why is “transportation community” playing almost no role in this revolution?
Consumer Challenge

Researchers, Policymakers, and Industry Need to Understand and Motivate Consumers and Travelers.... From Early Adopters to Followers

- Rational inattention (Sallee, 2013)
- Loss aversion (Greene et al, 2009)
Leadership Challenge

1. Vehicle Revolution
   - Motivated by social benefits (GHG/energy)
   - Policy leaders must embrace clever/effective regulations, consumer incentives, energy infrastructure

2. New Mobility Services Revolution
   - Motivated by consumers (pent-up traveler demand)
   - Policy leaders must nurture the baby (but with care)
   - Researchers can help steer the revolution to the social good
TRB, University, and Gov’t Leaders Need to Cross the Chasms
How might transport community engage in creating sustainable 21st century transportation?
Tom Deen prodded transportation community in this direction in 1994 by launching influential study on "Transportation and a Sustainable Environment."

How do we follow his leadership in bringing innovation and sustainability to our personal and professional lives—in government, business, and academia?

• Policies and regulations
• Short term and long term planning
• Project design
• Broadening work groups
• Expanding transportation curriculum
• Making purchase decisions
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Thank You