

# **Cars: Past, Present and Future**

Larry Wittig

18 November 2015

# Past predictions are becoming true

Predicted in the 1950's



Now (Mercedes F015)

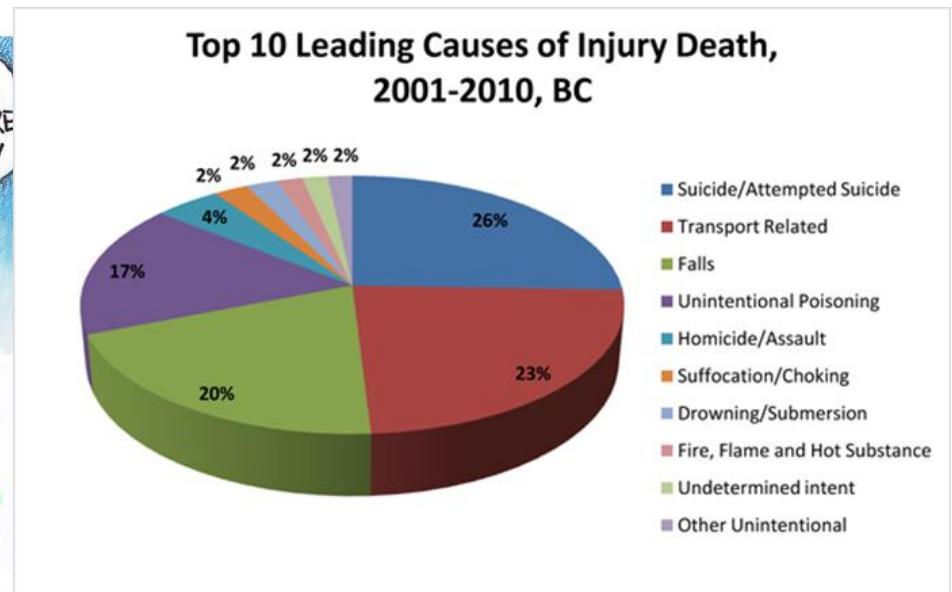
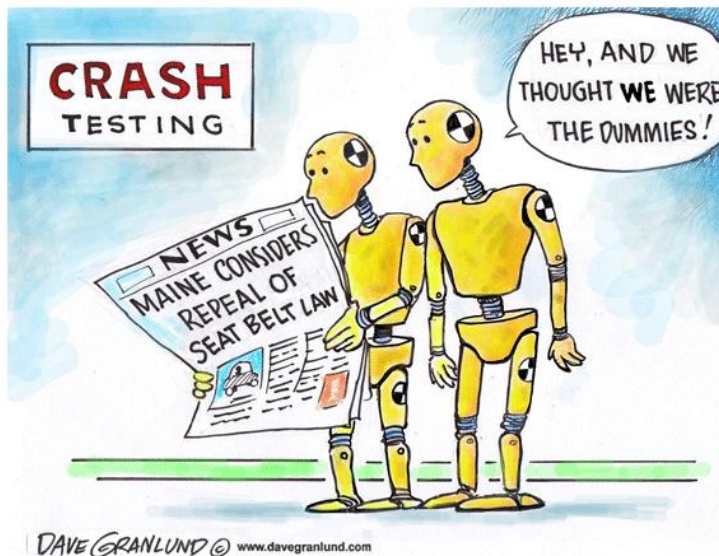


# Overview of Presentation

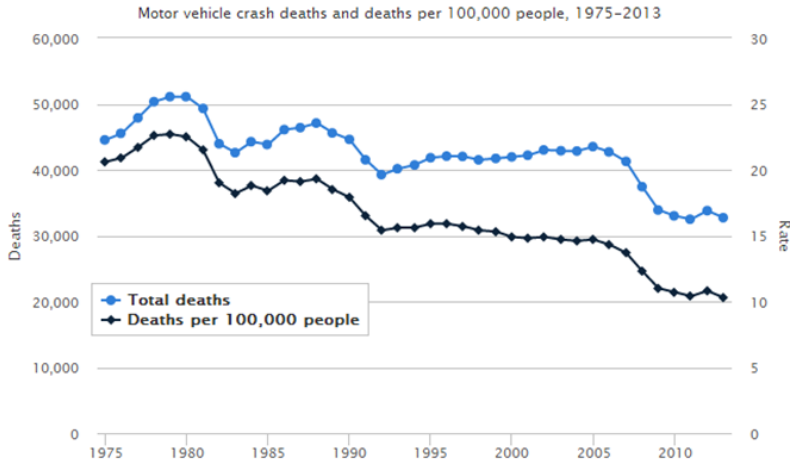
- Automobile accidents and deaths
- Some past improvements from horseless carriages to ~2000
- Presently available innovation to improve safety and comfort
- Electric Cars
- Driverless (autonomous) cars & trucks
- Extra Stuff (that I probably not have time for)

# Accidents/Safety

- Many present and near future auto improvements are to improve safety – this has not always been a good selling point. A lot of people still don't want mandatory seat belts. Maine was considering repealing seat belts for adults earlier this year.
- In ~2010 WHO estimates there were 1,240,000 auto accident fatalities. The three largest were: China (275,000) , India (238,000) & Nigeria (53,000).  
[https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_traffic-related\\_death\\_rate](https://en.wikipedia.org/wiki/List_of_countries_by_traffic-related_death_rate)
- In 2010 the US was 6<sup>th</sup> with ~36,000 fatalities, although it has been declining. It is now slightly less than drug-related and fire-arms related deaths. And much less than heart disease (611,000), cancer (585,000) and non-cancer respiratory disease (149,000).



# Causes of Accidents in the US



Insurance Information Institute & NHTSA	
Causes of automobile crash fatalities	
Drunk driving	31%
Speeding*	29%
Fatigue	21%
Distracted Driving #	16%
* 42% of speeding drivers were drunk	
# Including cellphone use	

Motor vehicle crash deaths per 100,000 people by type, 1975-2013

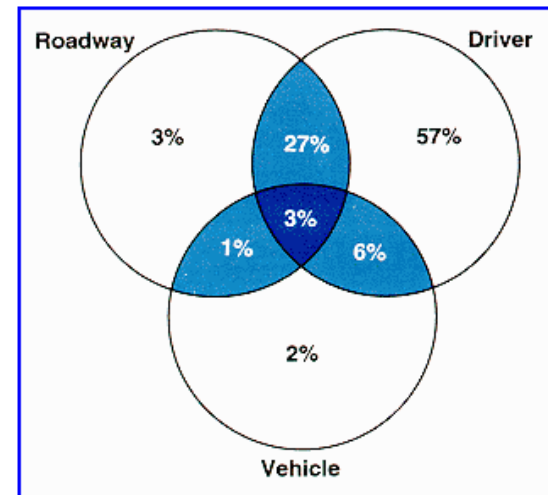
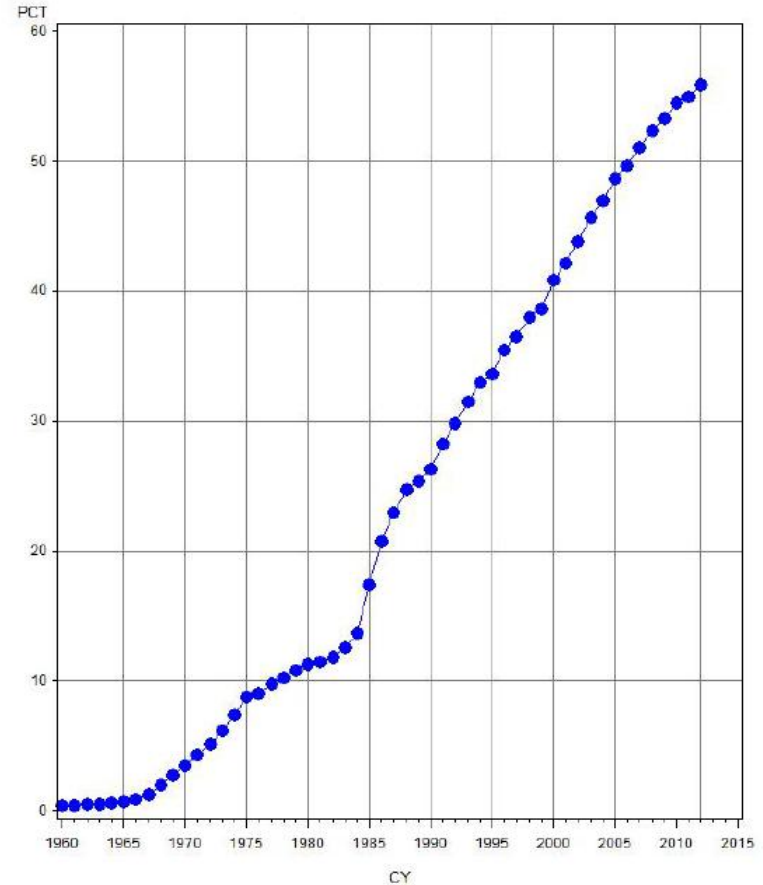


Figure 3 - Venn diagram showing the causes by percentage, of road accidents in the United States. (8)

# NHTSA – effectiveness of Auto Safety devices and regulations

Note that a large number of the automotive changes on the previous page are safety related. This plot from a 2015 NHTSA report “*Lives Saved by Vehicle Safety Technologies and Associated Federal Motor Vehicle Safety Standards, 1960 to 2012*” shows that fatalities have been reduced by more than 50% by such devices and regulations.

FIGURE 3: PERCENT OF POTENTIAL FATALITIES SAVED BY VEHICLE SAFETY TECHNOLOGIES, 1960 TO 2012



## Pedestrian safety




Automobiles are much more dangerous to pedestrians than they are to drivers and passengers. Worldwide two-thirds of 1.3 million yearly auto related deaths are pedestrians. [https://en.wikipedia.org/wiki/Automobile\\_safety](https://en.wikipedia.org/wiki/Automobile_safety) Unfortunately, pedestrians were one of the few groups of road users to experience an increase in fatalities in the United States in 2013, totaling 4,735 deaths. <http://www.nhtsa.gov/Pedestrians>

# Past/Present Improvements

speedometers  
padded interior surfaces  
rear view mirror  
& auto dimming rear view mirror  
auto dimming head lights  
safety glass  
lap seat belts / 3-pt seat belts  
air bags -- incl. side air bags  
radio -- 8-track tape players  
Infotainment centers  
brake lights  
center rear brake light  
head restraints  
auto transmission  
pollution reduction systems  
antilock brakes (ABS)  
traction control  
electronic stability control  
safety cage & crumple zones

split hydraulic brake systems  
telescoping steering column  
disk brakes with anti-lock  
automatic collision avoidance braking  
radial tires -- higher mileage  
tubeless tires  
run flat tires  
pressure monitoring tires  
power steering  
longer life batteries  
air conditioning  
cruise control  
fuel injection  
GPS -- maps -- driving instructions  
hybrid cars -- regen brakes  
power windows  
wipers -- smart wipers  
4 - wheel drive  
heads up display  
infrared detection and displays


remoted ignition  
better batteries  
speech recognition / no hands cell phones  
remote door locks  
"keyless" entry & start -- just need to be close  
auto shut down & notification in accidents  
cameras for back-up  
higher power density engines (4 cyc turbos)  
self parallel parking  
diagnostic on board computers  
heated seats & steering wheels  
blind spot warning  
carbon-fiber & aluminum replacing steel  
self parking  
in-wheel motor & brakes  
power adjusting seats  
self cleaning paint  
active steering headlights

 mostly safety  
 mostly convenience or ride quality  
 mostly pollution control or better mileage

For a much more extensive list of car changes over the years see <http://www.carhistory4u.com/the-last-100-years>

# Major auto improvements that are available now

## *Safety related*

- Forward collision warning and auto-braking
- Rear view cameras
- Lane departure warning and prevention
- Blind spot detection 
- Adaptive headlights
- Rear cross traffic alert
- Drowsiness alert

For a series of short videos that explains most of these see:

<https://www.cartelligent.com/blog/should-your-next-car-have-crash-prevention-system>

This is ~ 3:00 min long plus a 2:00 min video on crash prevention ratings

## *More convenience related*

- Hands off parallel parking
- Dynamic cruise control
- GPS navigation (e.g., show the route to the closest ☆☆☆☆☆ Italian restaurant)
- Improved alarms and stolen car recovery systems
- Bluetooth connectivity
- Hands off cell phones
- “keyless” door unlock and push button start
- Power rear lift gate
- Auto headlights on/off & auto high beam adjustment & auto dimming rear view mirrors
- **OVERKILL SOUND SYSTEMS**



# Gary Patrick's 2015 Subaru Sedan

## EyeSight Functions

EyeSight includes the following functions.

### ■ Pre-Collision Braking System

This function uses a following distance warning feature to warn the driver to take evasive action when there is the possibility of a collision with a vehicle or obstacle in front of the driver's vehicle. If the driver still does not take evasive action, the brakes are quickly applied automatically just before the collision in order to reduce the collision damage or, if possible, prevent the collision.

⇒ Refer to page 20.

### ■ Adaptive Cruise Control

This function maintains the set vehicle speed and when there is a vehicle in front in the same traffic lane, it tracks the speed of the vehicle in front up to the maximum of the set vehicle speed.

⇒ Refer to page 32.

### ■ Pre-Collision Throttle Management

This function reduces accidental forward movement caused by the selector lever being placed in the wrong position or the accelerator pedal being accidentally depressed, or depressed too strongly.

⇒ Refer to page 54.

### ■ Lane Departure Warning

This function warns the driver when the vehicle is about to depart the traffic lane during driving.

⇒ Refer to page 60.

### ■ Lane Sway Warning

This system detects vehicle drifting caused by driver fatigue, failure to concentrate on the road, inattention, strong crosswinds or other factors, and warns the driver.

⇒ Refer to page 63.

### ■ Lead Vehicle Start Alert

This function notifies the driver when the vehicle in front has started moving but the driver's vehicle has not.

⇒ Refer to page 66.



# Recent, Present and Future Technologies

## Exhibit 2

Adoption of safety-related technology has grown dramatically, addressing more types of vehicle crashes.

## Self-Driving Cars: The Future of Automobiles

October 21, 2013 Zachary Barrett Tech Add comment

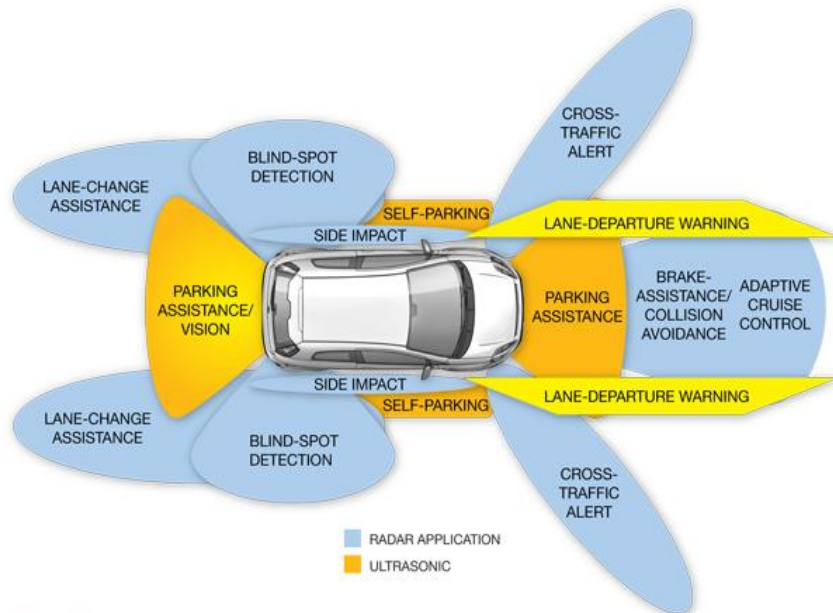


Figure 2 Several driver-assistance systems are currently using radar technology to provide blind-spot detection, parking assistance, collision avoidance, and other driver aids (courtesy Analog Devices).

■ Collision-avoidance safety technologies relevant to crash type

Vehicle crash type	From 1971 to 2013											Today		Future			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Off roadway	■	■		■			■			■	■		■	■	■	■	■
Rear end	■		■		■	■							■	■	■	■	■
Lane change							■		■		■		■	■	■	■	■
Opposite direction							■		■	■			■	■	■	■	■
Bicyclist												■	■		■	■	■
Crossing paths													■	■		■	■
Pedestrian								■					■		■	■	■
Animal	■													■	■		■
Backing								■								■	■
Other																■	■

- A. Antilock brakes
- B. Traction control
- C. 3rd brake light
- D. Electronic stability control
- E. Forward collision warning
- F. Adaptive cruise control
- G. Lane-departure warning
- H. Park assist and back-over prevention
- I. Adaptive headlights
- J. Lane-departure prevention
- K. Blind-spot detection
- L. Forward-collision avoidance
- M. Fatigue warning
- N. Evasive maneuvers
- O. Exit-to-exit highway driving<sup>1</sup> Vehicle-to-vehicle (V2V)
- P. communication
- Q. Vehicle-to-infrastructure (V2I)<sup>2</sup> communication

<sup>1</sup>Systems programmed to make smart decisions about navigating interstate on- and off-ramps.

<sup>2</sup>For example, communication between vehicle and traffic light.

Source: McKinsey analysis

# Automatic braking demos

- Mercedes Truck (2:18)
  - <https://www.youtube.com/watch?v=1Db5JpglbKw>
- NHTSA --National Highway Traffic Safety Administration (1:25)
  - <https://www.youtube.com/watch?v=Src2jhS4wcA>
- Mercedes Auto during development (30 sec)
  - [https://www.youtube.com/watch?v=\\_8nnhUCtcO8&oref=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D\\_8nnhUCtcO8&has\\_verified=1](https://www.youtube.com/watch?v=_8nnhUCtcO8&oref=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D_8nnhUCtcO8&has_verified=1)
- Volvo S60 Pedestrian Detection System Test  
(2:34 but can show less)
  - <https://www.youtube.com/watch?v=w2pwxv8rFkU>

# Electric Cars

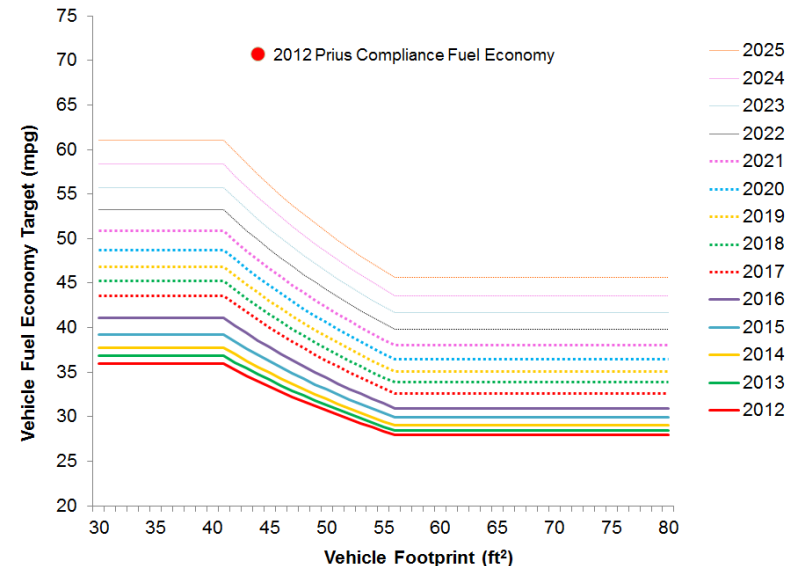
Three types of electric cars:

- **Hybrid**
  - A car, truck, SUV, or other type of vehicle that is propelled by more than one power source mated together to work in conjunction. Generally uses a gasoline engine and regenerative braking to store energy in a battery that is used by an electric motor. (Prius is now about 15 years old.)
- **Plug-in Hybrid**
  - A plug-in hybrid electric vehicle (PHEV), plug-in hybrid vehicle (PHV), or plug-in hybrid is a hybrid electric vehicle that utilizes rechargeable batteries, or another energy storage device, that can be restored to full charge by connecting a plug to an external electric power source (usually a normal electric wall socket).
- **Battery Electric Car (or Fuel Cell Powered)**
  - A battery electric vehicle (BEV) is a type of electric vehicle (EV) that uses chemical energy stored in rechargeable battery packs. BEVs use electric motors and motor controllers instead of internal combustion engines (ICEs) for propulsion. It does not have a second means of propulsion. Fuel cell cars are similar to BEV but use high pressure hydrogen to make electricity.

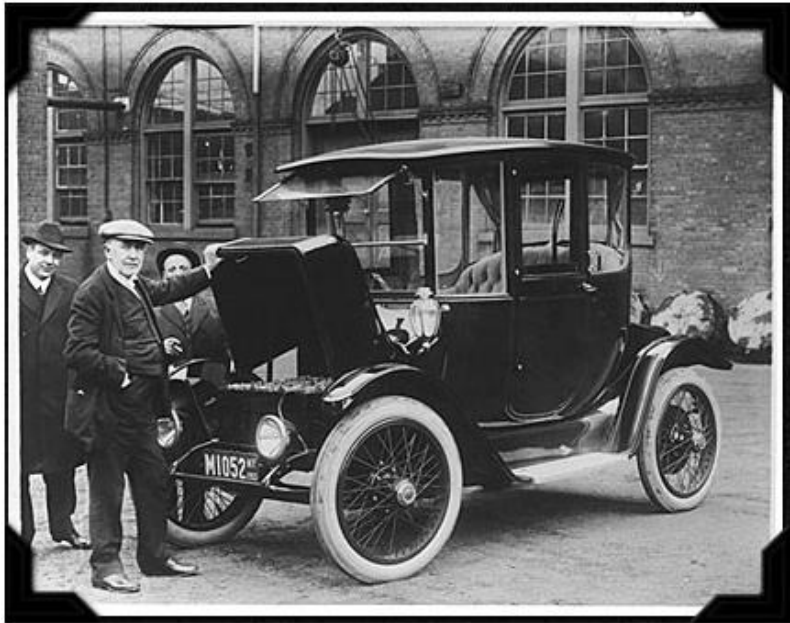
# PHEV – Plug-in Hybrid Electric Vehicles

- There are about a dozen PHEVs for sale in the US today and they are becoming more popular  
<http://www.fueleconomy.gov/feg/PowerSearch.do?action=alts&year1=2015&year2=2016&vtype=Plug-in+Hybrid&srchtyp=newAfv>
- Petrol-Powered cars could be banned from European cities by 2050 – so there could be a massive change over to PHEV and EV in the future with diesel cars banned in some major cities by 2020
- The US CAFE standards now mandates an average of about 29 miles per gallon, with gradual increases to 35.5 m.p.g. by 2016 and an average fuel economy of 54.5 miles per gallon for the 2025 model year.

2015 Volkswagen e-Golf Automatic (A1), Electricity							
Compare		kW-hrs/100 mi			171.5 Show Details	\$550 per year	
		27 City	29 Combined MPGe	32 Highway			
		126 City	116 Combined	105 Highway			
MSRP: \$33,450 - \$35,445							
2015 Toyota Prius Plug-in Hybrid 1.8 L, 4 cyl, Automatic (variable gear ratios), Gas and Electricity							
Compare		95 Combined (MPGe)			Not Available	\$650 per year	
		.2 gal/100 mi of gas plus 29 kW-hrs/100 mi					
		Elec + Gas					
Gas Only	51 City	50 Combined	49 Highway				



# Electric Cars



Formula E race car; circuit races started in 2014  
[https://en.wikipedia.org/wiki/Formula\\_E](https://en.wikipedia.org/wiki/Formula_E)

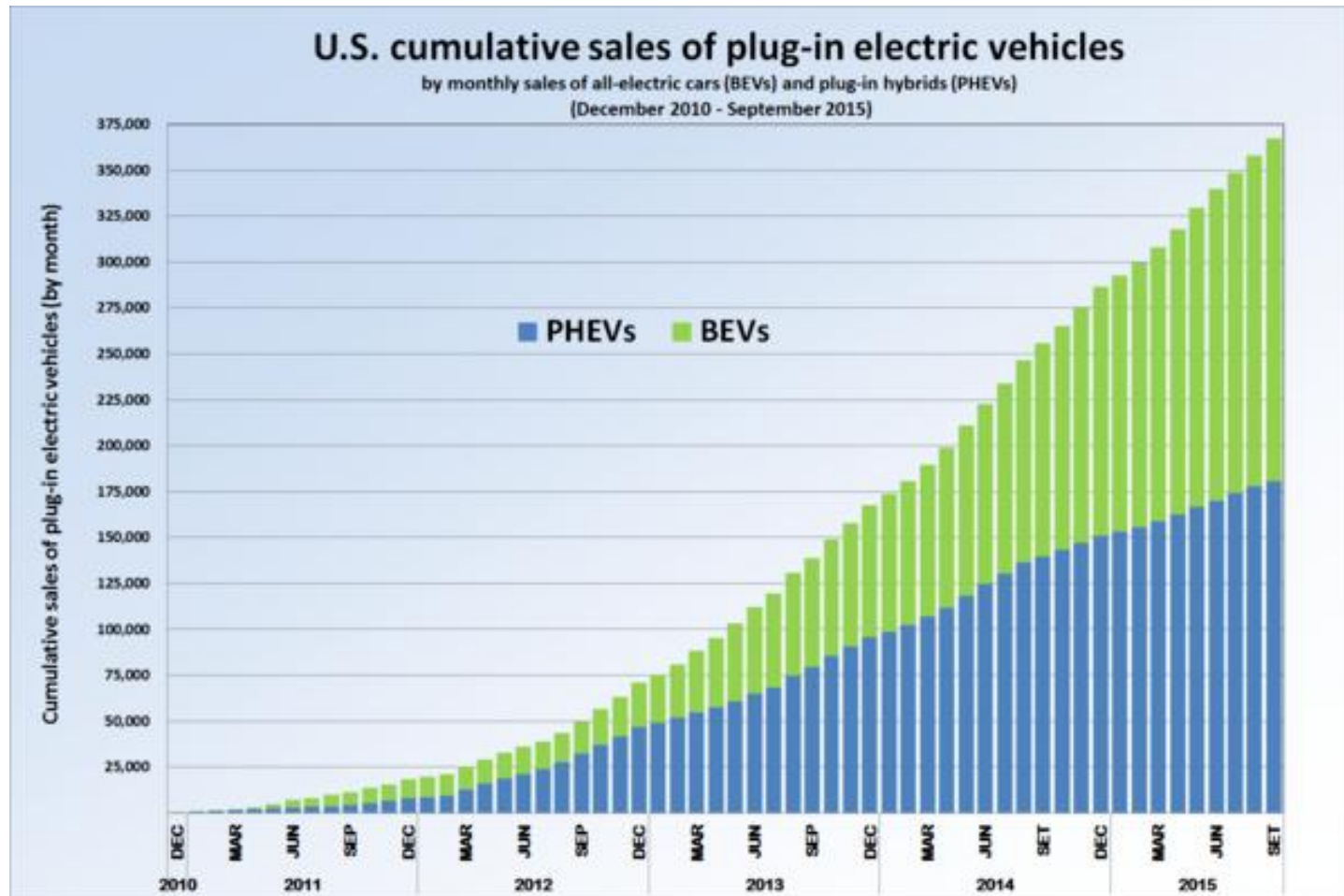
For more BEVs, including PHEVs, see: <http://www.plugincars.com/cars>

# Haven't talked about

- Fuel cell cars – similar to battery electric cars with better range – it's in a race with bigger better batteries.
  - This is from a 2006 TED talk, and he's promoting a fuel cell platform.  
[https://www.ted.com/talks/reinventing\\_the\\_car](https://www.ted.com/talks/reinventing_the_car) (9 min)
  - NYT article (April 2015), several manufactures are investigating Hydrogen Fuel Cell cars and you can lease one from Hyundai in California.  
<http://www.nytimes.com/2015/04/17/automobiles/hydrogen-fuel-cell-cars-return-for-another-run.html>
- Natural gas cars
  - Some companies with fleets of cars or light trucks use natural gas
  - You can buy a Honda Civic natural gas car <http://automobiles.honda.com/civic-natural-gas/>
- Flex fuel vehicles – e.g., cooking oil
  - Some of this is for hobbyists but there are also some small fleets that use it
  - <https://www.youtube.com/watch?v=EYzJFQ6UXiA> (1:40)

# Sales PHEV & BEV cars

PHEV & BEV are catching on to the tune of about 170,000 vehicles/yr vs. all autos, SUVs and light trucks in U.S. at about 16 million in 2014



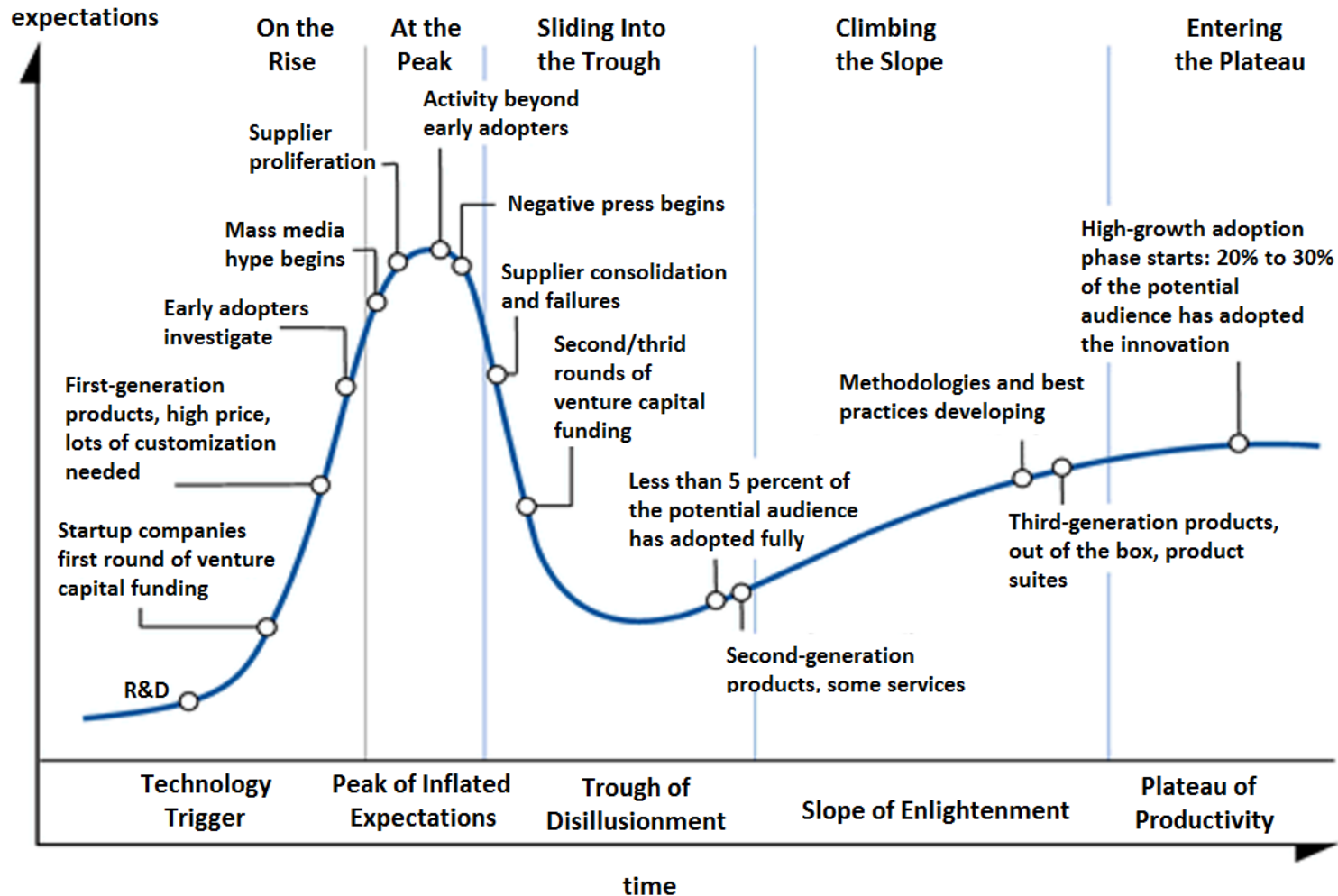
Note that the three top selling vehicles in the U.S. are all trucks.



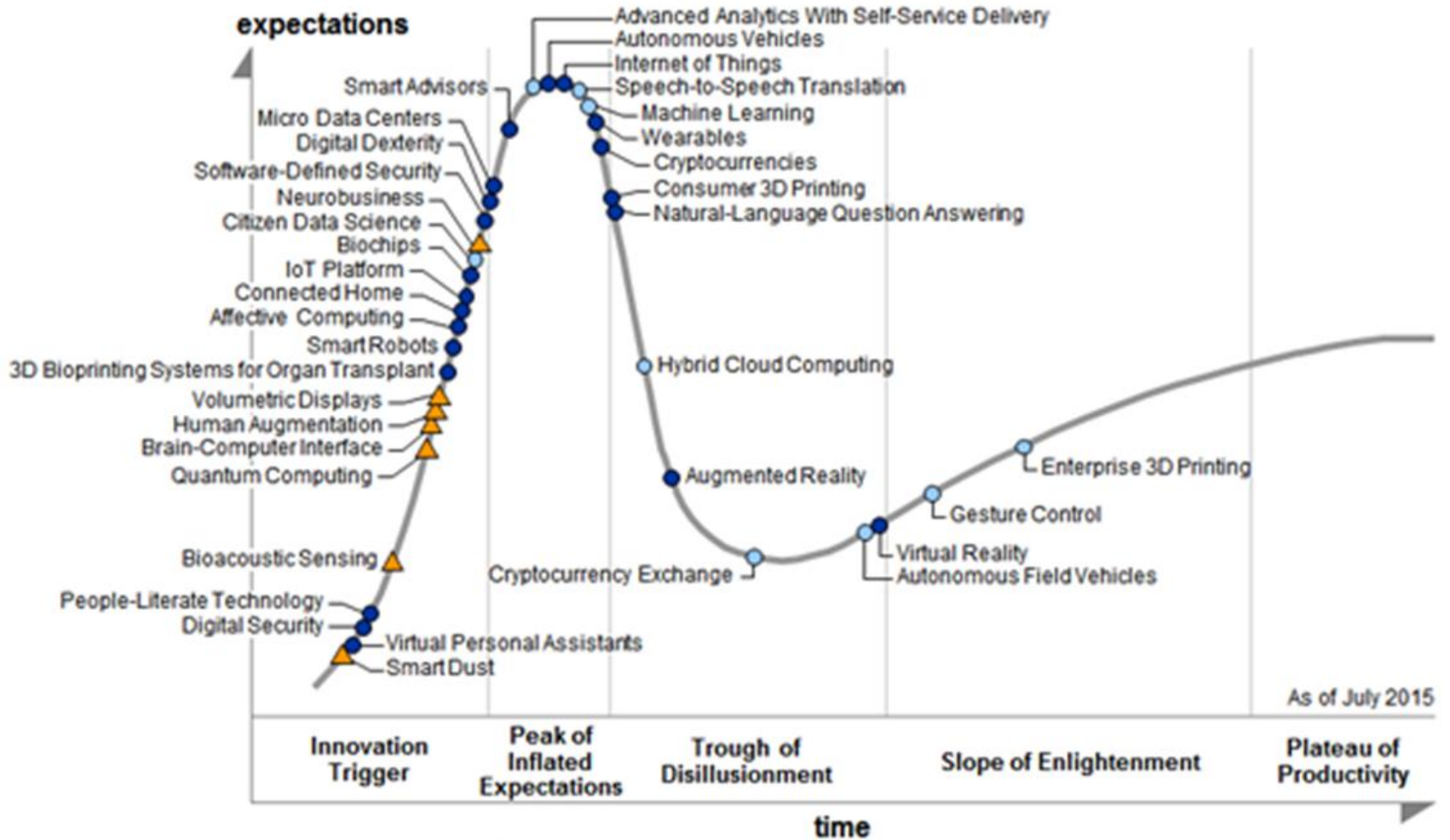
# Driverless Cars

Where are they in there development cycle?

Gartner hype-cycle for new products



# Hype cycle – note location of autonomous vehicles



# A brief history driverless car

- Pre DARPA a few universities (like CM) dabbled in driverless cars
- DARPA (Defense Advanced Research Projects Agency) Grand Challenge
  - [https://www.google.com/search?q=DARPA+Grand+Challenge&es\\_sm=122&source=lnms&tbm=isch&sa=X&ved=0CAkQ\\_AUoA2oVChMlopaz8\\_CpyAIVAzM-Ch0MLAGM&biw=1440&bih=726](https://www.google.com/search?q=DARPA+Grand+Challenge&es_sm=122&source=lnms&tbm=isch&sa=X&ved=0CAkQ_AUoA2oVChMlopaz8_CpyAIVAzM-Ch0MLAGM&biw=1440&bih=726)  
(Pictures of vehicles)
  - <https://www.youtube.com/watch?v=IPG0hzoKIto> (6 min desert race)
  - <https://www.youtube.com/watch?v=PONTV2mbJhA> (2007, 6 min, Urban, 11 cars)
- Google et. al.
  - A lot of the students that did the DARPA challenge went to Google or mainline auto manufactures to work on driverless cars
- Mercedes on 60 Minutes & Google (video is **13 minutes**)
  - <http://www.cbsnews.com/news/inside-the-self-driving-car-of-the-future/>
- Audi racing car (**3:45 min**)
  - <https://www.youtube.com/watch?v=VHmjfl4Otiw>

# Complications with Driver-Less Cars in Accidents

## Who's at fault in the case of an accident

- Sensor provider
- Dirty or damaged sensors
- Software code writers
- System testers
- What if traffic signals, signs or painted lines are not maintained
- Unforeseen combination of events (multi car accidents) some with “smarts” and others without

## Need to communicate to others

- Pedestrians – will the car know when to honk?
- Blind pedestrians (electric cars are quiet at low speed)
- Other cars (car-to-car)
- Other cars (occupant-to-occupant)
- Bicyclists (some of who are scofflaws)
- Traffic cops, crossing guards

# Pluses of autonomous cars

From Wikipedia's list: [https://en.wikipedia.org/wiki/Autonomous\\_car](https://en.wikipedia.org/wiki/Autonomous_car)

- Avoid traffic collisions caused by human driver errors
- Increased roadway capacity and reduced traffic congestion
- Relief of vehicle occupants from driving and navigation chores
- Higher speed limit for autonomous cars.
- Removal of constraints on occupants' state – in an autonomous car, it would not matter if the occupants were under age, over age, unlicensed, blind, distracted, intoxicated, or otherwise impaired.
- Reduction of physical space required for vehicle parking, and vehicles will be able to drive where space is not scarce.
- Reduction of physical road signage – autonomous
- Reduction in the need for traffic police
- Cars could receive necessary communication electronically (although physical signs may still be required for any human drivers).
- Smoother ride.
- Reduction in car theft, due to the vehicle's increased awareness.
- Increased cabin space and flexibility of use due to removal of the steering wheel and remaining driver
- Interface where no occupant needs to sit in a forward facing position.
- Increased ease-of-use of large vehicles such as motorhomes
- **Police could disable a car if the driver doesn't obey their commands**

# Potential obstacles of autonomous cars

From Wikipedia's list: [https://en.wikipedia.org/wiki/Autonomous\\_car](https://en.wikipedia.org/wiki/Autonomous_car)

- Liability for damage. Where does the liability lie.
- Resistance by individuals to forfeit control of their cars.
- Software reliability.
- A car's computer could potentially be compromised, as could a communication system between cars.
- Implementation of legal framework and establishment of government regulations for self-driving cars.
- Drivers being inexperienced if situations arose requiring manual driving.
- Loss of driving-related jobs
- Must work with human driven cars for many years to come (forever?)
- Self-driving cars could potentially be loaded with explosives and used as bombs
- Ethical problems analogous to the **trolley problem** arise in situations where an autonomous car's software is forced during an unavoidable crash to choose between multiple harmful courses of action
- Susceptibility of the car's navigation system to different types of weather. (As of 2014 Google's prototype has not driven in snow or heavy rain.)
- Current police and other pedestrian gestures and non-verbal cues are not adapted to autonomous driving.
- **Loss of privacy due to GPS tracking – it knows where you have been and if you were speeding**

# Unforeseen consequences of substantially safer cars (and driverless cars) all obeying the traffic laws better

- Less revenue from traffic tickets – or what if they issue tickets based on interrogating the cars? On 11/12/15 a Mountain View CA cop pulled over a Google driverless car for going too slow, and didn't have anyone to give a ticket to. <http://www.cnn.com/2015/11/13/us/google-self-driving-car-pulled-over/>
- Changes in insurance payments – who's at fault
- Fewer organs for transplants <http://www.boston.com/cars/news-and-reviews/2015/01/23/what-driverless-cars-have-with-organ-donors/nhSxw0YRrCOXiNUjUuXwNP/story.html>
- Could lead to a large reduction in driver-related jobs
- For electric cars:
  - Closing a large portion of the gasoline supply and delivery infrastructure
  - Reduction of a good portion of the auto repair infrastructure
  - Starting a new large infrastructure of electric charging stations
- New layers of infrastructure
  - Driverless cars could park in a garage with twice the density
  - Highways could have optimum fast lanes with closely spaced cars – like little trains of cars drafting each other

# How safe is all this software?

- With so many lines of code what could go wrong ?
  - Will you need Ad-Block Plus for your car?
  - The “blue screen of death” could actually result in real deaths
  - What about hackers ?
    - Kim Komando article: <http://www.komando.com/happening-now/329328/unhackable-car-security-system-takes-just-half-an-hour-to-crack> re breaking in and stealing your car
    - NYT article -- Complex Car Software Becomes the Weak Spot Under the Hood (15 Sept '15), David Hathaway pointed this out: [http://www.nytimes.com/2015/09/27/business/complex-car-software-becomes-the-weak-spot-under-the-hood.html?\\_r=1](http://www.nytimes.com/2015/09/27/business/complex-car-software-becomes-the-weak-spot-under-the-hood.html?_r=1)
    - See video starting at 10 min to 13:37 [https://www.youtube.com/watch?v=A4itwQ0bb\\_U](https://www.youtube.com/watch?v=A4itwQ0bb_U)
- This is not very encouraging.

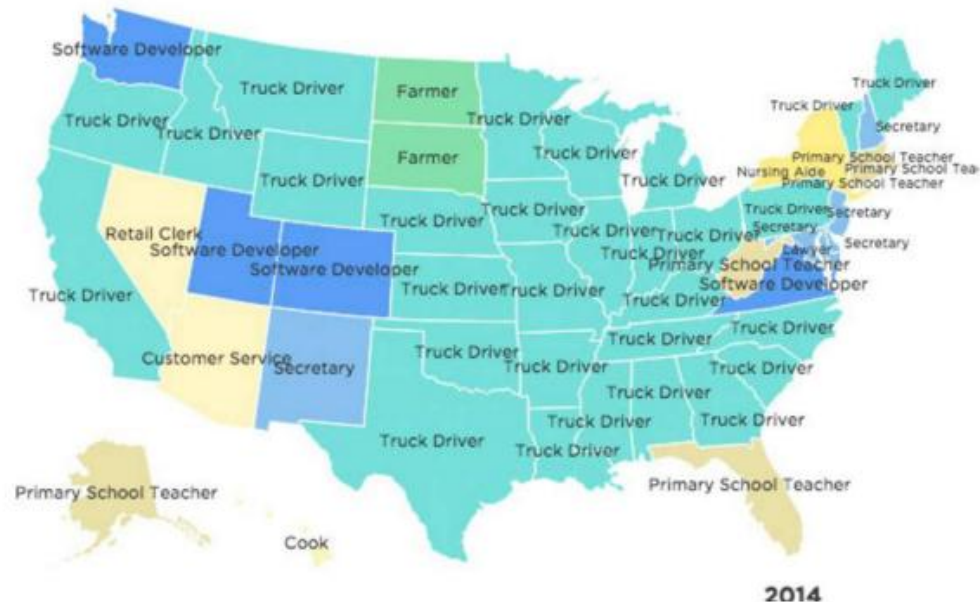


# What about driverless trucks?

- Load your truck in Boston and send it to Chicago on its own
- There are 8.7 million trucking-related jobs in the USA
- Driverless trucks could be a major disruption of the economy
- Long haul truck drivers earn \$40K (average) to \$71.5K (Walmart) per year
- A driverless truck could operate 24 hrs. a day without breaks (with but brakes)
- Mercedes driverless truck: <https://www.youtube.com/watch?v=7bFc0rBoFY8> (2:40 min)

Truck driving is the number one occupation in the vast majority of states.

The Most Common\* Job In Each State 1978-2014



# Many experts believe Tesla Model S is the best car ever made

- Tesla (Model S P85D) overview (6 min)
  - <https://www.youtube.com/watch?v=XrzGMjuE2vI>
  - <http://www.treehugger.com/cars/tesla-model-s-loses-recommended-seal-consumer-reports-because-reliability-issues.html>
- Other things on same video
  - Adaptive headlights (6:30 to 9:00)
  - Hacking potential (10:00 to 13:00)
  - Reasons for buying a new car (17:20 to 20:00)
- In case you think electric cars are like golf carts, here's a drag race between a \$100K Tesla (Model S P85D) at 4800 lbs. and a \$400K Lamborghini Aventador with 700 HP at 3500 lbs.

See: <https://www.youtube.com/watch?v=0e-jquwHKtI>



# Mercedes F015

Powered by Hydrogen fuel cells and batteries with a 600 mi range

See (from 1:00 to ~6:45) for F015 stuff

<https://www.youtube.com/watch?v=PI0hdVMOWqs>

Also see (from 7:20 to 10:20) for more info on these items:

- Rear view cameras
- Cross traffic alert
- Adaptive cruise control
- Forward collision control
- Blind spot warning
- Lane departure control
- Adaptive Headlights
- Auto high beam dimming
- Objective detection
- Drowsiness warning



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Most of these items are available on many cars today , at least if you buy a higher trim levels.



# Flying Cars



Terrafugia  
Woburn, MA  
~ \$300K

Moller Skycar  
worked on for  
50+ years but  
never got FAA  
approval



Video of three existing Flying Cars (4:35 min):  
<https://www.youtube.com/watch?v=7-1pXbW5wVg>

Extra Stuff

# Insurance Institute for Highway Safety **TOP SAFETY PICKs**

**TSP+** indicates a **TOP SAFETY PICK+** winner

**TSP** indicates a **TOP SAFETY PICK** winner

## Minicars

- TSP** 2015 Chevrolet Spark
- TSP** 2015 Honda Fit
- TSP+** 2016 Scion iA
- TSP** 2015 Toyota Prius c  
Applies only to vehicles built after May 2015.

## Small cars

- TSP+** 2016 Acura ILX  
with optional front crash prevention
- TSP** 2015 Chevrolet Sonic  
Applies only to vehicles built after February 2015.
- TSP** 2015 Chevrolet Volt
- TSP** 2015 Dodge Dart
- TSP** 2015 Ford C-Max Hybrid
- TSP** 2015 Ford Focus
- TSP** 2015 Honda Civic 2-door coupe
- TSP** 2015 Honda Civic 4-door sedan
- TSP** 2015 Hyundai Elantra  
Applies only to sedan models.
- TSP** 2015 Kia Soul

- TSP+** 2015 Lexus CT 200h  
with optional front crash prevention  
Applies only to vehicles built after September 2014.
- TSP+** 2015 Mazda 3  
with optional front crash prevention  
4-door hatchback | 4-door sedan
- TSP** 2015 Mini Cooper Countryman
- TSP** 2015 Mitsubishi Lancer  
Does not apply to Ralliart and Evolution models.
- TSP** 2015 Nissan Sentra
- TSP** 2015 Scion FR-S
- TSP** 2015 Scion tC
- TSP** 2015 Subaru BRZ
- TSP+** 2015 Subaru Impreza  
with optional front crash prevention
- TSP+** 2016 Subaru WRX 4-door sedan  
with optional front crash prevention
- TSP** 2015 Subaru WRX 4-door sedan
- TSP+** 2015 Subaru XV Crosstrek  
with optional front crash prevention
- TSP+** 2015 Toyota Prius  
with optional front crash prevention

- TSP+** 2016 Volkswagen Golf 4-door hatchback  
with optional front crash prevention  
Applies only to 4-door and SportWagen models.
- TSP** 2015 Volkswagen Golf 4-door hatchback  
Applies only to 4-door and SportWagen models.
- TSP+** 2016 Volkswagen GTI 4-door hatchback  
with optional front crash prevention  
Applies only to 4-door models.
- TSP** 2015 Volkswagen GTI 4-door hatchback  
Applies only to 4-door models.

## Midsize moderately priced cars

- TSP** 2015 Chevrolet Malibu
- TSP+** 2015 Chrysler 200  
with optional front crash prevention
- TSP** 2015 Ford Fusion
- TSP+** 2016 Honda Accord 2-door coupe  
with optional front crash prevention
- TSP** 2015 Honda Accord 2-door coupe
- TSP+** 2015 Toyota Camry  
with optional front crash prevention
- TSP+** 2015 Toyota Prius v  
with optional front crash prevention
- TSP+** 2016 Volkswagen Jetta 4-door sedan  
with optional front crash prevention
- TSP** 2015 Volkswagen Jetta 4-door sedan
- TSP** 2015 Volkswagen Passat

- TSP** 2015 Honda Accord 4-door sedan

- TSP+** 2016 Hyundai Sonata 4-door sedan  
with optional front crash prevention

- TSP** 2015 Hyundai Sonata 4-door sedan

- TSP** 2015 Kia Optima

- TSP+** 2015-16 Mazda 6  
with optional front crash prevention  
2016 | 2015

- TSP** 2015 Nissan Altima

- TSP+** 2015 Subaru Legacy  
with optional front crash prevention

- TSP+** 2015 Subaru Outback  
with optional front crash prevention

- TSP+** 2015 Toyota Camry  
with optional front crash prevention

- TSP+** 2015 Toyota Prius v  
with optional front crash prevention

- TSP+** 2016 Volkswagen Jetta 4-door sedan  
with optional front crash prevention

- TSP** 2015 Volkswagen Jetta 4-door sedan

- TSP** 2015 Volkswagen Passat

# Insurance Institute for Highway Safety **TOP SAFETY PICKs**

**TSP+** indicates a **TOP SAFETY PICK+** winner

**TSP** indicates a **TOP SAFETY PICK** winner

## Midsize luxury/near luxury cars

**TSP+** 2015 Acura TLX  
with optional front crash prevention

**TSP+** 2015 Audi A3  
with optional front crash prevention

**TSP+** 2015 BMW 2 series  
with optional front crash prevention

**TSP+** 2015 Infiniti Q50  
with optional front crash prevention

**TSP+** 2016 Lexus ES 350  
with optional front crash prevention

**TSP** 2015 Lincoln MKZ

**TSP+** 2015 Volvo S60

**TSP+** 2015 Volvo V60

## Large family cars

**TSP** 2015 Toyota Avalon

## Large luxury cars

**TSP+** 2015-16 Acura RLX  
with optional front crash prevention (2015 models); standard on 2016 models  
2016 | 2015

**TSP+** 2016 Audi A6  
with optional front crash prevention  
Applies only to vehicles built after January 2015.

**TSP+** 2015 Hyundai Genesis  
with optional front crash prevention

**TSP+** 2015 Infiniti Q70  
with optional front crash prevention  
Does not apply to V8 4-wheel-drive models.

**TSP+** 2015 Lexus RC  
with optional front crash prevention

**TSP+** 2015 Mercedes E class

**TSP+** 2015 Volvo S80

## Small SUVs

**TSP** 2016 Audi Q3

**TSP** 2015 Buick Encore

**TSP** 2015 Chevrolet Trax

**TSP+** 2016 Fiat 500X  
with optional front crash prevention  
Applies only to vehicles built after July 2015.

**TSP+** 2015 Honda CR-V  
with optional front crash prevention

**TSP+** 2016 Hyundai Tucson  
with optional front crash prevention

**TSP+** 2015-16 Mazda CX-5  
with optional front crash prevention  
2016 | 2015

**TSP+** 2015 Mitsubishi Outlander  
with optional front crash prevention

**TSP** 2015 Nissan Rogue

**TSP+** 2015 Subaru Forester  
with optional front crash prevention

**TSP** 2015 Toyota RAV4  
Applies only to vehicles built after November 2014.

## Midsize SUVs

**TSP** 2015 Chevrolet Equinox

**TSP** 2015 Ford Edge  
Applies only to vehicles built after May 2015.

**TSP** 2015 Ford Flex

**TSP** 2015 GMC Terrain

**TSP+** 2016 Honda Pilot  
with optional front crash prevention

**TSP** 2016 Kia Sorento

**TSP+** 2015 Nissan Murano  
with optional front crash prevention

**TSP** 2015 Nissan Pathfinder

**TSP+** 2015 Toyota Highlander  
with optional front crash prevention

## Midsize luxury SUVs

**TSP+** 2015-16 Acura MDX  
with optional front crash prevention  
2016 | 2015

**TSP+** 2016 Acura RDX  
with optional front crash prevention

**TSP+** 2015 Audi Q5  
with optional front crash prevention  
Applies only to vehicles built after January 2015.

**TSP** 2015 Infiniti QX60

**TSP+** 2015 Lexus NX  
with optional front crash prevention

**TSP+** 2015 Mercedes M class  
with optional front crash prevention

**TSP+** 2015 Volvo XC60

**TSP+** 2016 Volvo XC90

## Minivans

**TSP** 2015 Honda Odyssey

**TSP** 2015 Kia Sedona

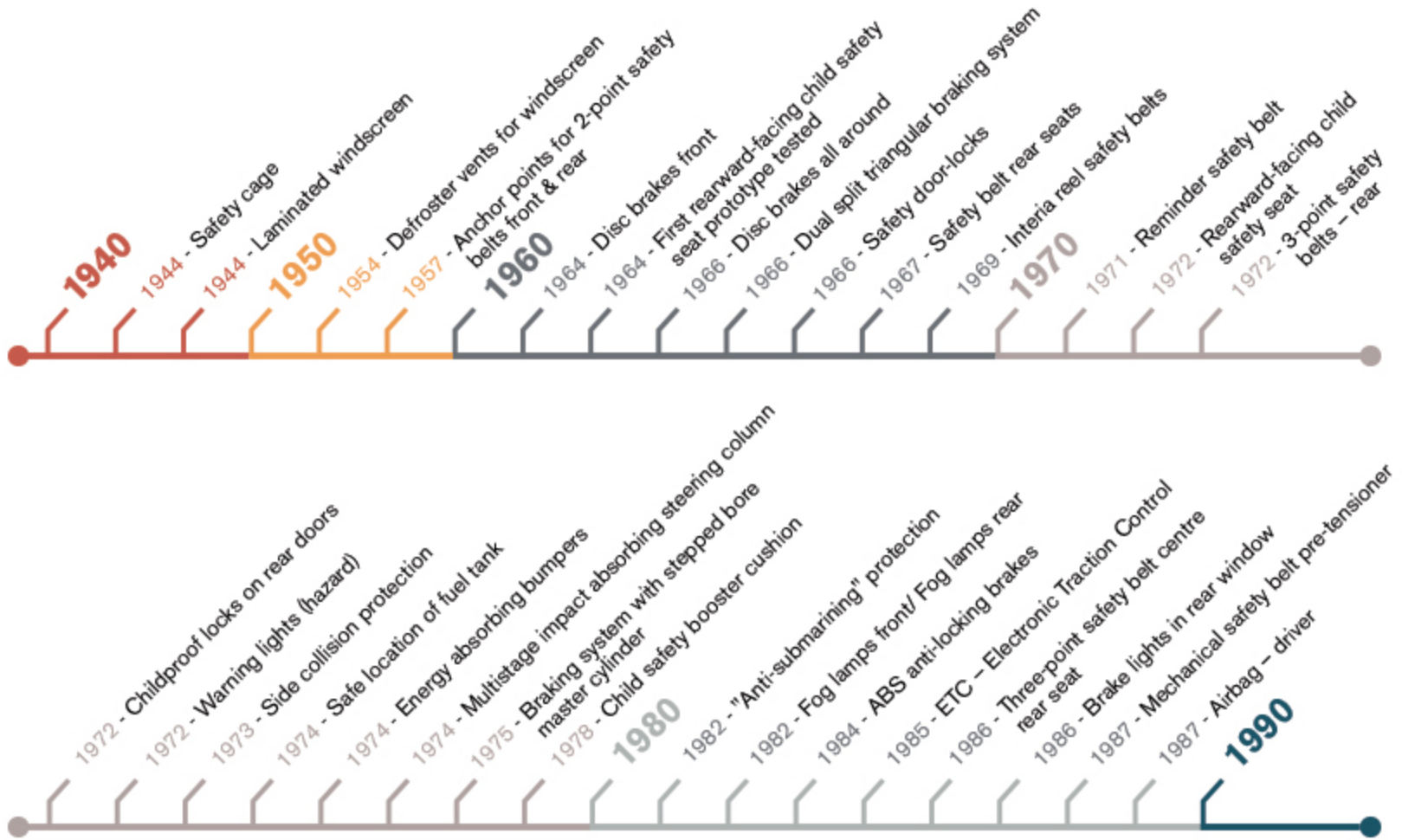
**TSP+** 2015 Toyota Sienna  
with optional front crash prevention

## Large pickups

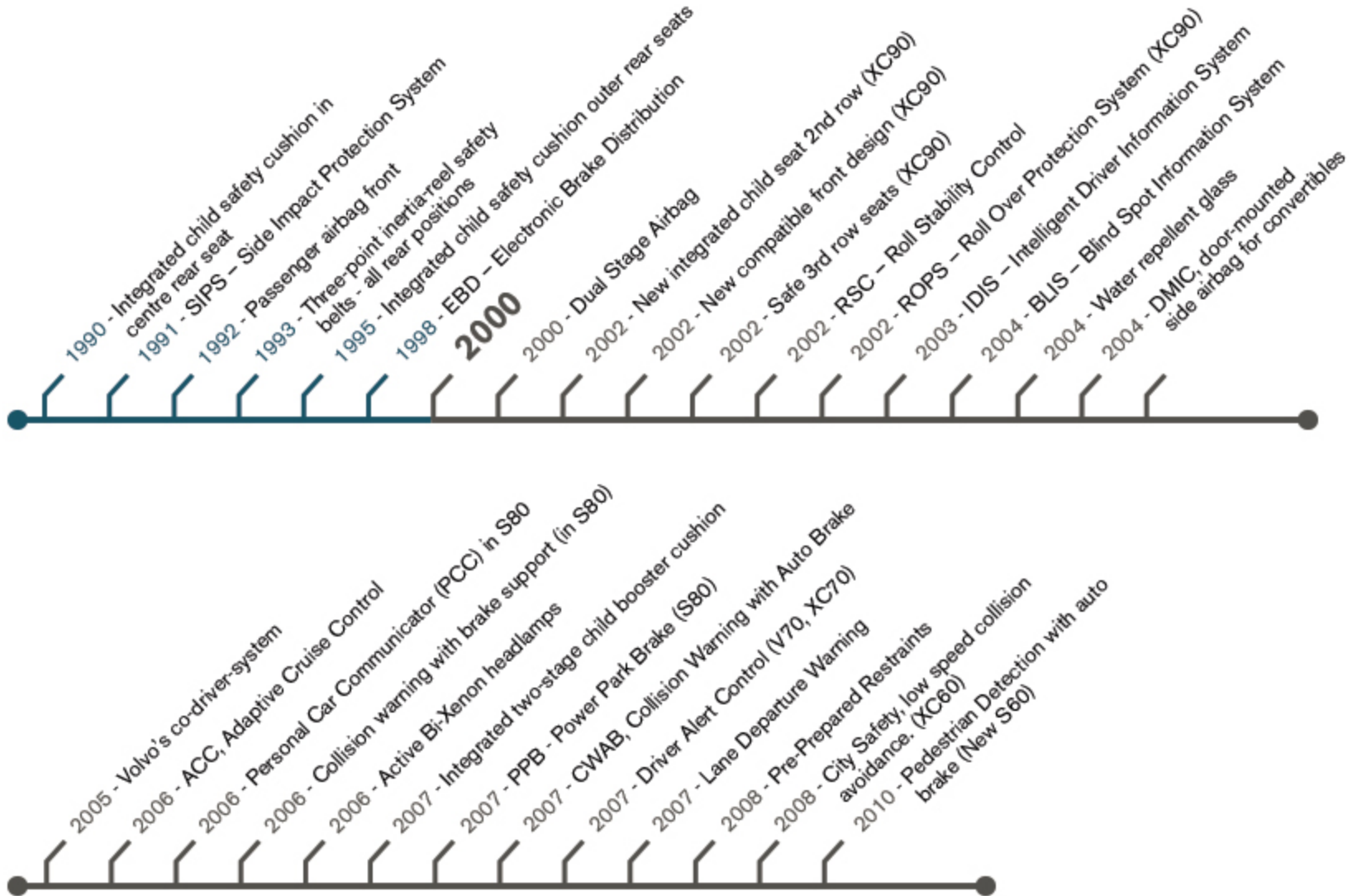
**TSP** 2015 Ford F-150  
Applies only to SuperCrew models.



# Auto safety innovations by year (Part 1)



# Auto safety innovations by year (Part 2)



# More detailed cause of death breakdown by the Insurance Information Institute

## DRIVING BEHAVIORS REPORTED FOR DRIVERS AND MOTORCYCLE OPERATORS INVOLVED IN FATAL CRASHES, 2013

Behavior	Number	Percent
Driving too fast for conditions or in excess of posted speed limit or racing	8,864	19.9%
Under the influence of alcohol, drugs or medication	6,005	13.5
Failure to keep in proper lane	3,720	8.3
Failure to yield right of way	3,149	7.1
Distracted (phone, talking, eating, etc.)	2,959	6.6
Operating vehicle in a careless manner	2,116	4.7
Overcorrecting/oversteering	1,990	4.5
Failure to obey traffic signs, signals or officer	1,780	4.0
Swerving or avoiding due to wind, slippery surface, other vehicle, object, nonmotorist in roadway, etc.	1,628	3.7
Operating vehicle in erratic, reckless, or negligent manner	1,511	3.4
Vision obscured (rain, snow, glare, lights, buildings, trees, etc.)	1,493	3.3
Drowsy, asleep, fatigued, ill, or blacked out	1,231	2.8
Driving wrong way in one-way traffic or on wrong side of road	858	1.9
Making improper turn	689	1.5
Other factors	5,165	11.6
None reported	13,692	30.7
Unknown	5,441	12.2
<b>Total drivers (1)</b>	<b>44,574</b>	<b>100.0%</b>

# Miscellaneous

- List of countries by traffic-related death rate
  - [https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_traffic-related\\_death\\_rate](https://en.wikipedia.org/wiki/List_of_countries_by_traffic-related_death_rate)

Here's the full list of the 15 most-wanted new-car features, noted with the percentage of consumers surveyed that showed interest in them, as determined by AutoPacific's research:

1. Power Driver's Seat: 79%
2. Heated Front Seats: 70%
3. Active Blind-Spot Detection System: 65%
4. Easy-to-Clean Seat & Floor Materials: 64%
5. USB Ports: 64%
6. Built-In Navigation System: 61%
7. Heated Windshield (auto fog prevention): 60%
8. Power Front Passenger Seat: 60%
9. Backup Collision Intervention/Auto Stop: 59%
10. Leather Seats: 58%
11. Side Mirror Turn Signals: 58%
12. Hidden Storage for Computer/Purse: 58%
13. Voice-Activated Controls (phone, audio, climate): 56%
14. Bluetooth Streaming Audio: 56%
15. Push-button Ignition: 55%

# Some TED Talks on Cars

<https://www.ted.com/topics/cars>



*Chris Urmson*  
**How a driverless car sees the road**

Posted Jun 2015



*Jennifer Healey*  
**If cars could talk, accidents might be avoidable**

Posted Apr 2013



*Jonas Eliasson*  
**How to solve traffic jams**

Posted Nov 2012



*Chris Gerdes*  
**The future race car – 150mph, and no driver**

Posted Jul 2012



*Anna Mracek Dietrich*  
**A plane you can drive**

Posted Nov 2011



*Bill Ford*  
**A future beyond traffic gridlock**

Posted Jun 2011



*Robin Chase*  
**The idea behind Zipcar (and what comes next)**

Posted Jan 2008

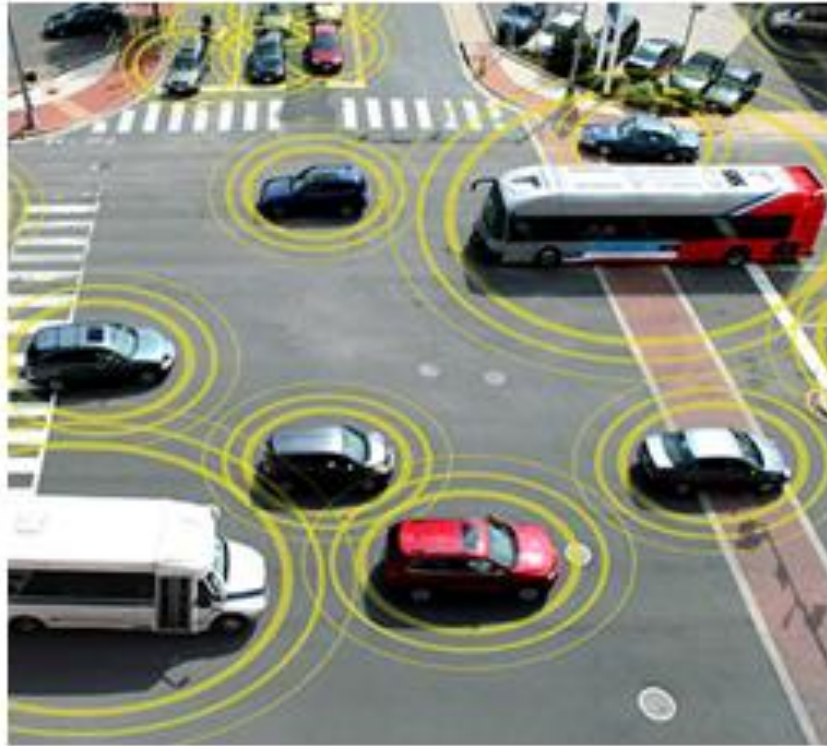


*James Howard Kunstler*  
**The ghastly tragedy of the suburbs**

Posted May 2007

Several of the things he talked about in 2011 have already happened

# Increased road capacity with smart cars



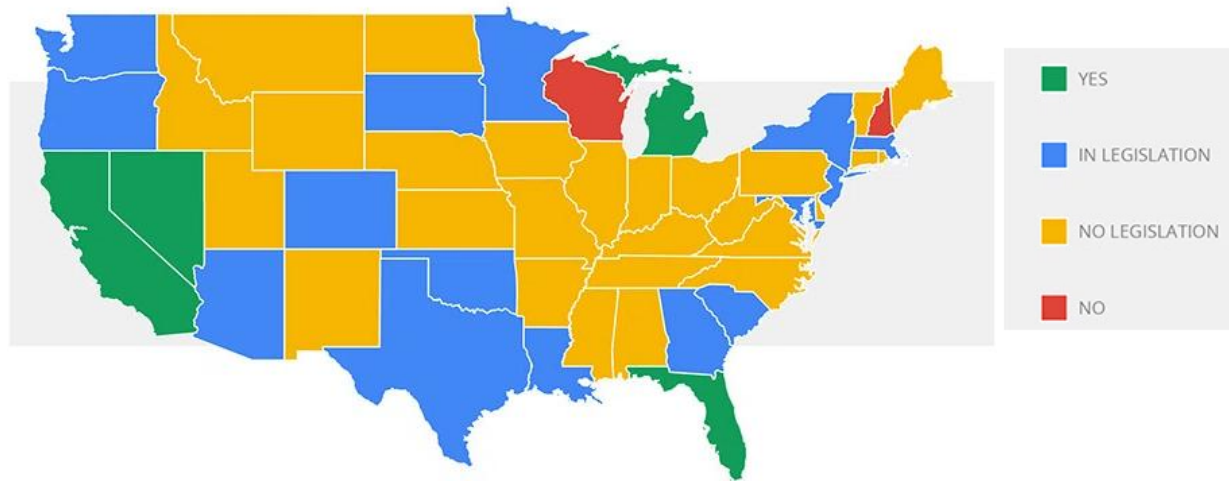
## Study: Intelligent Cars Could Boost Highway Capacity by 273%

Tue, September 04, 2012 IEEE Spectrum *Inside Technology*

*Highway Capacity Benefits from Using Vehicle-to-Vehicle Communication and Sensors for Collision Avoidance*, by Patcharinee Tientrakool, Ya-Chi Ho, and Nicholas F. Maxemchuk from Columbia University, was presented last year at the IEEE Vehicular Technology Conference.

# Driverless Cars Street Legality

- You can not buy a driverless car today
- They are strongly being pursued by Google as well as all major manufactures
- An Audi Q5 with Delphi electronics was the first driverless\* car to cross the U.S. in 9 days in April of 2015
- Self driving cars don't have to be electric cars, but they probably will be
- Driverless cars are presently street legal in four states



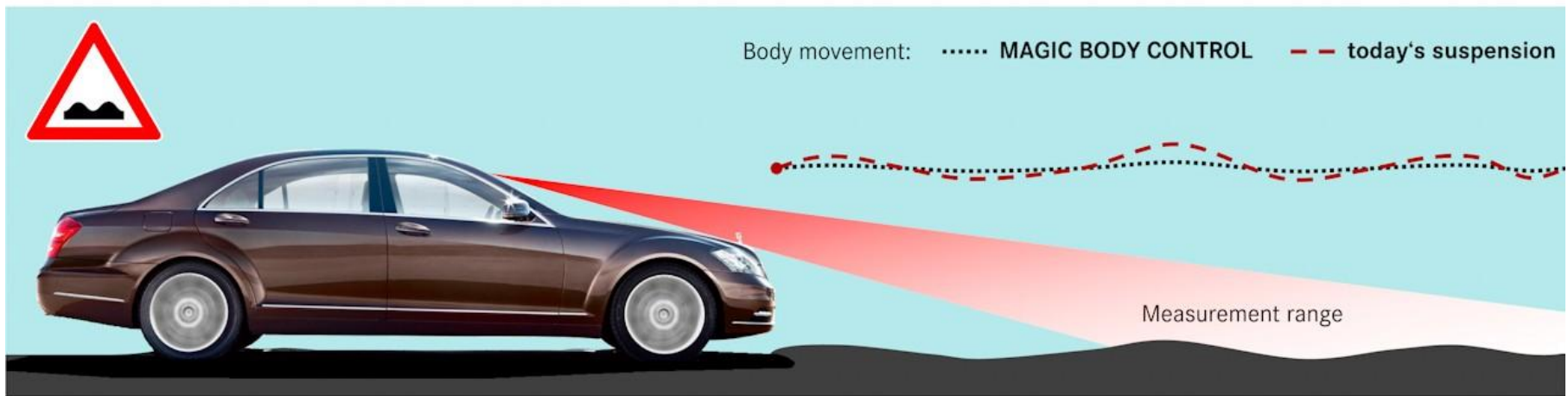
\* There was someone in the driver's seat that could take over if necessary, and there was some learning (i.e., software upgrades) along the way.  
<http://www.nbcnews.com/tech/innovation/driverless-car-completes-cross-country-trip-9-days-n334776>



# Magic Body Control

- <https://www.youtube.com/watch?v=Df2mM5jP1W0> (2 min)
- <https://www.youtube.com/watch?v=8ZLKxoFAsh8> (1:34 min)

## MAGIC BODY CONTROL



The **stereo camera** at the top of the windshield scans the road surface in front of the vehicle precisely and in real time. Therefore the suspension already knows in advance which bumps in the road will act on the vehicle and can control the four spring struts so that body movements are compensated to a large extent.

These forward-active control of the chassis can improve the ride comfort by more than one vehicle class compared to today's production models. Therefore **MAGIC BODY CONTROL** allows a unique synthesis of comfort and agility even on bad roads.

# How to adjust your drivers side rear-view mirror

