



Automated Connected Vehicles

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Triangle J Council of Governments
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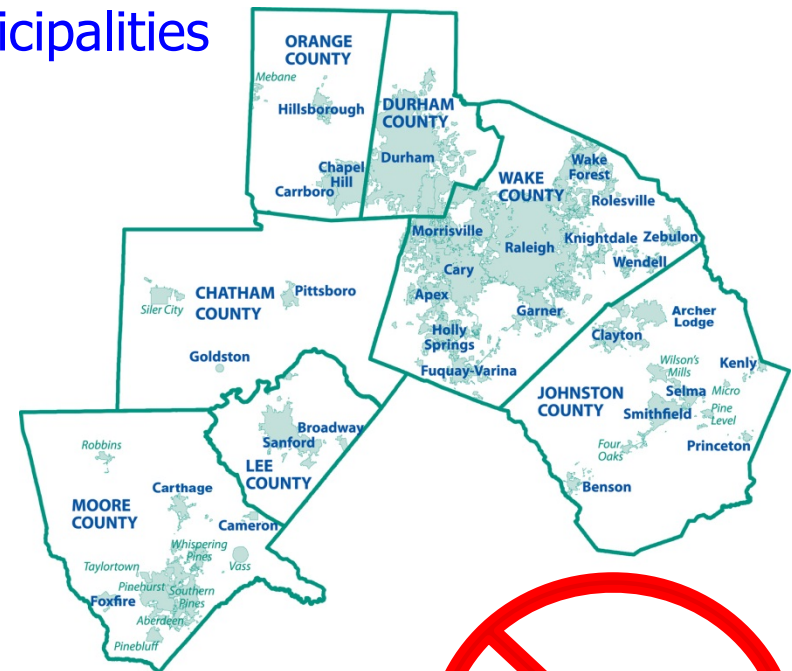
- ❖ 7 counties and ~ 30 municipalities
- ❖ Voluntary organization
- ❖ 3 program areas

- ❑ Regional Planning
- ❑ Aging Services
- ❑ Member Services

❖ Planning program focus:

- ❑ Water Resources
- ❑ Energy & Environment
- ❑ Development & Infrastructure
- ❑ Economic Development

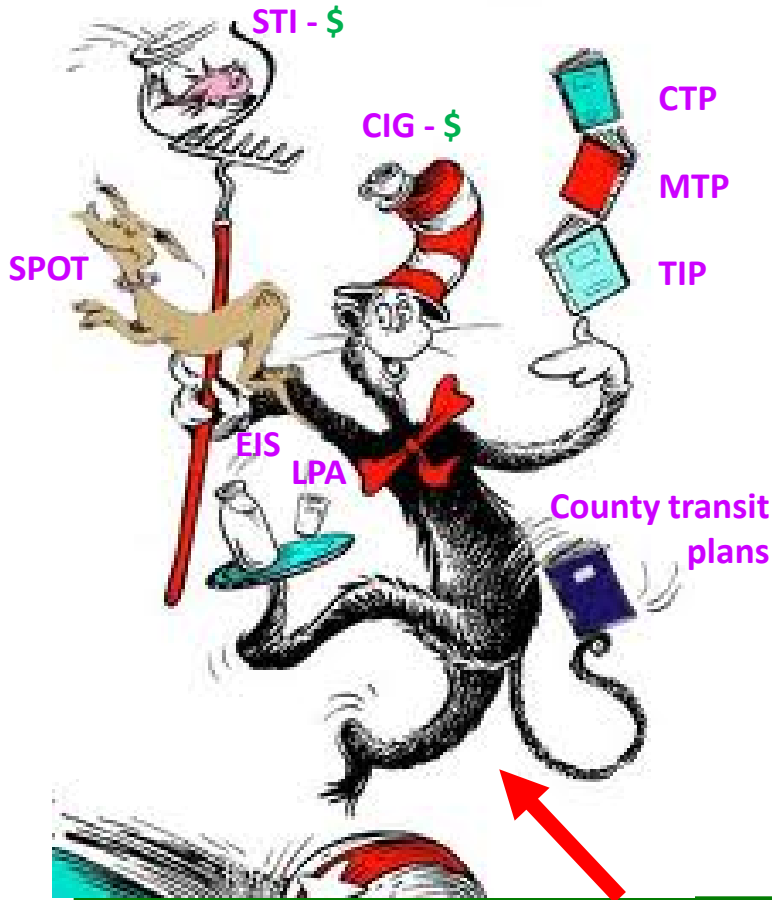
- Economic Development District
- Foreign Trade Zone
- NC Next Generation Networks (Gigabit Broadband)



(Un)Official Transportation Planning Chart

Actual Decision-Making Organizations

- ❖ 2 Metropolitan Planning Organizations
- ❖ NCDOT (multiple geographic & modal divisions)
- ❖ GoTriangle
- ❖ Counties (transit plan → sales tax)
- ❖ Cities (roads & transit & walking/biking)
 - ❑ Transit agencies (GoDurham, CHT, GoRaleigh, GoCary)
- ❖ North Carolina Railroad (if in their corridor)
- ❖ Federal ... (Highway or Transit or Railroad) ... Administration
- ❖ Anchor Institutions (if applicable)
 - ❑ Universities (Duke Transit, Wolfline)
 - ❑ Research Triangle Park



Distracted Driver on Autonomous Vehicle



Levels of Vehicle Automation

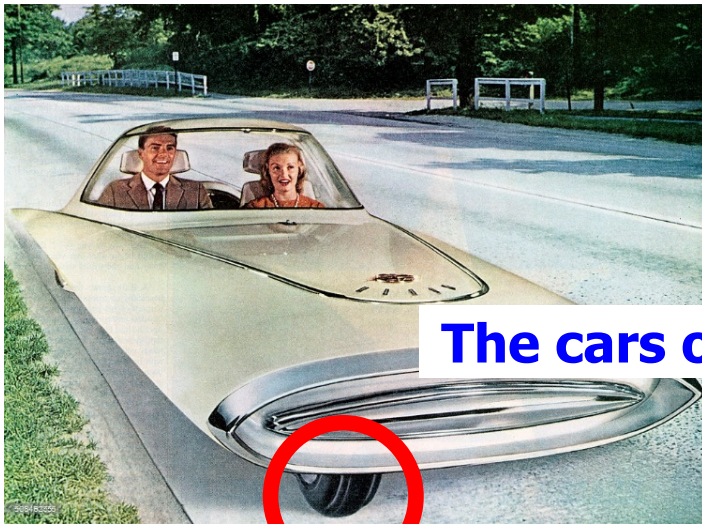
SAE Level	
0	The human driver does everything
1	An automated system on the vehicle can sometimes assist the human driver conduct some parts of the driving task
2	An automated system on the vehicle can actually conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task
3	An automated system can both conduct some parts of the driving task and monitor the driving environment in some instances, but the human driver must be ready to take back control when the automated system requests
4	An automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions
5	the automated system can perform all driving tasks, under all conditions that a human driver could perform them.



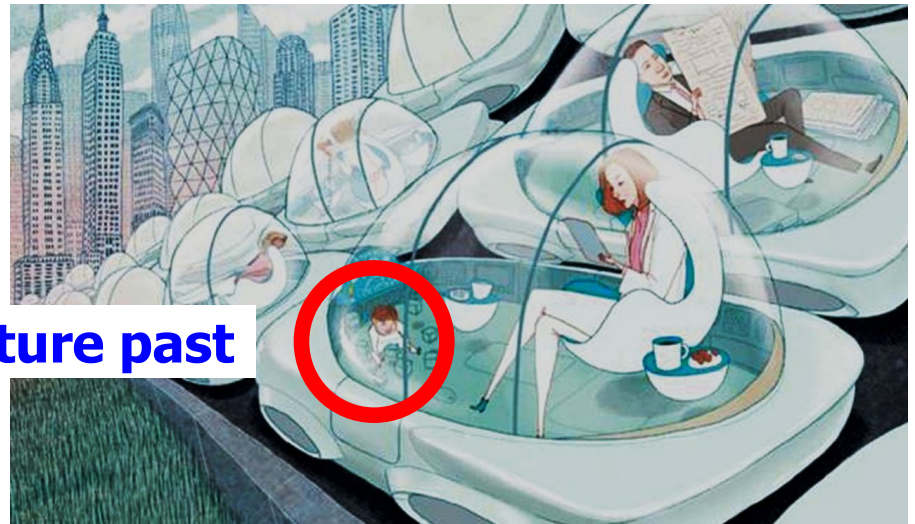
Triangle Air Quality is Largely About Travel

Factor (everything else being equal, which it rarely is)	Automated Connected Technology influence?
If more people ...	
...take more trips ...	✓
... and these trips are more often by single-occupant vehicle ...	?
... and if more of these trips are longer distance ...	✓
... and these trips are in more polluting cars ...	?
... and these trips are at sub-optimal “speeds” ...	✓
... then the more we get to send people to the hospital with respiratory conditions.	

Key isn't the technology of automation and connection, but how we end up using it

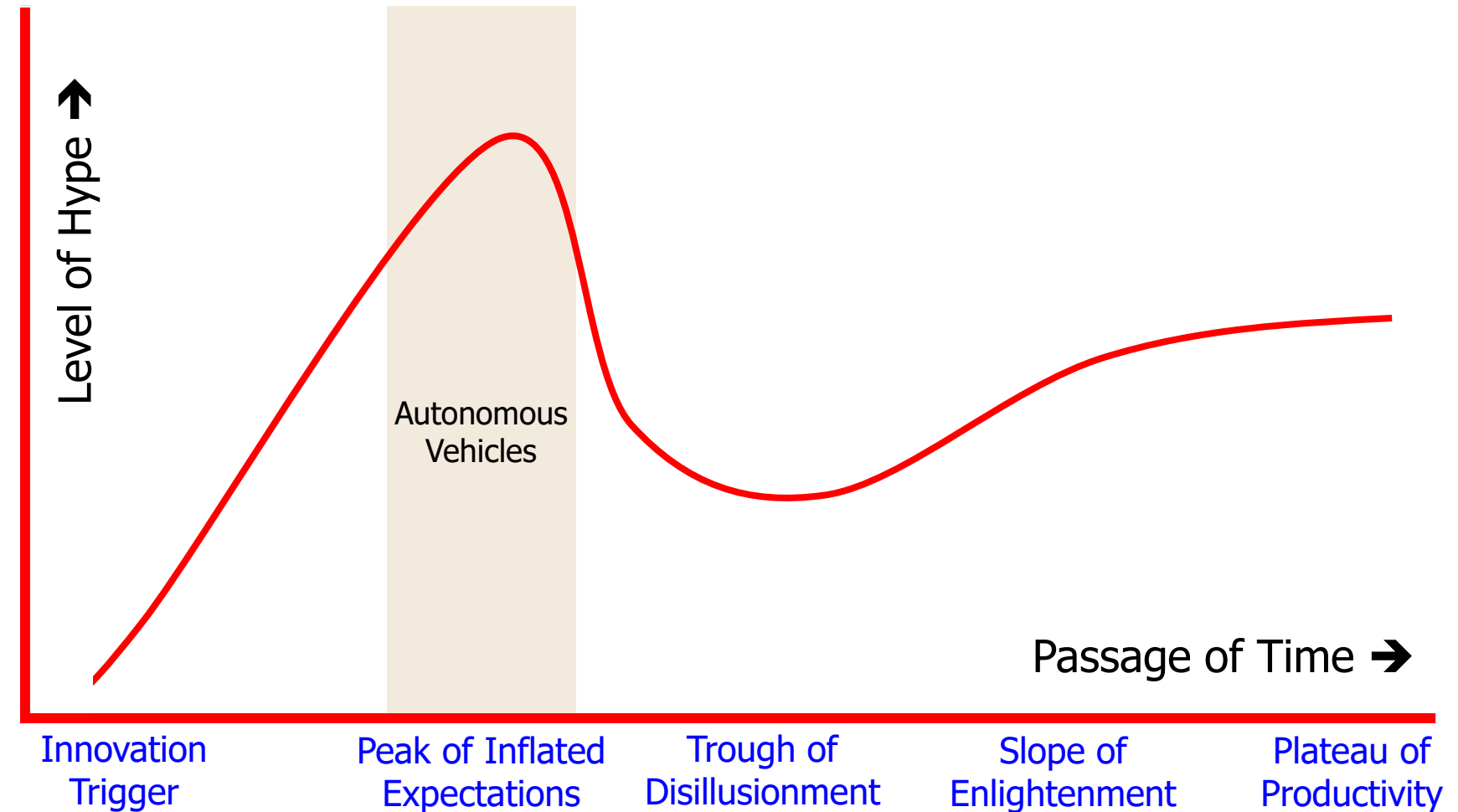


The cars of future past



The Hype Cycle for Emerging Technologies

(Gartner 2017)



Are We Hyping?

- ❖ Just 5 vehicles!
 - ❑ And they are small
 - ❑ And apparently bend around corners
- ❖ 1-lane roads!
 - ❑ Crouch and roll as we slow down to drop you off
- ❖ We love AV's so much we walk and bike instead!

Source: American Planning Association, September 2018



Framework

Automated, connected vehicle deployment hinges on 4 factors:

- ❖ Technology

- What are we able to do?

- ❖ Cost

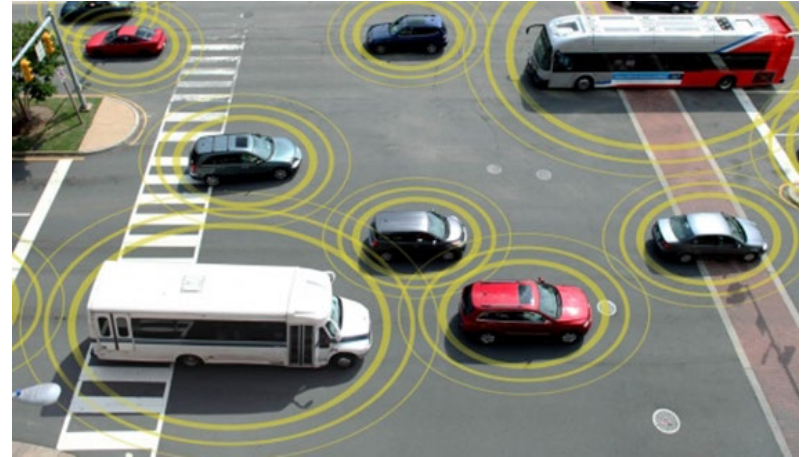
- What can we afford to do?

- ❖ Regulation

- What should we do (as a society)?

- ❖ Culture/Behavior

- What are we willing to do (as individuals)?





Framework

Each factor is driven by a different set of actors:

❖ Technology



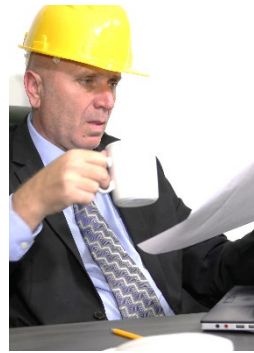
❖ Regulation



banker



city attorney



traffic engineer



actuary



legislator





Technology

The technology will doubtless be safer and more efficient than current conditions, and yet ...

❖ Hacking?

- ❑ The banks told us we were safe, the retailers told us we were safe -- if our credit cards crash, it is one thing, but if our cars crash ...

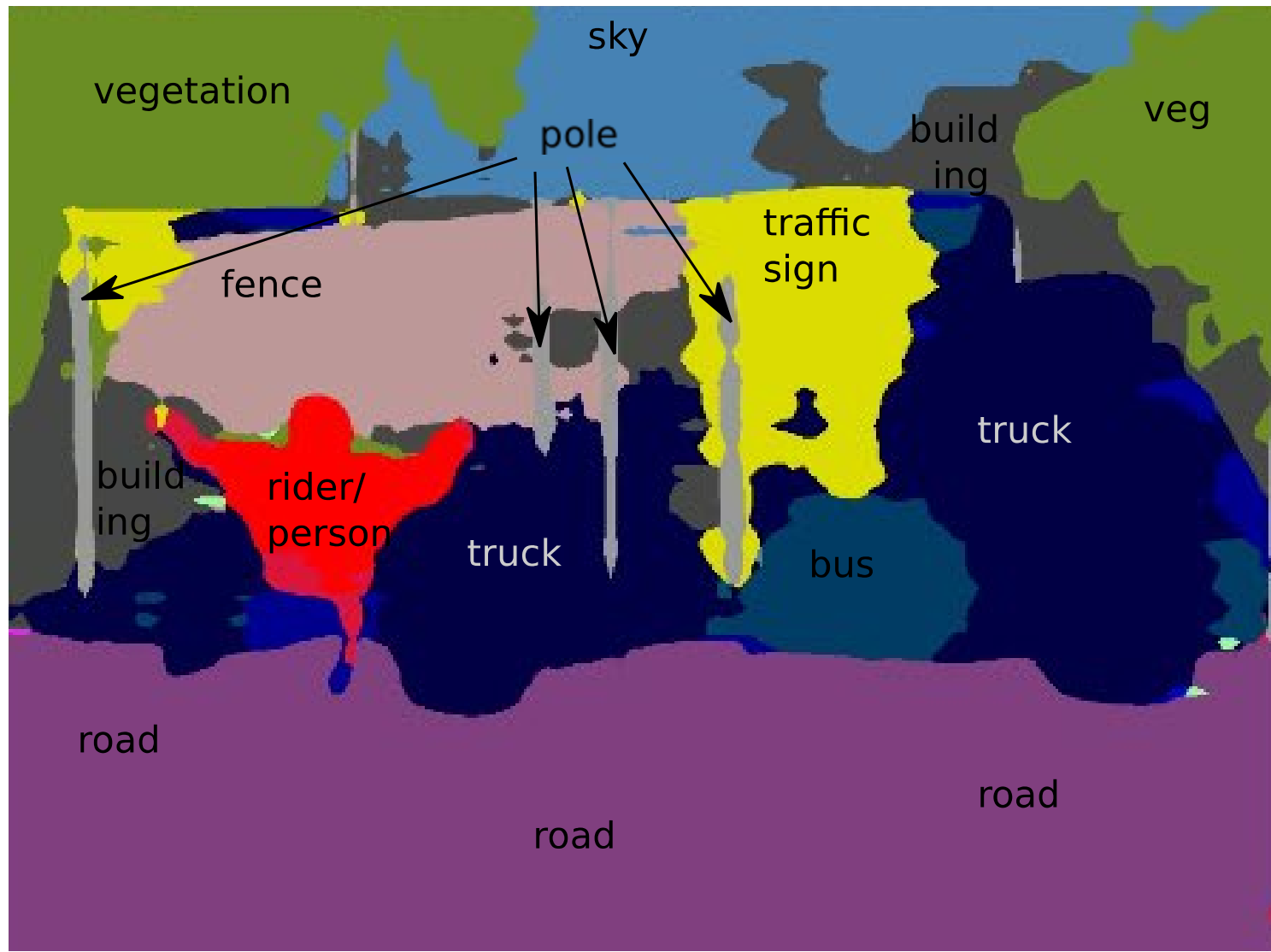
❖ Nausea (hacking of a more “visceral” kind!)

- ❑ ~ 5-10% of adults are expected to feel nauseous riding in an autonomous vehicle

❖ Human error is tragic but understandable, technological error is unforgiveable

- ❑ Liability and lawsuits

Current State of the Art in Perception





Cost

To succeed, companies are going to have to make money from AV, and consumers are going to have to save money over competing alternatives for market penetration to be deep. In general ...

- ❖ Autonomous technology *raises* the unit cost of the vehicle
 - ❑ Many estimates ~5%
- ❖ Moderate cost savings come in shared vehicle *ownership*
 - ❑ A trip in a shared AV car might be ~20% less costly than the privately-owned non-AV car
- ❖ Significant cost savings likely come with shared vehicle *travel*
 - ❑ But that involves other people, no matter how compatible and how identical their trip, and carpooling has had only modest (and generally declining) success



Regulation

Government responses are unpredictable and can shift

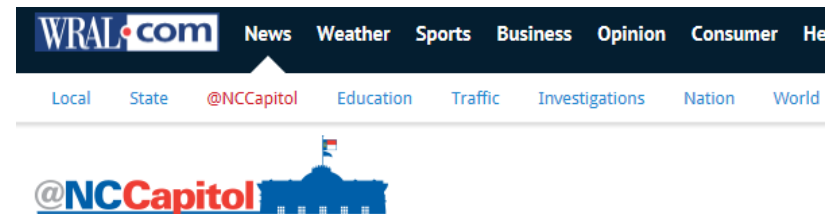
❖ Insurance & liability

- ❑ Insurance costs from actual crashes very likely to be much lower; liability costs for those crashes that do occur ...?

❖ Market penetration needed to transform infrastructure?

- ❑ Average age of car on the road today is 11 years, many are much older. What degree of market penetration at what technology level is needed to substantially achieve benefits?

❖ There is often little reward for legislators and regulators to move quickly and take risks



Senate leaders tap brakes on 'platooning' trucks



Culture/Behavior

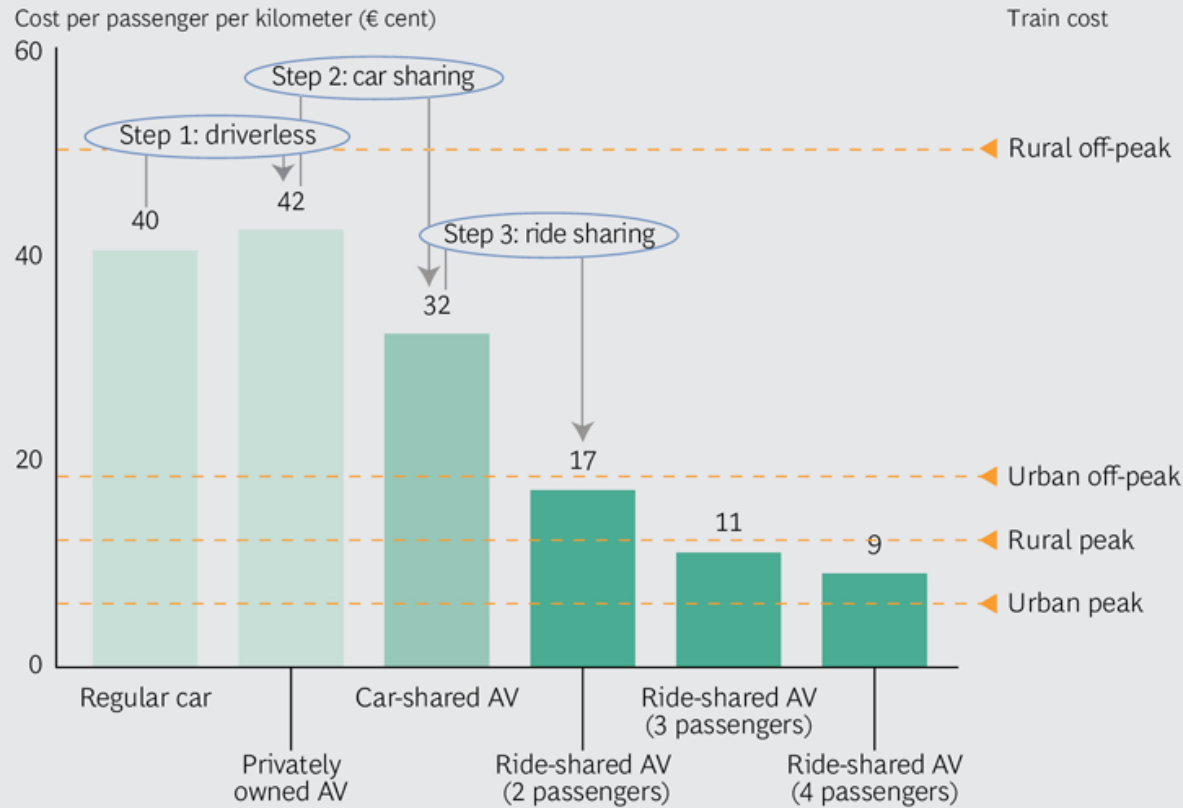
Most automated vehicle discussions seem to have a cultural assumption that everyone will embrace technologies based on exciting features, evidence-based benefits, and the guidance of experts, but ...



The Intersection of Technology, Cost & Behavior

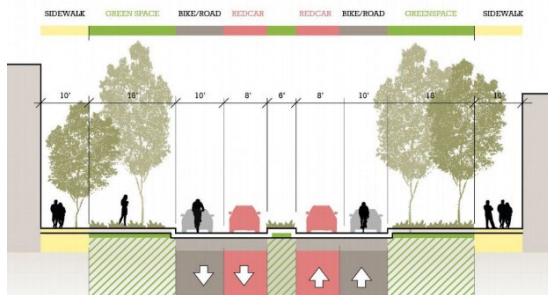
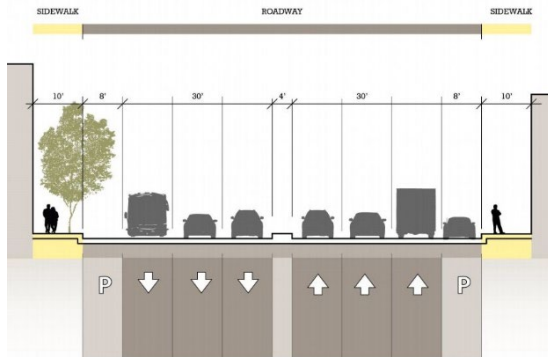
EXHIBIT 2 | For Urban Peak Travel Times, the Train Will Probably Remain the Least Expensive Option

BASED ON NETHERLANDS EXAMPLE



- ❖ Assuming a stable regulatory environment
- ❖ Applying the filters of trip type and cost of competing mode

Community Planning Implications?

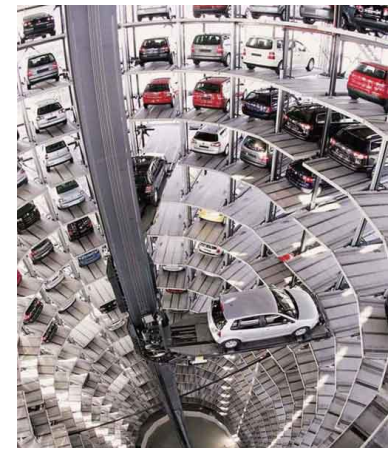


Uncertainty is the key word -- flexibility and adaptability would seem to be important components moving forward

❖ Road capacity and design?

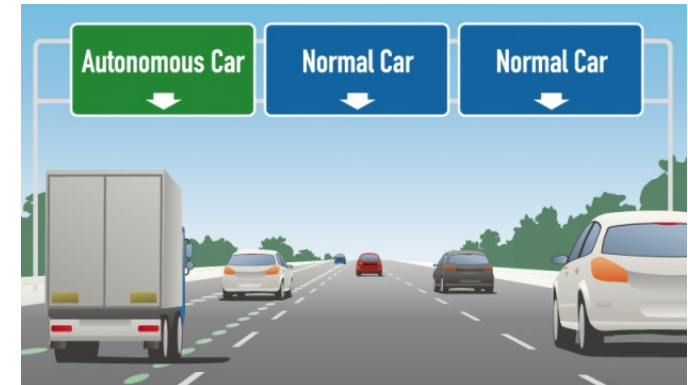
- ❑ Induced travel
- ❑ Sending the car home and summoning it again: 2 trips where there used to be one
- ❑ Platooning, lane width reductions (12' → 8')

❖ Parking supply, cost and location?



Community Planning Implications?

- ❖ Highway Infrastructure Investment
 - Busway → HOV lane → Managed (“HOT”) lane → Managed Autonomous Lane?
- ❖ Land use and urban design
 - Who is the parking lot designed for?



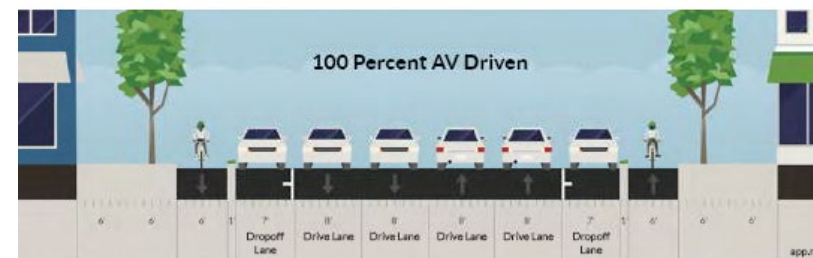
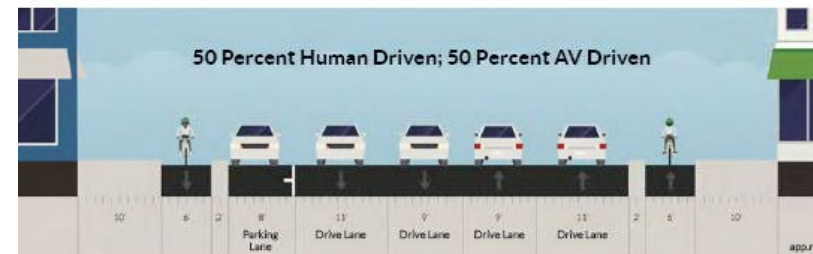
Community Planning Implications?

❖ Streetscape

- ❑ How much of the curb lane is devoted to what uses?
- ❑ Degree of vehicle-sharing rather than degree of automation may be the critical factor for streetscape impacts, if curb parking replaced by curb PUDO and delivery – marginal difference?

❖ Transit and Other Shared Vehicles

- ❑ Transit technology is not the first decision; it is the last
- ❑ Travel Markets → Travel Corridor → Route Alignment → PUDO Locations → Service Characteristics (e.g. span, fare, frequency) → Technology (e.g. LRT, BRT)



Place Your Bets!

❖ When

- ❑ Market penetration substantial enough to reach a “tipping point” that affects decisions on land use & roadway design likely decades away



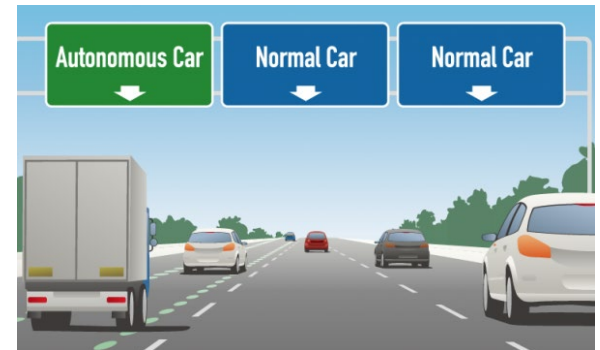
❖ Who First

- ❑ Fleets with paid drivers and where vehicle down-time is \$: trucks, buses, ride-hailing



❖ Where First

- ❑ Straightforward, well-maintained interstates with multiple lanes, where speeds can increase and vehicle separations can decrease and where lane designations can shift over time





Thanks!

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