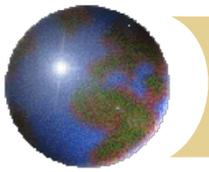


# *Moving Goods, People, & Services Amidst Transportation Changes*

Robert W. Poole, Jr.,  
Director, Transportation Policy,  
Reason Foundation

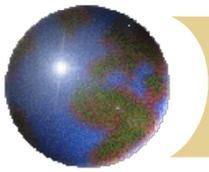




## *Four major transportation disruptions*

- ⊕ Electric vehicles (EVs)
- ⊕ Connected vehicles (CVs)
- ⊕ Autonomous vehicles (AVs)
- ⊕ Mobility as a Service (MaaS)

All are coming, and all will bring benefits—  
but how soon and how much are still  
very uncertain.

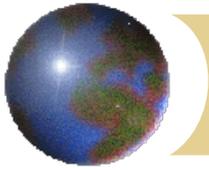


## *Utopian visions are not credible, but gain media attention*

### RethinkX example:

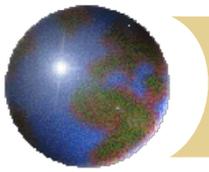
- Fully autonomous vehicles on the market by 2020.
- By 2030, those AVs provide 95% of passenger miles of travel.
- These will all be shared vehicles (MaaS).
- These will all be EVs, with battery lives of 500-700,000 miles.

Source: RethinkX, "Rethinking Transportation 2020-2030," May 2017



## *Reality says otherwise*

- ⊕ EVs currently cost 2X comparable IC vehicles, and battery packs are warranted for only 80-100,000 miles.
- ⊕ Full autonomy is far more difficult than early researchers expected.
- ⊕ AV sensors and software make current partial AVs 4X the cost of comparable cars.
- ⊕ No evidence that most people will give personal car ownership.



# *Why full AV is decades away*

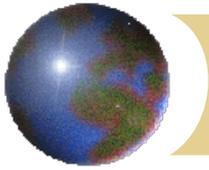
## ⊕ Serious technology challenges:

- ⊕ Detecting hazards vs. innocuous items under all conditions
- ⊕ Developing super-high-reliability software to even equal today's auto safety level
- ⊕ Software making life-or-death decisions

## ⊕ This is not like IT/telecom:

- ⊕ Consequence of bugs: death/injury
- ⊕ Long product life; slow fleet turnover

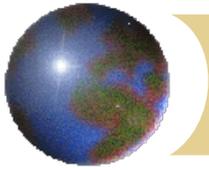
Source: Steve Shladover, UC Berkeley PATH



# *Shared mobility market penetration*

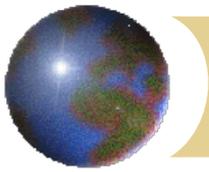
- ❖ Morgan Stanley estimates global increase from 5% today to 25% by 2030.
- ❖ Largest increase in developing countries, not US or Europe.
- ❖ In the US, “private car ownership is deeply woven into the American cultural fabric.”
- ❖ US share projected at 7% by 2030, from 5% today.

Source: Morgan Stanley Research, “Shared Mobility on the Road to the Future,”  
June 2016



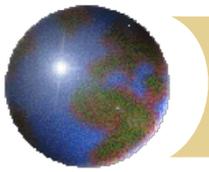
## *OECD case study findings*

- ⊕ Detailed simulation of Lisbon's daily travel, now and with cars replaced by AVs.
- ⊕ Shared robo-taxis and AV minibuses replace cars.
- ⊕ Per-vehicle VMT 10 times current average.
- ⊕ But total VMT 37% less.
- ⊕ Significant reductions in CO<sub>2</sub> emissions.
- ⊕ Rail transit continues; conventional bus transit does not.



## *OECD study assumptions*

- ❖ Privately-owned cars banned.
- ❖ A single dispatch system assigns individuals to vehicles.
- ❖ Shared robo-taxi rides provide “same level of mobility” for car owners. (false)
- ❖ Ignores people’s practice of trip-chaining.
- ❖ Waves away large-scale losses of transit jobs.

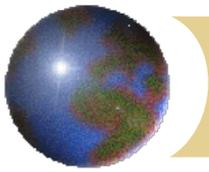


## *MaaS limitations in U.S. market*

Eight categories of travelers unlikely to use a shared vehicle:

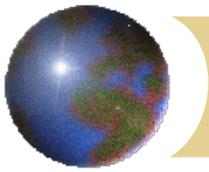
- ❑ Won't fit with trip-chaining
- ❑ Have young child in a car seat
- ❑ Disabled with assistive gear
- ❑ Need to carry tools, supplies
- ❑ Often drive with a pet
- ❑ Refuse to give up driving
- ❑ Concerned about communicable disease
- ❑ Smokers

Source: "Ownership Matters," Bern Grush & Brent Schlecter, Thinking Highways, August 2017



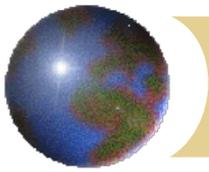
# *Implications for urban transportation planning*

- ⊕ Mixed AV/non-AV fleet for decades.
- ⊕ Adding AV-only lanes is premature.
- ⊕ Converting parking garages is premature.
- ⊕ Large CV safety benefits will take 20-30 years due to fleet turnover time.
- ⊕ Robo-taxis in motion 24/7 (vs. cars parked 95% of time) will greatly increase urban VMT.
- ⊕ Offsetting trends of AVs: densify core, but encourage moves from suburbs to exurbs.



## *Implications for urban transit*

- ⊕ Transit likely to be more disrupted than highways.
- ⊕ Affordable door-to-door robo-taxis will take much transit market share (already under way with Uber & Lyft).
- ⊕ 30-year plans for light rail transit mega-projects are likely unwise.
- ⊕ Automation may be key to keeping subways competitive.

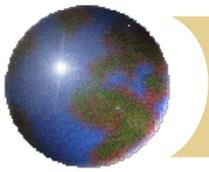


# *KPMG study estimated VMT increases from non-drivers*

## Non-driver categories:

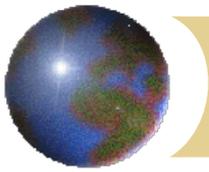
- Children and teenagers
  - Elderly people
  - Disabled people
- ⊕ Projected increased personal miles of travel for each group, then converted that to VMT.
  - ⊕ Projected VMT in 2050 would be up to 5 trillion, compared with around 3 trillion now.

Source: KPMG, "The Clockspeed Dilemma: What Does It Mean for Automotive Innovation?" 2015



# *Implications for highway planning*

- ⊕ Large VMT increase will require capacity expansion.
- ⊕ CACC will enable platooning on freeways, which will provide a modest increase in throughput—so less physical expansion needed.
- ⊕ Truck platooning and 24/7 operation will make trucking more competitive with railroads.
- ⊕ Dedicated truck lanes will be needed on major truck routes.
- ⊕ Growth in EVs, etc. will force replacement of per-gallon taxes with per-mile charges.
- ⊕ Per-mile charges will facilitate road pricing.

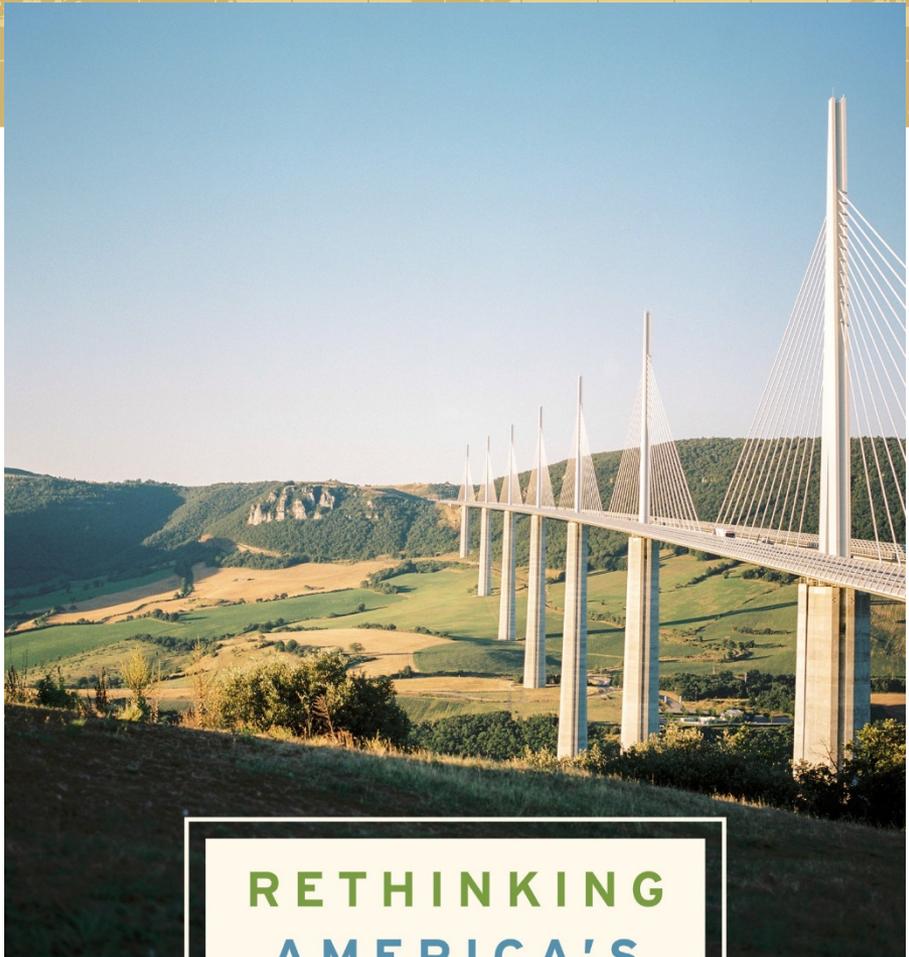
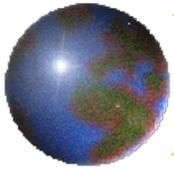


## *Summary and conclusions*

- ⊕ Full automation unlikely before 2030.
- ⊕ Replacing entire fleet will take 20 years from then (2050).
- ⊕ Hence, full AV benefits unlikely before then.
- ⊕ What fraction will own AVs is unknown.
- ⊕ Most experts see VMT increasing.
- ⊕ Conventional transit will be disrupted.
- ⊕ Impact on urban form is uncertain—and distant.

“Prediction is very difficult, especially if it is about the future.” - *Niels Bohr*





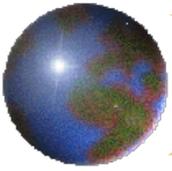
**RETHINKING  
AMERICA'S  
HIGHWAYS**

*A 21st-Century Vision for Better Infrastructure*

ROBERT W. POOLE JR.



**reason**  
FOUNDATION

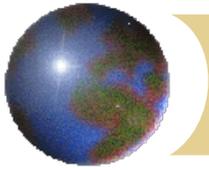


# *Questions?*

Contact information:

<http://reason.org/transportation>

[Bobp@reason.org](mailto:Bobp@reason.org)



# *Five levels of automation--SAE*

- ⊕ **Level 1:** driver assistance (e.g., adaptive cruise control—ACC)
- ⊕ **Level 2:** partial automation (ACC + lane-keeping)
- ⊕ **Level 3:** conditional automation (human driver fallback)
- ⊕ **Level 4:** high automation (for some driving modes)
- ⊕ **Level 5:** full automation (all driving modes, no driver needed ever)

The most dramatic impacts depend on Level 5.