Automated Vehicles and the Impact on the Insurance Industry

Casualty Actuarial Society
Alyce Chow
Matt Antol
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Google Self-Driving Car Test

http://www.youtube.com/watch?v=cdgQpa1pUUE

What this presentation tries to do…

- Ask the right questions
- Draw relevant historical comparisons
- Inform about the current state of vehicle technology, relevant regulations, social, environmental and liability considerations.

What this presentation is not about…

- We don’t have answers
- We don’t know when or how automated vehicles will change the auto insurance industry
- We don’t know when the technology will evolve and become socially and legally accepted to remove human interactions / faults from the auto collision equation

Agenda

- Background
- Adoption Scenarios / Projected Timeline
- Insurance Issues
- Actuaries and the Insurance Industry's Role / Responsibility

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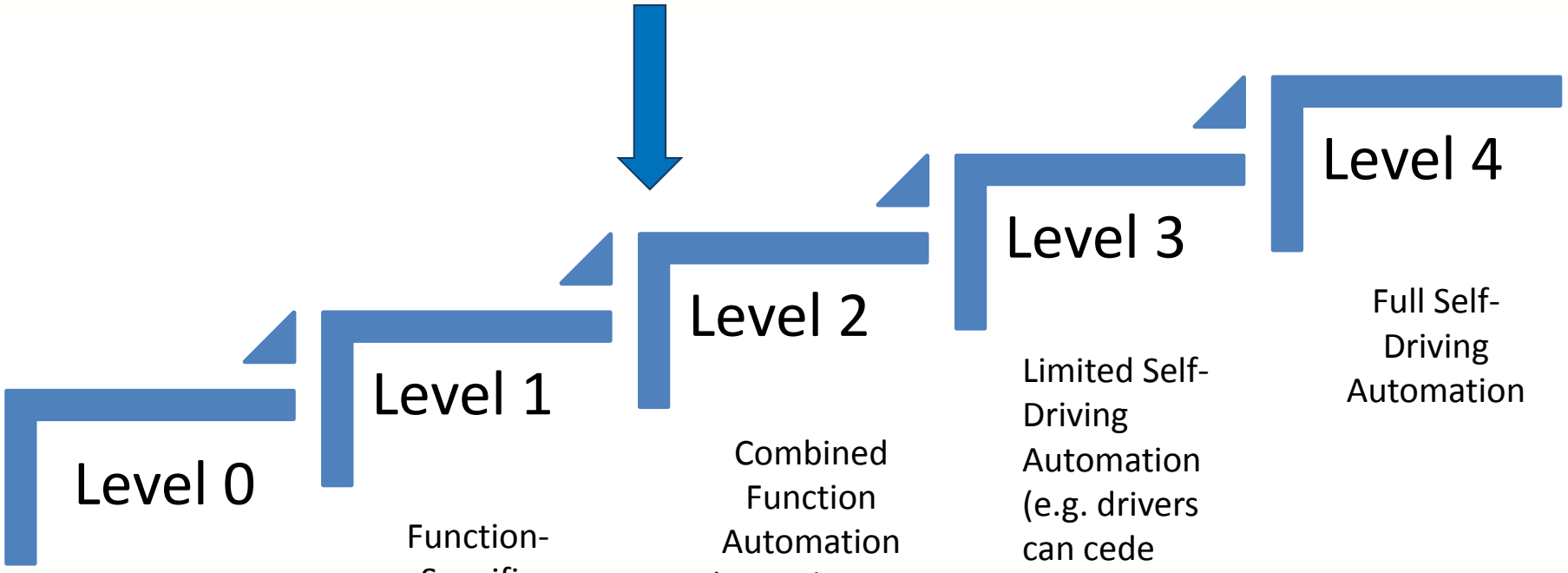
Definition

- Automated Vehicles (AV): Vehicles that are able to guide themselves from an origin point to a destination point without the active control or monitoring of a human operator.
- Also known as Autonomous Vehicles, Self-Driving Cars, and Driverless Cars

Societal Benefits of AV

- Reduce accidents
  - By eliminating or reducing driver error
- Reduce transportation costs
  - Reduce travel time and traffic congestion with V2V technology
  - More efficient use of infrastructure
  - Techniques like platooning can increase highway capacity by 500%
  - By reducing the number of incidents and network disruptions
- Support demographic change
  - By increasing mobility for elderly & impaired
- Greener
  - By increasing fuel efficiency and reduced pollutant emissions through vehicle operation improvement
  - Platooning can increase highway fuel efficiency by 20%

Levels of Vehicle Automation

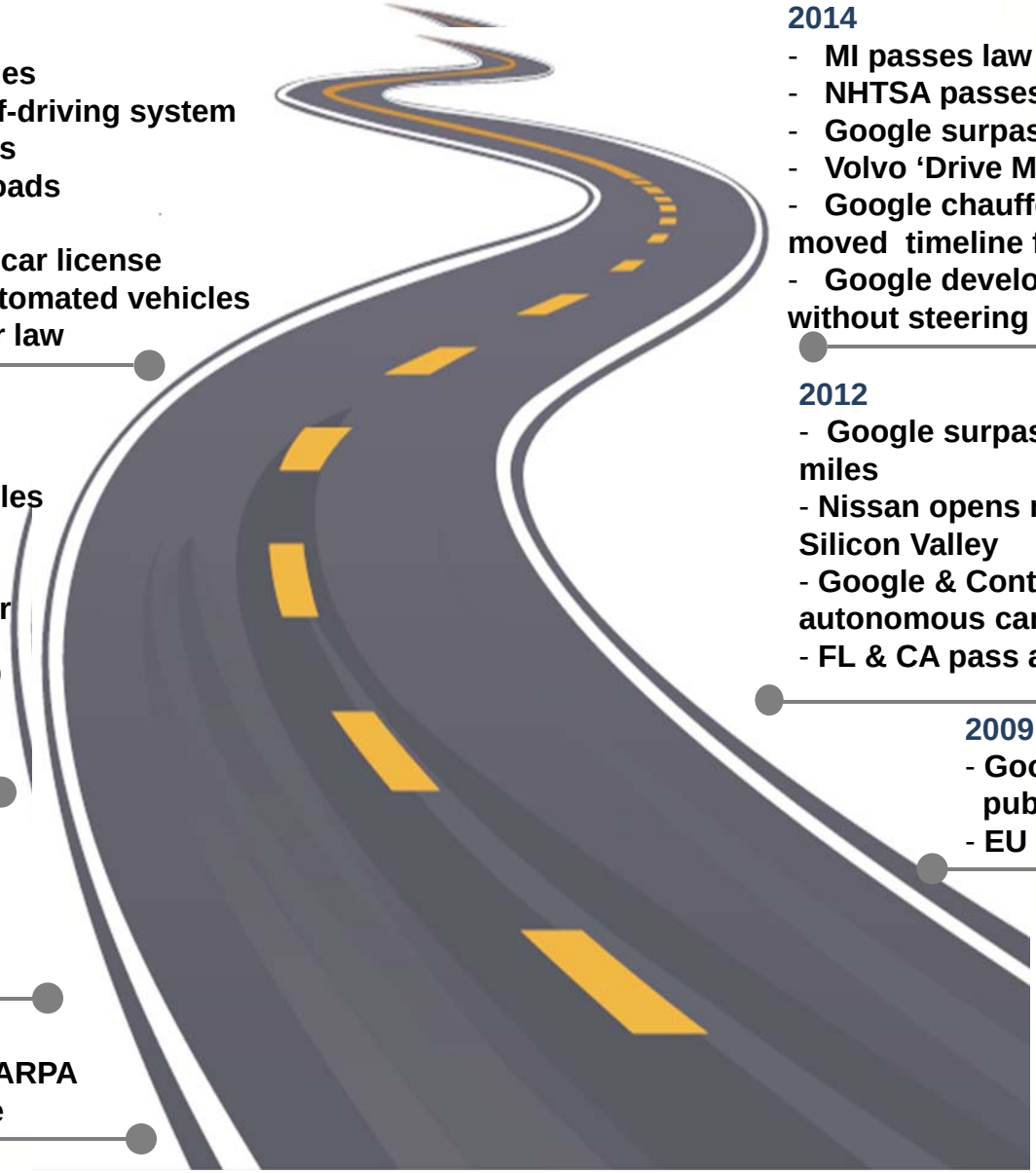


Enabling Technology

V2V/V2I: Stands for Vehicle to Vehicle or Vehicle to Infrastructure. Uses Dedicated Short Range Communications (DSRC), similar to wifi, to allow a vehicle to communicate to other vehicles or infrastructure (traffic signals, toll booths, etc).

LIDAR: combination of light and radar, and uses laser light to create 3D images of the surrounding environment.

Historic Developments



2013
- Google surpasses 500K miles
- Oxford creates a $7,750 self-driving system
- Britain tests on public roads
- Mercedes tests on public roads
- CMU tests on public roads
- Audi receives autonomous car license
- NHTSA issues policy on automated vehicles
- DC passes autonomous car law

2014
- MI passes law
- NHTSA passes V2V
- Google surpassed 700k miles
- Volvo 'Drive Me' tests in Gothenburg
- Google chauffeured 30 journalists; moved timeline for 2020 release
- Google developing driverless car without steering wheel or brakes

2012
- Google surpasses 300K accident free miles
- Nissan opens research facility in Silicon Valley
- Google & Continental receive autonomous car licenses
- FL & CA pass autonomous car laws

2011
- Google surpasses 150K miles
- BMW begins testing self driving car on public roads
- NV passes autonomous car law

2010
Volvo CitySafe standard

2009
- Google begins testing on public roads
- EU launches Project SARTRE

2007
CMU wins DARPA Urban Challenge

2005
Stanford wins DARPA Grand Challenge

Timeline

2020

2016

2014

LIDAR cost at least a few hundred dollars

"An autonomous package might only add $5K - $7K to the sticker price."
– Raj Rajkumar, director of CMU's program

2013

"The autonomous system package will only cost around $2,500." - Audi

2005

Continental
VOLVO
NISSAN
intel
TOYOTA
DENSO
NOKIA
IBM
Valeo
Carnegie Mellon University
Velodyne
TESLA

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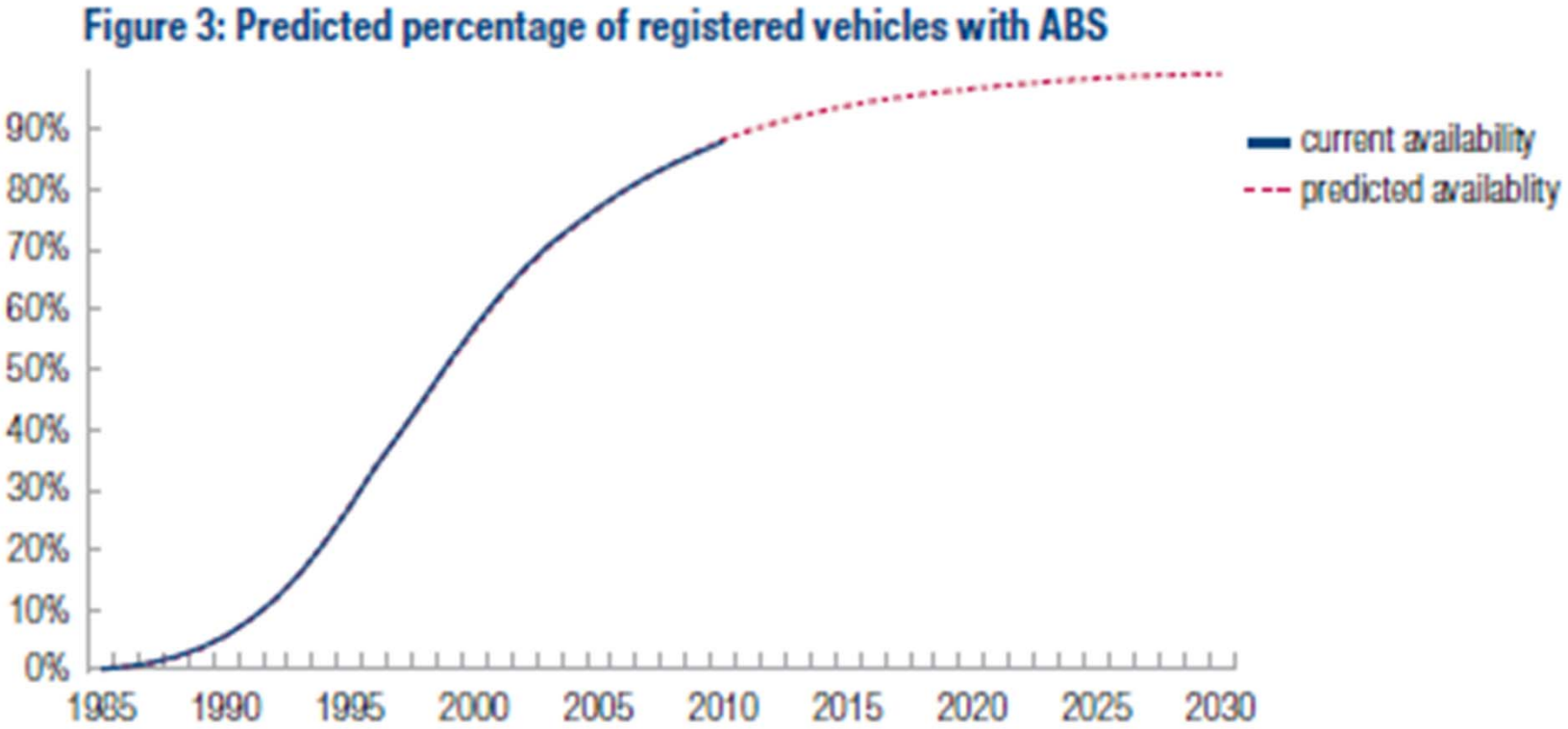
- **Adoption Scenarios / Projected Timeline**
- Insurance Issues
- Actuaries and the Insurance Industry's Role / Responsibility

Adoption Trends

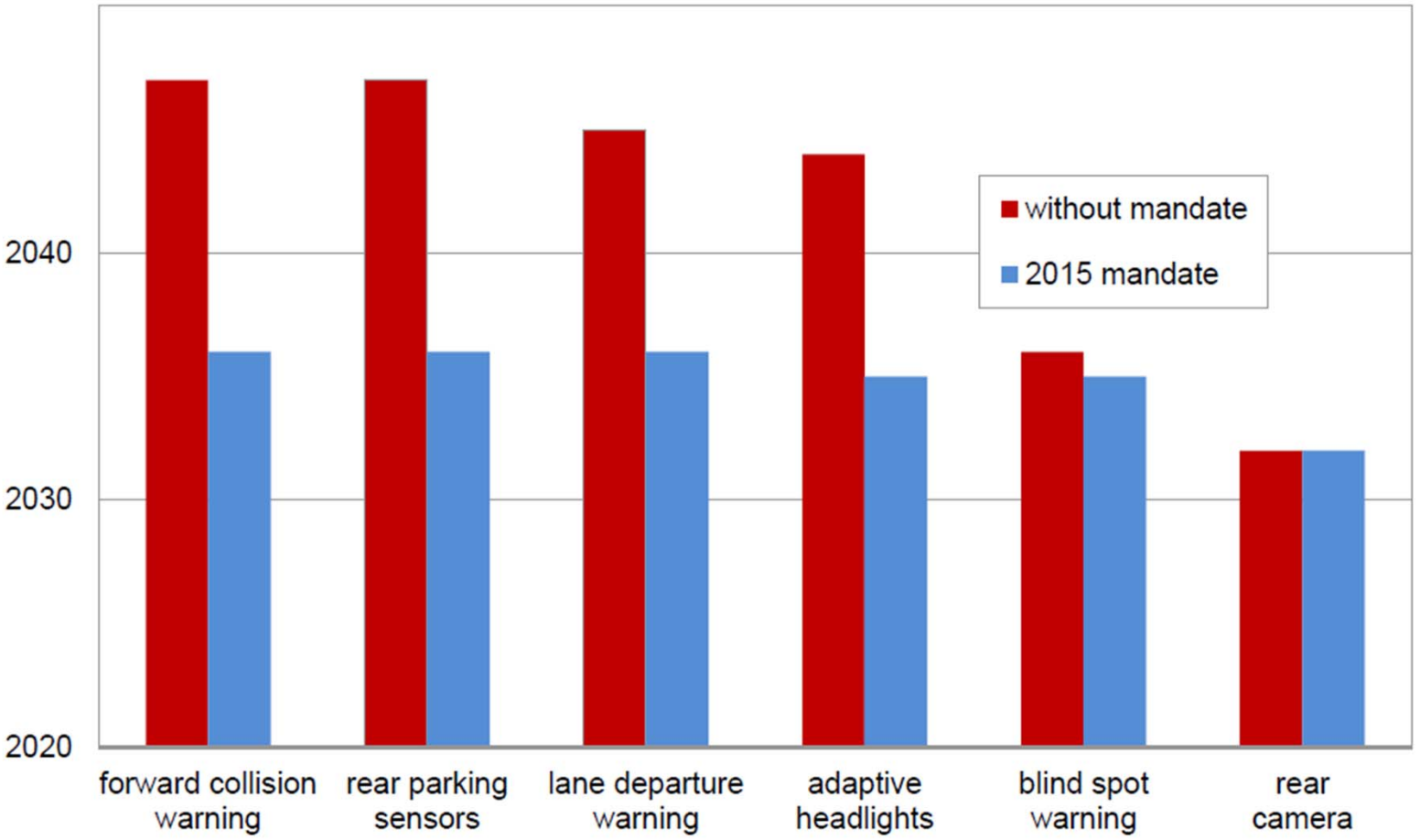
- One point of view: we can try to understand how and when automated vehicle technology will change the auto insurance market by examining the adoption of similar vehicle safety enhancements (ABS, ESC, etc)

Adoption Patterns: ABS



Adoption Patterns: Newer Technology

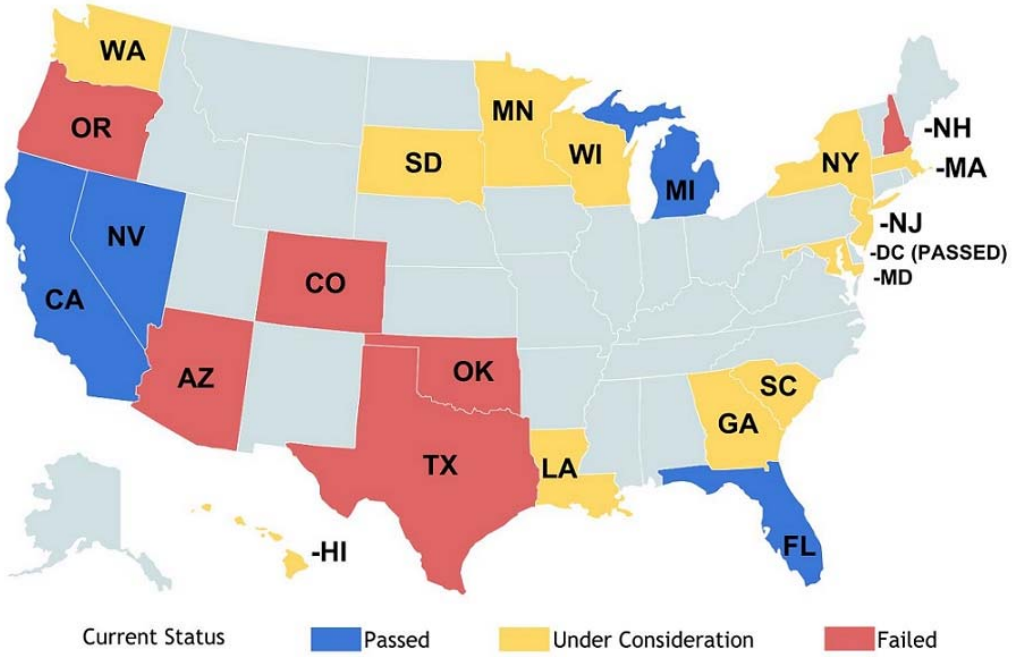
Calendar year features reach 95% of registered vehicle fleet with and without mandate



Adoption Trends

- Other point of view: AVs may be in market sooner, given quick advancements in technology as well as impact of non-traditional companies such as Google

Current Regulatory Approach



- **States**: NV, CA, MI, FL and DC have regulations that permit the operation/testing of autonomous vehicles.
- **NHTSA**: In May 2013, published a statement with guidance to states on autonomous vehicle regulations. Statement also outlined NHTSA plans for testing autonomous vehicle technology.

http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action

Current Regulatory Approach

- **UK**: Passed legislation in 2013 permitting the testing on public roads.
- **International**: In 2014, the UN passed an update to the 1968 Vienna Convention on Road traffic. The amendment agreed to by the UN Working Party on Road Traffic Safety would allow a car to drive itself, as long as the system "can be overridden or switched off by the driver." A driver must be present and able to take the wheel at any time.

Adoption Considerations

1. Safety
2. Social acceptability
3. Road infrastructure
4. Cybersecurity
5. Cost

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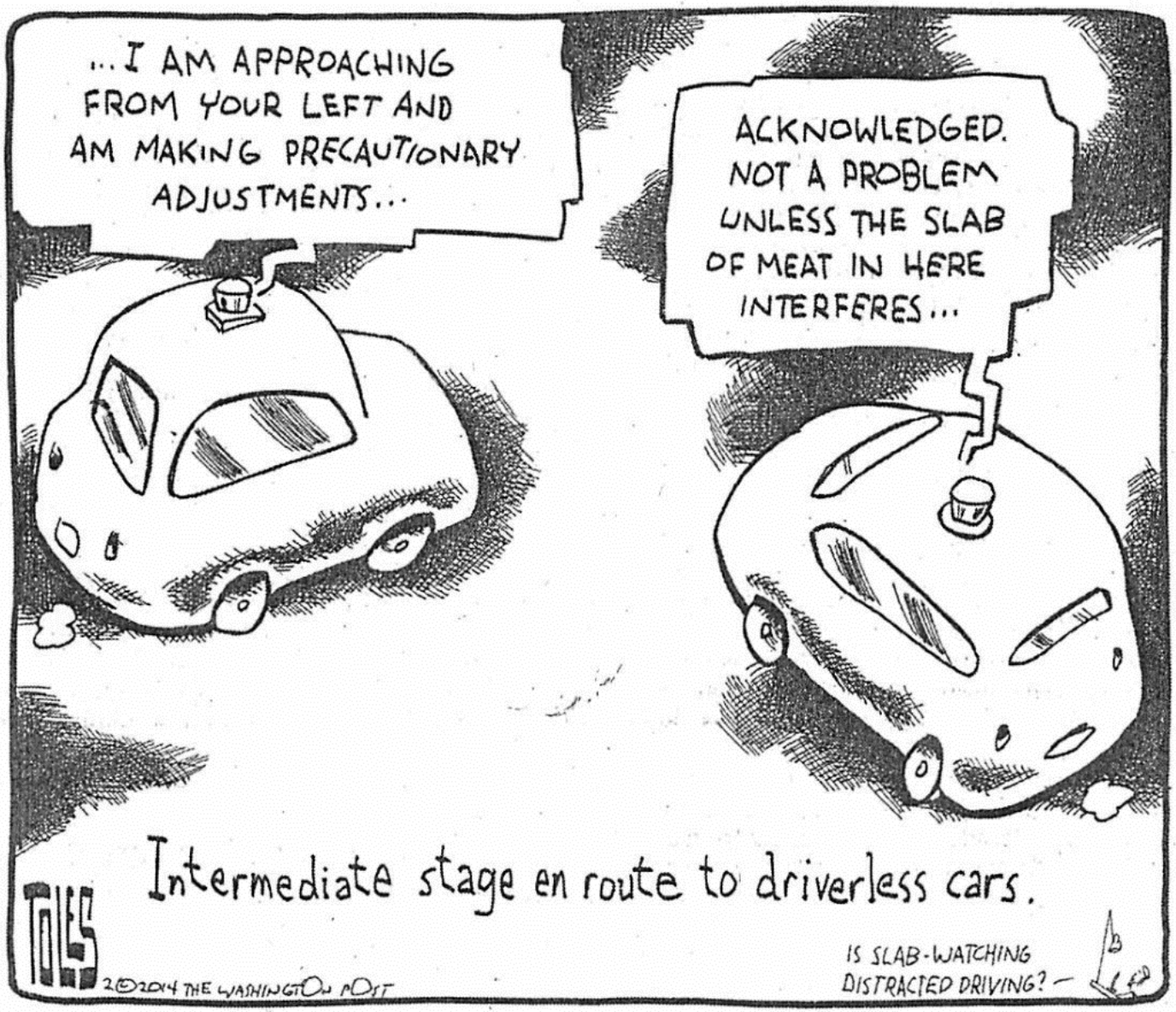


Intermediate stage en route to driverless cars.

Insurance Issues

1. **Auto insurance impact –** how will it impact the $200B business?
2. **Data** – who owns it and how can it be used?
3. **Pricing** – how do we price insurance when level 0 through level 4 vehicles are on the road at the same time? How are we currently pricing for the crash avoidance technology?
4. **Coverages** – are all the current coverages still relevant? What new ones might be introduced (ex. product liability, coverage for cyber attacks, etc)

Pricing Considerations

- Typical Rating Variables:

	Current	With Level 2/3	With Level 4
Driver Characteristics	√	√	?
Vehicle Characteristics	√	√	√
Mileage	√	√	√
Territory	√	√	√
Credit Score	√	?	?
Amount of Coverage	√	√	√

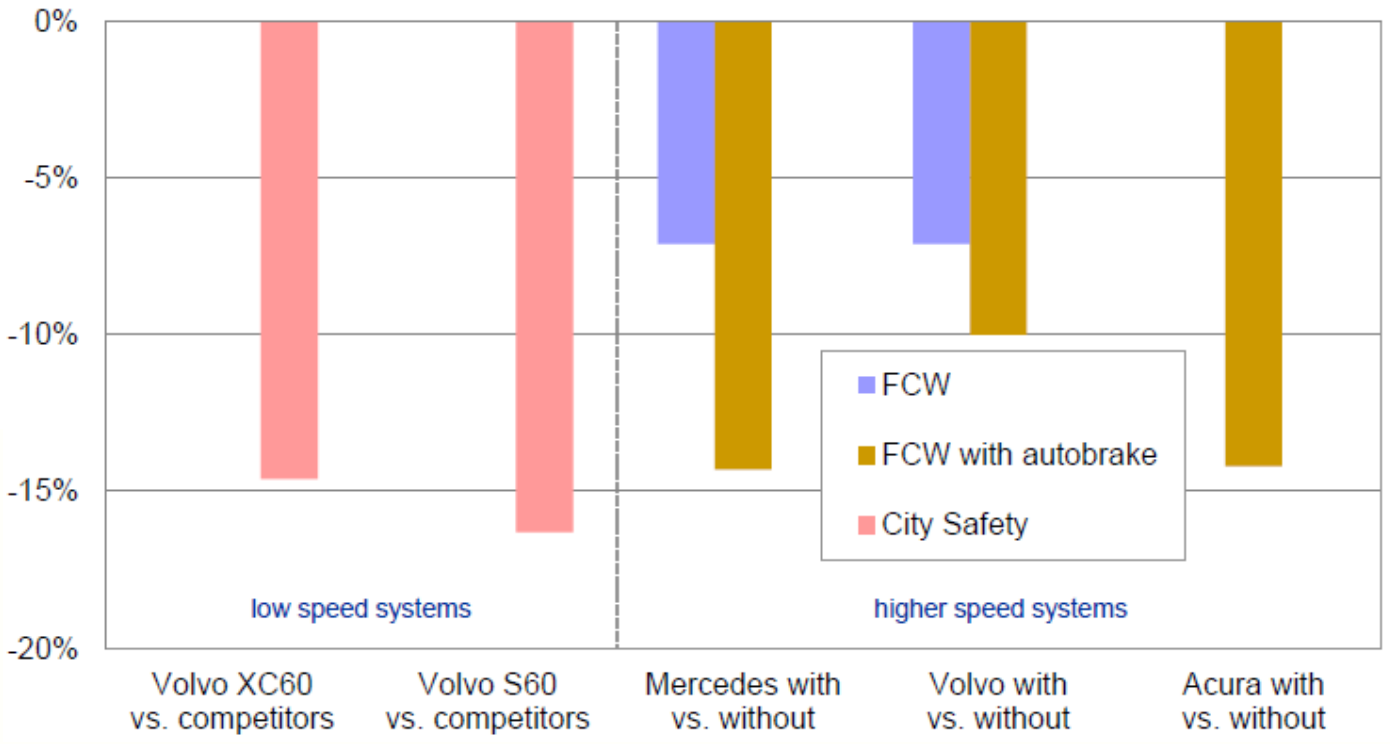
Reliance on driver and vehicle characteristics

How much reliance on driver versus vehicle?

Reliance on vehicle primarily; minimally on driver

Pricing Considerations

- HLDI has studied crash prevention features (level 2) and found they are reducing collision frequency.



Possible Insurance Frameworks for AVs

1. Product Liability
   - Attach major liability to sellers and manufactures of the vehicle
   - Tends to be complex and expensive – as the standard to establish a defect is vague/unpredictable
2. Strict liability when an AV is at fault
   - Making the owner of the vehicle responsible when the owner's automobile is at fault
3. First party insurance
   - Similar to UM coverage, injured parties would look to their own insurers
4. A combination of above?

Coverages

First-Party

- **Comprehensive:**
  - Expenses due to theft, vandalism, glass breakage, and related matters to your car that weren't caused by an auto accident.
- **Collision:**
  - Damages incurred by your vehicle in an auto accident.
- **Medical payment coverage:**
  - Cover medical expenses you incur up to a limit
- **Others**: Towing/Rental

Liability

- **Bodily Injury**:
  - Medical-related expenses you caused to others.
- **Physical damage**:
  - Cost to repair or replace other's property (such as a car)

Coverage not as affected in a world of AVs (though cost/pricing would be affected)

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- **Actuaries and the Insurance Industry's Role / Responsibility**

Actuarial Responsibility

- **We are responsible for coming up with a rate that is not inadequate, excessive or unfairly discriminatory.**
  - Past <> Future: Represents a fundamental change in relationship between driver & vehicle
  - Complex: Technology based on a sensor input of a GB per second
  - Heterogeneous: Different products perform differently
  - Black box: Cannot readily discern differences
  - Outside influence: Outside interests may put pressure on rates
  - Consequences of failing to match price to risk

What should we do?

- Understand and influence the regulatory environment which will determine future liability costs for auto collision / injury costs.
- Communicate issues surrounding automated vehicles to stakeholders in your organization. Insurance companies need to understand the impact automated vehicles will have on their business model.
- Work with stakeholders at your organization to develop long term strategy that addresses the evolution of automated vehicles.

What should we do?

- Proactively address current issues on safety, liability and regulation
  - CAS Task Force on Automated Vehicles

- Collaborate with automakers, state & federal regulators and other insurance companies to create a robust & transparent testing and risk management structure that brings the technology to market as safely and efficiently as possible.

- Other objectives
  - Increases influence
  - Increases tests' strength & validity
  - Protects against uncompetitive pricing

What is the CAS Doing

- CAS Task Force on Automated Vehicles
  - Quick Studies
    - Accident Causation Analysis
    - Potential Premium Reduction Analysis – Determine how our current rate calculation analyses will interpret the results and detail how long it will take for premiums to be reduced under various scenarios.

What is the CAS Doing

- CAS Task Force on Automated Vehicles
  - The analysis from the CAS shows that still about half of all accidents are not avoidable without further technological or regulatory advancements:

Category	Disabling Factor	UnWtd Freq	Wtd Freq	UnWtd Freq	Wtd Freq
Technology Issues	Inoperable Weather	602	267,657	11.0%	12.2%
	Vehicle Issue Present	681	254,948	12.4%	11.6%
	Inoperable Traffic Control Device	22	7,933	0.4%	0.4%
	Total Technology Issues	**1,183**	**466,269**	**21.6%**	**21.3%**
Driver Usage Issues	Driver Disables	152	67,304	2.8%	3.1%
	Alcohol/Illicit Drugs	502	241,596	9.2%	11.0%
	Physical Impairment (heart attack)	138	49,868	2.5%	2.3%
	Sleeping	159	62,974	2.9%	2.9%
	Distraction	929	365,436	17.0%	16.7%
	Total Usage Issues	**1,742**	**709,153**	**31.8%**	**32.4%**
	Total AV Issues	**2,644**	**1,070,757**	**48.3%**	**48.9%**
	Total Accidents	**5,470**	**2,188,970**	**100.0%**	**100.0%**

What is the CAS Doing

- CAS Task Force on Automated Vehicles
  - Liability Studies
    - The liability team is pursuing multiple estimates of the cost to insure an AV as a products liability exposure
    - Researching past legislative reforms, including caps on damages, on risky activities including vaccines and nuclear power plants, and considering the implications of hypothetically applying them to automated vehicles
  - Communications Team

Insurance Industry's value

- Risk management expertise
- Adept at handling tremendous amounts of data
  - More detailed accident data & models
  - Technology based on a sensor input of a GB per second
- Best understanding of every state's unique driving regulations
- Best understanding of products liability & general liability
- Financial incentive to decrease losses and encourage risk mitigation

Additional Sources

NEWS	• www.Highwaysandhorizons.com • www.DriverlessCarHQ.com – follow on FB • www.motorauthority.com • Google alerts
Gov't Group	• Senate Committee on Transportation – Sen. Rockefeller III • House Committee on Transportation – Rep. Shuster • House Subcommittee on Highways and Transit – Rep. Petri • National Highway Traffic Safety Administration
Other Group	• Center for Automotive Research (CAR Group) • IIHS & HLDI • SAE International • ENO Center for Transportation

Questions and Discussion

Appendix

- Comparison to Mortgage Backed Securities
- Issues with current approach
- Benefits

Appendix – Comparison to MBS

Case Study: Mortgage Back Security (MBS)

- **Potential Benefits**
  - Allow underprivileged to become homeowners
  - Allow banks to increase profit while minimizing risk
  - Help the housing sector grow the economy
- **Credit Agencies**
  - Trusted model that required new mortgages to be written similarly to old mortgages
- **AIG**
  - Trusted the credit agencies' rating

Comparison to MBS's

Inadequate testing, reporting and risk control measures can transform a safe product into a risky one.

- **MBS**
  - Tremendous societal benefits
  - Complex risk with little transparency
  - Built in fail-safe
  - "No way that MBS's can be riskier than a single home loan"
- **AV**
  - Tremendous societal benefits
  - Complex risk with little transparency
  - Built in fail-safe
  - "No way that automated vehicles can be riskier than human drivers."

Appendix - Adoption

Current approach: General Issues

1. **Lower product safety**
   - Less transparency
   - Inconsistent standards between states & companies
   - Misunderstanding of risk
   - Encourages risky behavior
   - Inadequate oversight

2. **Higher testing costs**
   - 51 separate regulatory codes
   - Duplicate tests required

3. **Higher adoption costs**
   - High levels of uncertainty
   - Auto insurance premiums unchanged
   - GL/PL insurance unavailable or unaffordable

Adoption trends

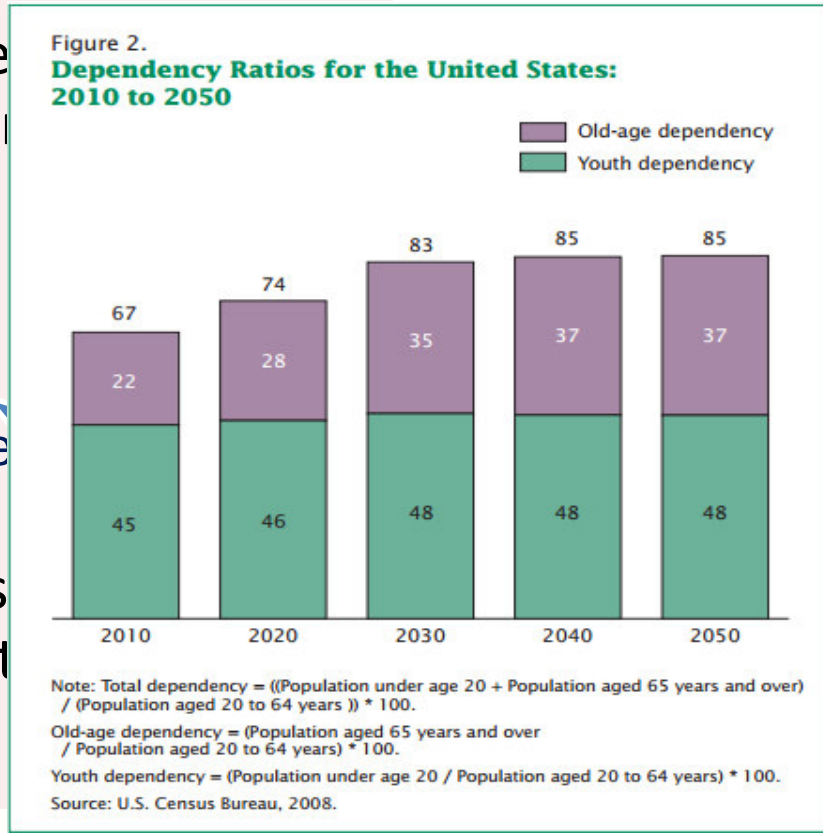
- **Rapid adoption**
- Critical mass could be reached at 25%
- Demand driven by elderly & young
  - 2030: 2X as many old/young as in between (20-65)
- Government intervention
  - International competition
  - Dramatic growth reduces debt
  - Reducing weight only way to produce transportation
    - New fuel usage standards in 2025
  - Reduce infrastructure spending

Less Congestion

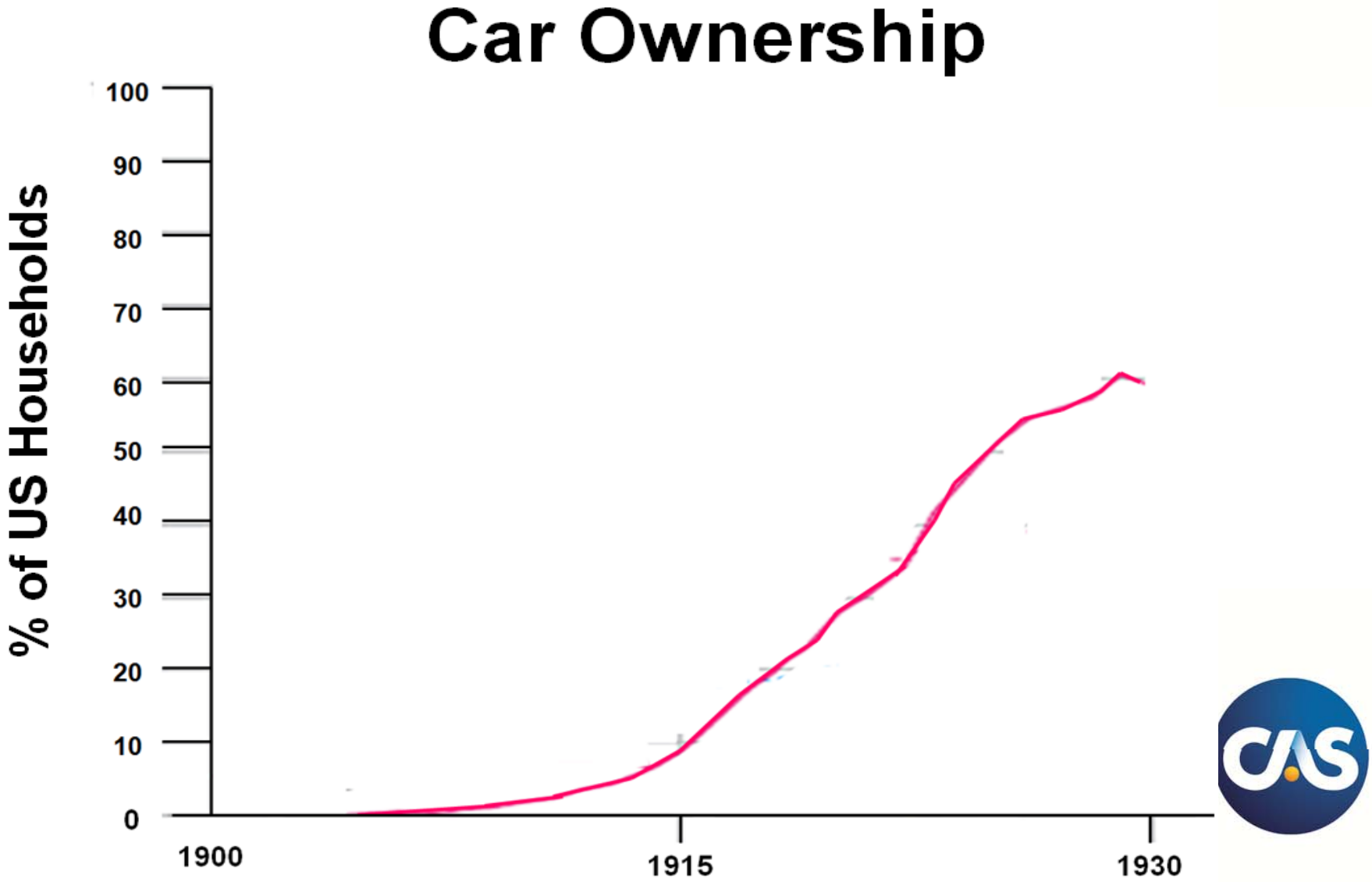
Fewer Accidents

Fewer

Less Congest



Adoption trends

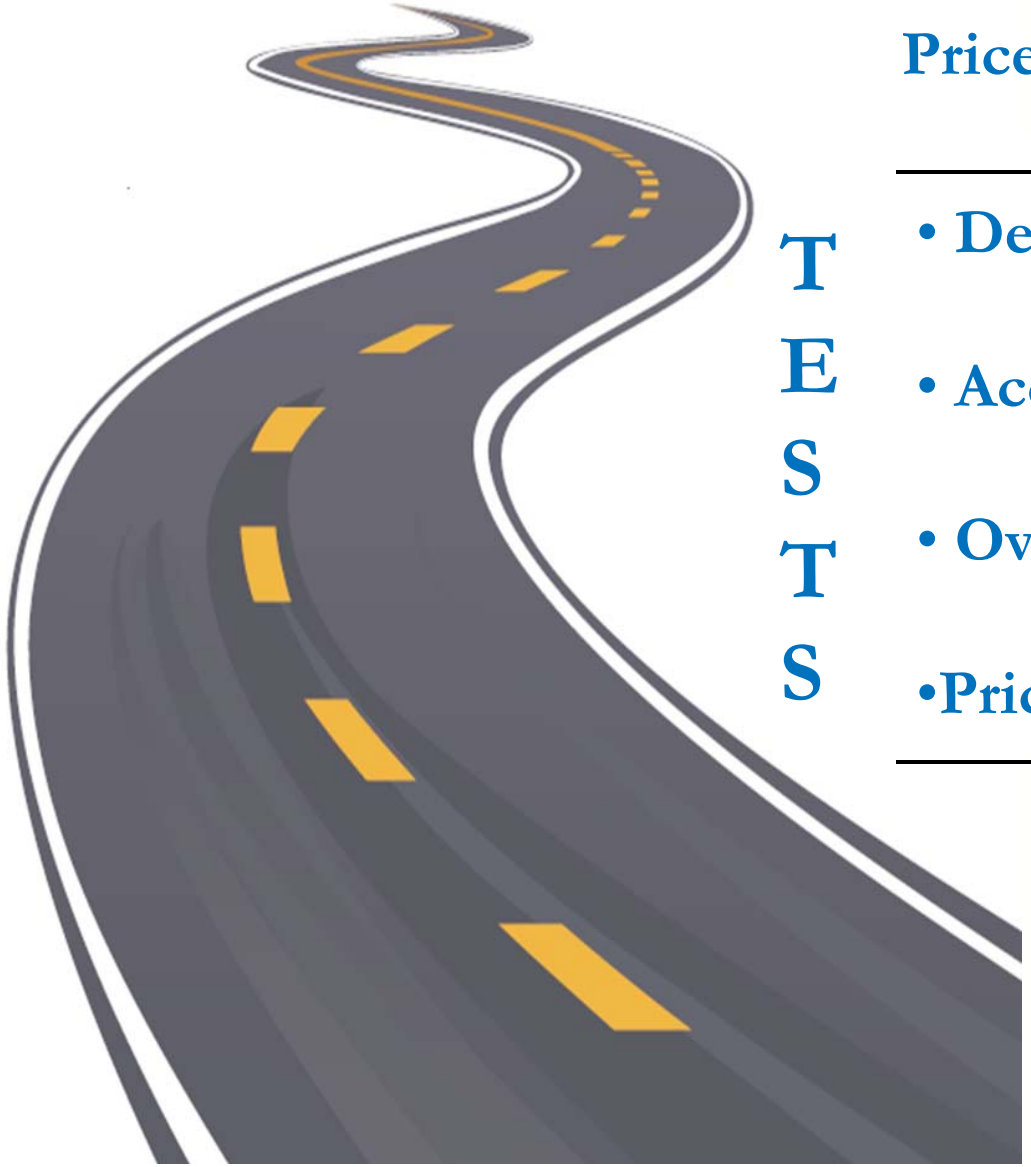


Adoption trends

- **Two issues:**

1. Assumes the answer to *"when should we act"* is *"when automated technology reaches XX% of registered vehicles."*
   - Market will be established
     - Liability will be clearly defined
     - Reporting requirements will be clearly established
     - Insurance industry's influence will be minimal
2. Risk management
   - Concern ourselves with the chance that something bad will happen
   - Likelihood that adoption could reach critical mass before expected

When to Act?



TESTS

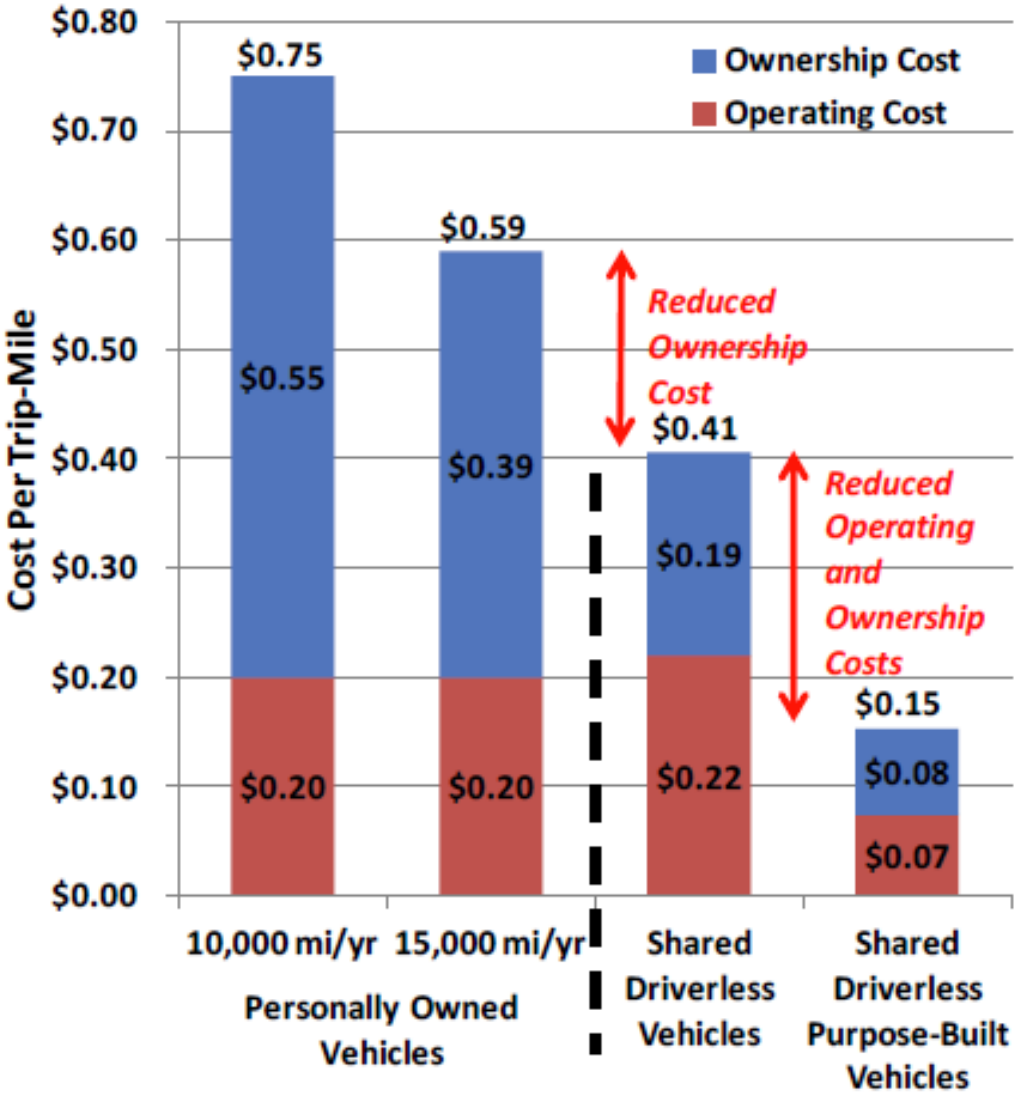
Price Self Driving Cars

- Determine explanatory factors
- Account for process risk
- Overcome unknown
- Price explanatory factors

Set up testing regulations & data requirements

Appendix - Benefits

Reduce transportation costs

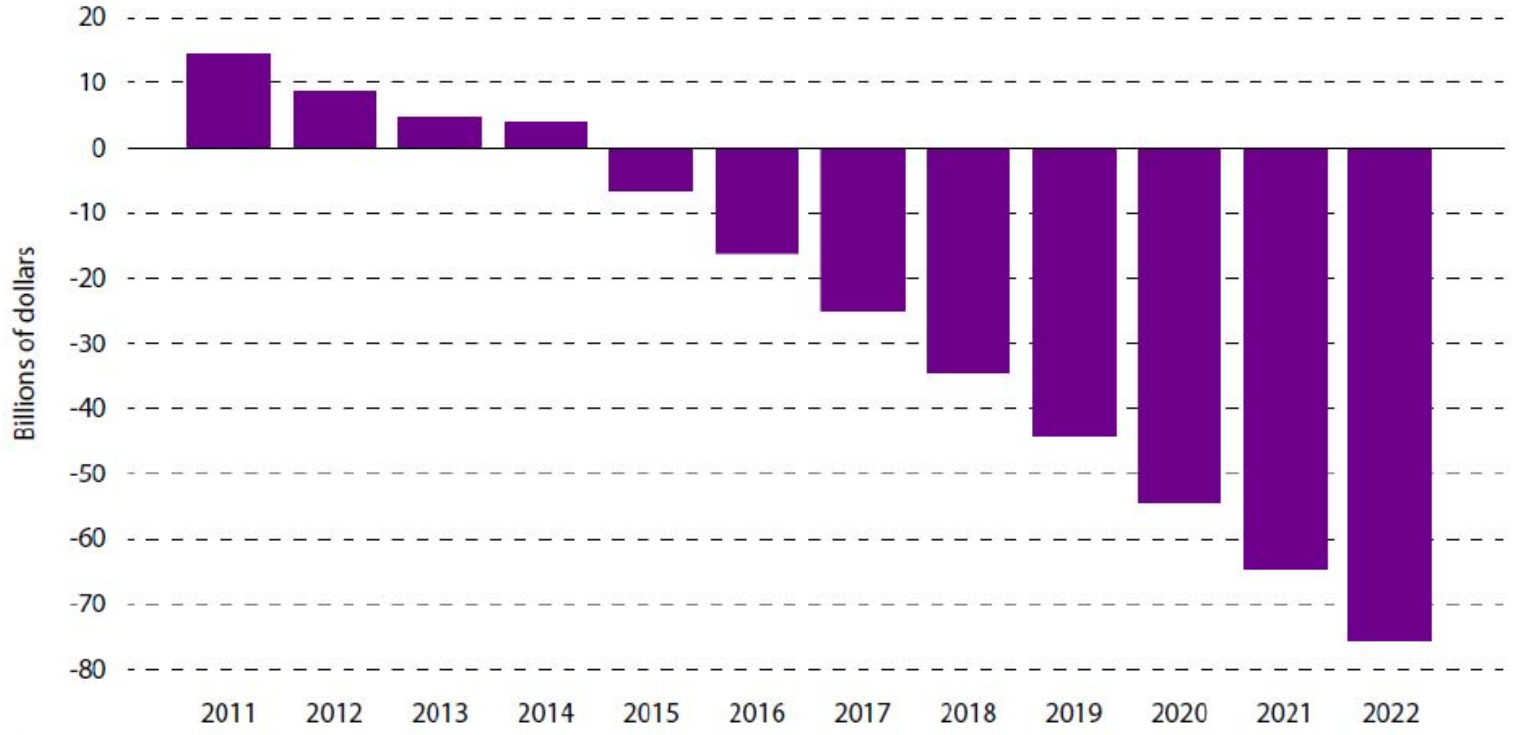


- A shared, driverless vehicle fleet can provide the same mobility as personally owned vehicles at far less cost
- Cost/trip-mile could be reduced by 80% compared to a personally owned vehicle driven 10,000 miles/yr
- Reduced parking costs and the value of time not spent driving would further increase these benefits

Infrastructure Issues

- 25% of urban roads are in poor condition
- Poor road quality costs drivers $335 to

Highway Trust Fund Projections



Source: CBO 2012.

Greener

- Increase highway fuel efficiency by 20%
- 40% of fuel in cities is wasted looking for parking
- Reduce stop & go traffic
- Reduced accident risk allows vehicles to be lighter
  - Lighter vehicles key for dramatic improvement needed

Greener – How power is generated

- **Gas Automobile**
- Oil pumped from ground & transported to factory
- Refinery turns oil into gas, ships to gas station
  - 82% of well energy makes it to gas station
- In car, gas burned to turn engine.

Electric Vehicle/Train

• Coal mined from ground & shipped to power plant

• Fuel burned

› DoE estimates plants are 40% efficient turning coal into energy

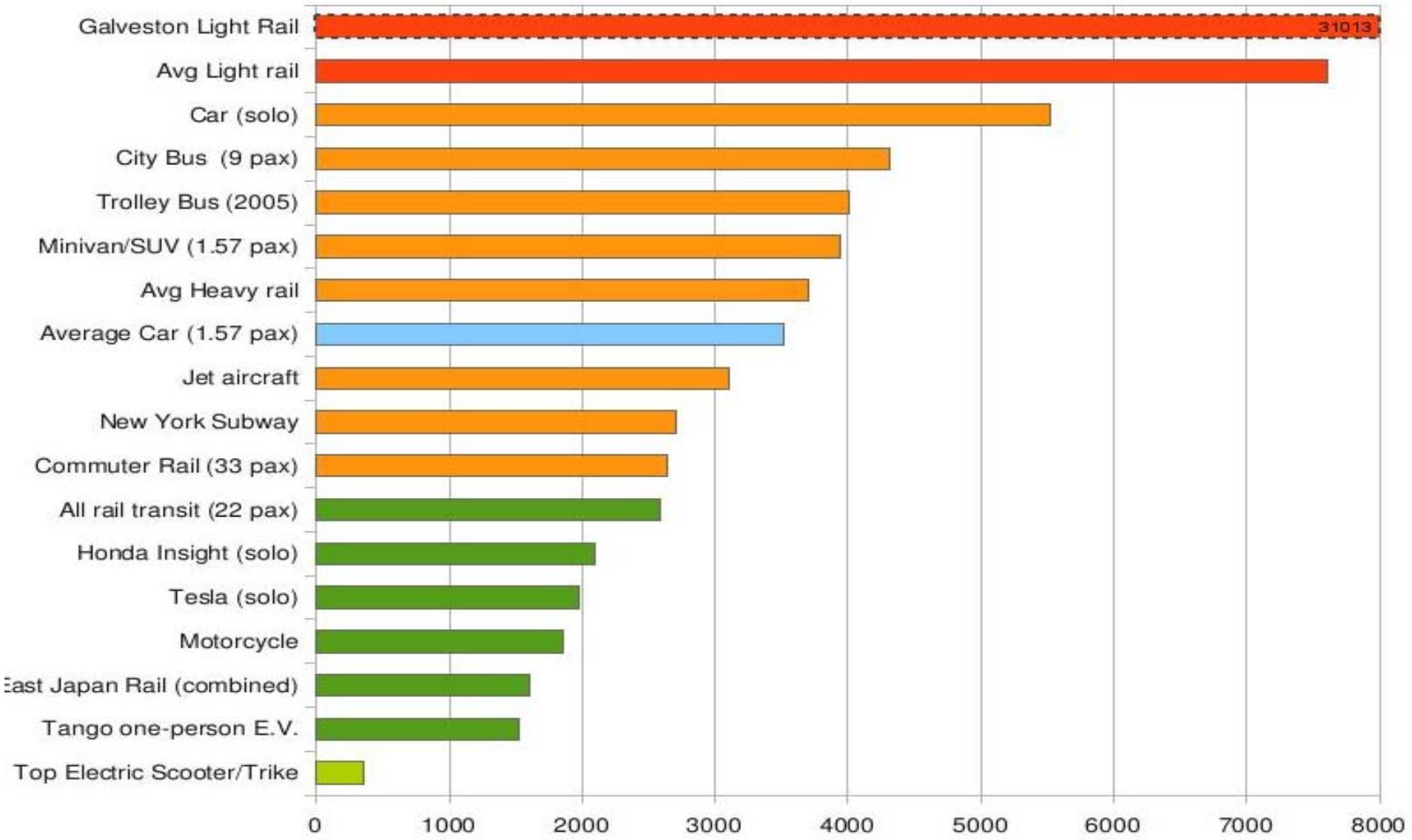
• Electricity sent over wires & then into electric battery

› Approx 7% energy lost

• Electric motor powers motor with minimal loss

➢**Really run on 50% coal, 18% natural gas, 20% nuclear & some renewables**

Greener


Galveston Light Rail
31013
Avg Light rail
Car (solo)
City Bus (9 pax)
Trolley Bus (2005)
Minivan/SUV (1.57 pax)
Avg Heavy rail
Average Car (1.57 pax)
Jet aircraft
New York Subway
Commuter Rail (33 pax)
All rail transit (22 pax)
Honda Insight (solo)
Tesla (solo)
Motorcycle
East Japan Rail (combined)
Tango one-person E.V.
Top Electric Scooter/Trike
0
1000
2000
3000
4000
5000
6000
7000
8000

Opportunities – machine and man

- Human and computer interactions