Autonomous Vehicles: The Next Disruptive Technology

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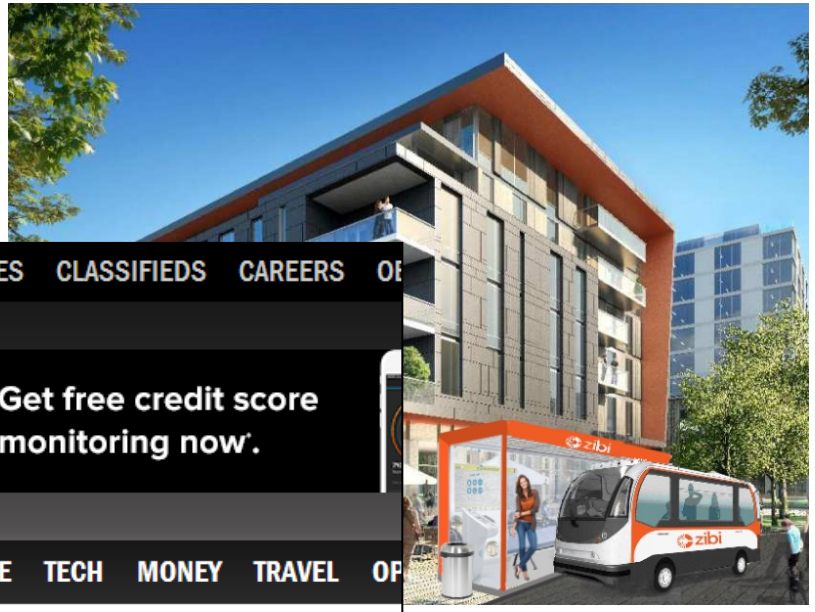
Executive Director, Canadian Automated Vehicles Centre of Excellence
Presentation to Foresight Synergy Network
June 29, 2017

The Conference Board of Canada | Le Conference Board du Canada

Automated Vehicles.

The Coming of the Next Disruptive Technology



DRIVING HOMES CLASSIFIEDS CAREERS OF

TORONTO SUN WEDNESDAY OCTOBER 19 2016

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NEWS CANADA

Driverless cars would mean 'a lot more sex' behind the wheel: expert

TERRY PEDWELL, THE CANADIAN PRESS

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AV Update

Uber's driverless car
September 2016

From the Editors

Another incredible month for AVs. The month saw several advancements related to the testing of AVs on public roads. Tesla, Uber and Volvo led the news. California and Michigan also made some strides on the legislative front.

AVs are being taken more and more seriously across the globe. Japan, UK, Australia got in the

Agenda

- **Status and deployment**
- Trends and impacts
- Impact on tech and auto sectors
- Conclusions

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1898: The Vision

- Nikola Tesla proposed an automated car which, “left to itself, would perform a great variety of operations involving something akin to judgement”

Deployment Timing

1st gen: now	• Commercial, semi-autonomous cars • Commercial, fully-automated vehicles for applications in controlled environments
2nd gen: 2020 ± 1 yr	• First street-legal, fully-autonomous cars • Includes driverless taxis • Limited capability, limited rollout
2020s	• Ramp-up in capability and deployment • AVs increasing part of total Vehicle Kilometres Travelled (VKTs)
3rd gen: 2030s	• Advanced fully-automated vehicles: no steering wheel, pedals, etc.

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EDF
EDF
transdev

Trial of RDM's fully-automated taxis, Milton Keynes, UK

Komatsu: Fully-Automated Heavy Hauler

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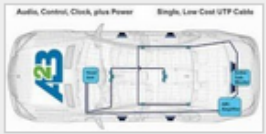
ElectronicsWeekly.com

By David Manners 16th August 2016 Add to Bookmarks

Ford targets driverless taxis by 2021

Ford aims to build a driverless car without steering wheel or pedals by 2021.

RECOMMENDED ARTICLES



Ford to use ADI single pair audio bus in cars

It aims to make vehicles “specifically designed for commercial” services like taxis.


WAYMO

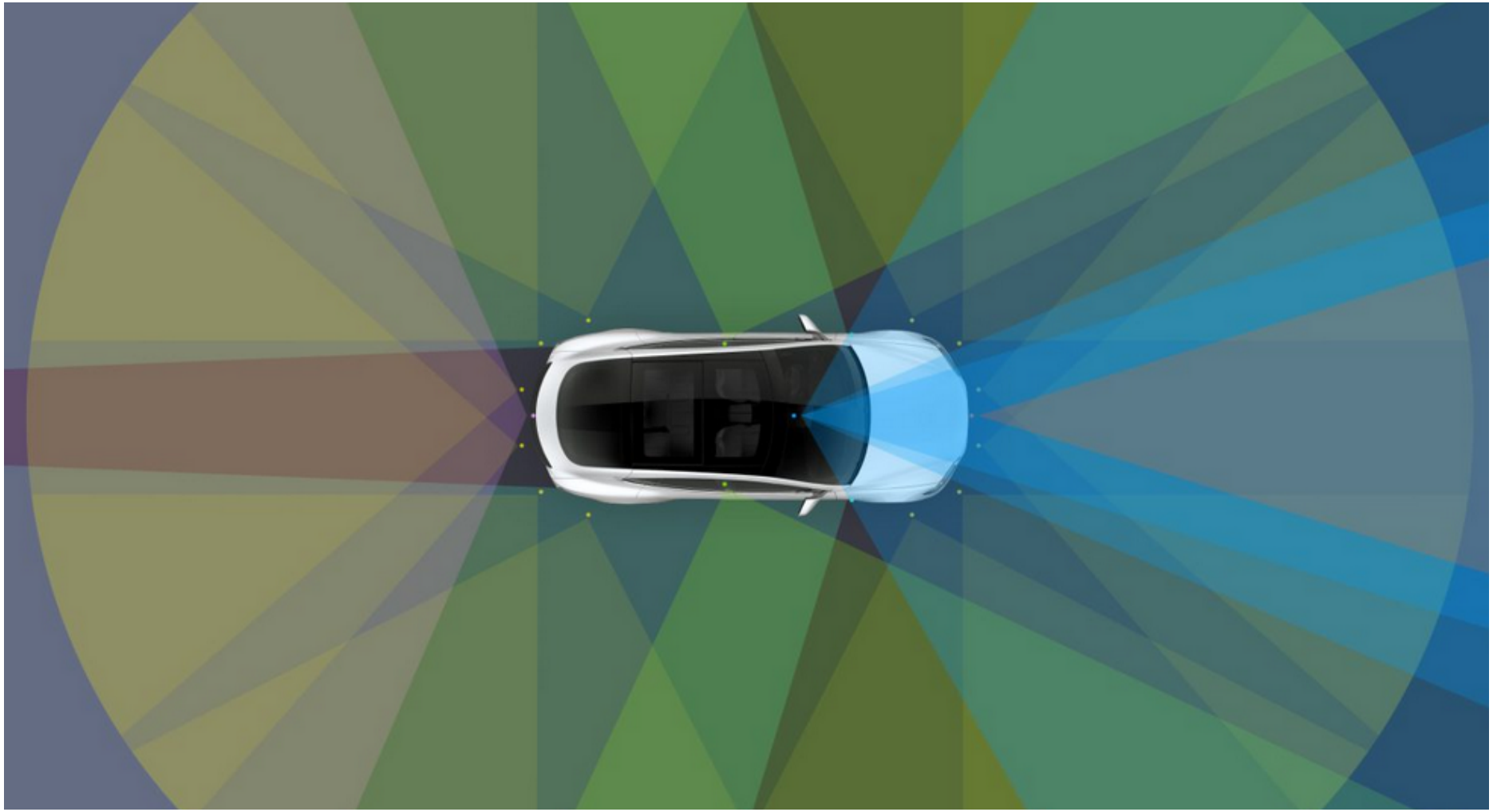
Mercedes-Benz Concept Car

Fewer Collisions

- AVs have the potential to be much safer than human drivers
- 93% of collisions involve driver error
- Hopefully, we can reduce collisions by 80%

Ottawa Citizen

Video processing, LiDARs, Radars



- **There is no such thing !!!**
- All hardware, software fails occasionally
- 7% of collisions have nothing to do with the driver
  - Will happen whether a human or computer is driving
- There will be collisions, fatalities, injuries - but far fewer

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Development Challenges

- Cyber-security
- Extreme weather
- Work zones, detours
- Traffic signals AND police officer
- Pedestrian prediction
- Hand gestures
- Reversing

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Regulatory and other Challenges

- Regulatory frameworks:
  - Vehicle standards (Federal)
  - Vehicle operation (Provincial / State)
- Municipal planning for AVs
- Insurance
- Legal

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Automated Vehicles

Connected Vehicles

Electric Vehicles

ACE Vehicles

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Automated Vehicles

Connected Vehicles

Electric Vehicles

Sharing Economy

ACES / Driverless Taxis

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Transportation-as-a-Service (TaaS)

- Aka “Mobility-as-a-service”, “Personalized mass transit” or “Micro-transit”
- Trend away from personal car ownership
  - To use of fully-automated taxis
- Merging of regular taxi, Uber, car rental and transit business models
- Call one via smartphone
  - Slightly more expensive than premium transit ticket

Ford

- “Our plan is to quickly become part of the growing transportation ***services*** market, which already accounts for $5.4 trillion in annual revenue”
  - “Nearly twice as much as the global auto industry brings in each year”
- Ford invested $1B in ArgoAI

GM

- "A ride sharing network is the logical first place to deploy driverless technology"
- “Pieces in place to develop ride sharing, autonomous cars”
  - Invested $500 million in ride-hailing service Lyft
  - Acquired self-driving vehicle technology start-up Cruise Automation
  - Continue to equip new vehicles with high-speed mobile internet connections

Related Trends

- Driverless taxis will be a competitive option for commuting
- Convergence between automotive, taxi, car-sharing, transit business models
- Technology companies moving into the auto sector
  - Apple, Google, Uber, QNX, RDM

Impacts on Private Sector

- Auto industry: OEMs, Tier 1 and 2s
- Auto insurance
- Car dealers, service operations
- Electricity generation, distribution
- Forest products
- Gas stations
- Oil / pipeline industry
- Parking
- Resource industry
- Taxis, rental cars
- Technology industry
- Trucking: long-haul and local

Direct Employment Displacement

- Auto-body repair
- Auto insurance
- Bus drivers
- Courier service drivers
- Driving instructors
- Health staff: health and tissue donation
- Lawyers & staff: car collision litigation
- Taxi / Uber drivers
- Tow-truck drivers
- Traffic police
- Transport truck drivers

Impacts on Government

- All levels / most departments
  - Finance, economy and GDP
  - Health-care
  - Hydro
  - National security
  - Policies on technology, industry, R&D
  - Policing
  - Transit including transit infrastructure
  - Transportation policies and regulations
  - Urban planning, housing

First Commandment of AVs

- Thou shalt have no special infrastructure
  - Far too expensive
  - Put all the AI into the vehicles

Second Commandment of AVs

- When AVs have reached a significant level of penetration, thou shalt optimize the infrastructure
  - Road design
  - Parking
  - Intersections
  - Urban planning
  - Charging stations

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Anthony Foxx, Fmr US Trans'n Secretary

- "Widespread adoption of automated vehicles would change transportation as we know it"
- "A fully-automated fleet for the US could provide for a five-fold increase in highway capacity"

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Advice to Governments

- Require that all requests for funding for *new* transportation and transit infrastructure include an analysis of the impact of AVs on the design and business case
- Set aside a portion of the Federal and Provincial infrastructure spends for smart infrastructure

Autonomous Friendly Corridors (AFCs)

- Central North America Trade Corridor Association (CNATCA)
- Roadway designed for autonomous trucks
- Air corridor - drones
- Mexico to Canada
- **Opportunities for West Coast and Trans-Canada AFCs**

Mercedes Benz Future Truck 2025

Sidewalk Friendly AVs

Starship

Dispatch's 'Carry'

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Sidewalk Friendly AVs

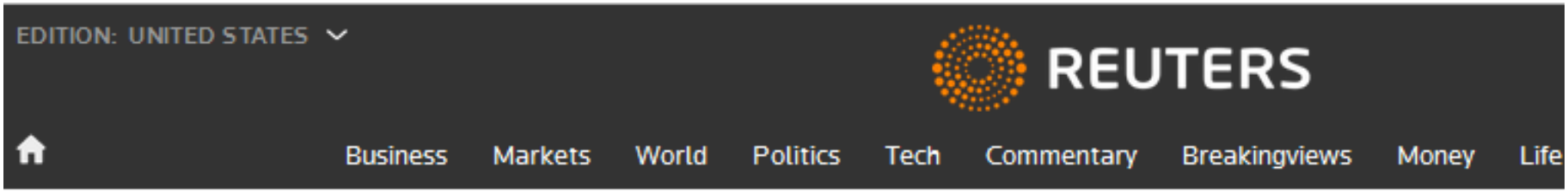
Domino’s pizza delivery robot.

Delivery Robots

Delivery Robots

Delivery Drones

Airbus “Vahana” Project



TECHNOLOGY NEWS | Mon Jan 16, 2017 | 7:05am EST

Airbus CEO sees 'flying car' prototype ready by end of year

ALEX DAVIES TRANSPORTATION 10.27.16 9:00 AM

INSIDE UBER'S PLAN TO TAKE OVER THE SKIES WITH FLYING CARS

WIRED

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- **Impact on tech and auto sectors**
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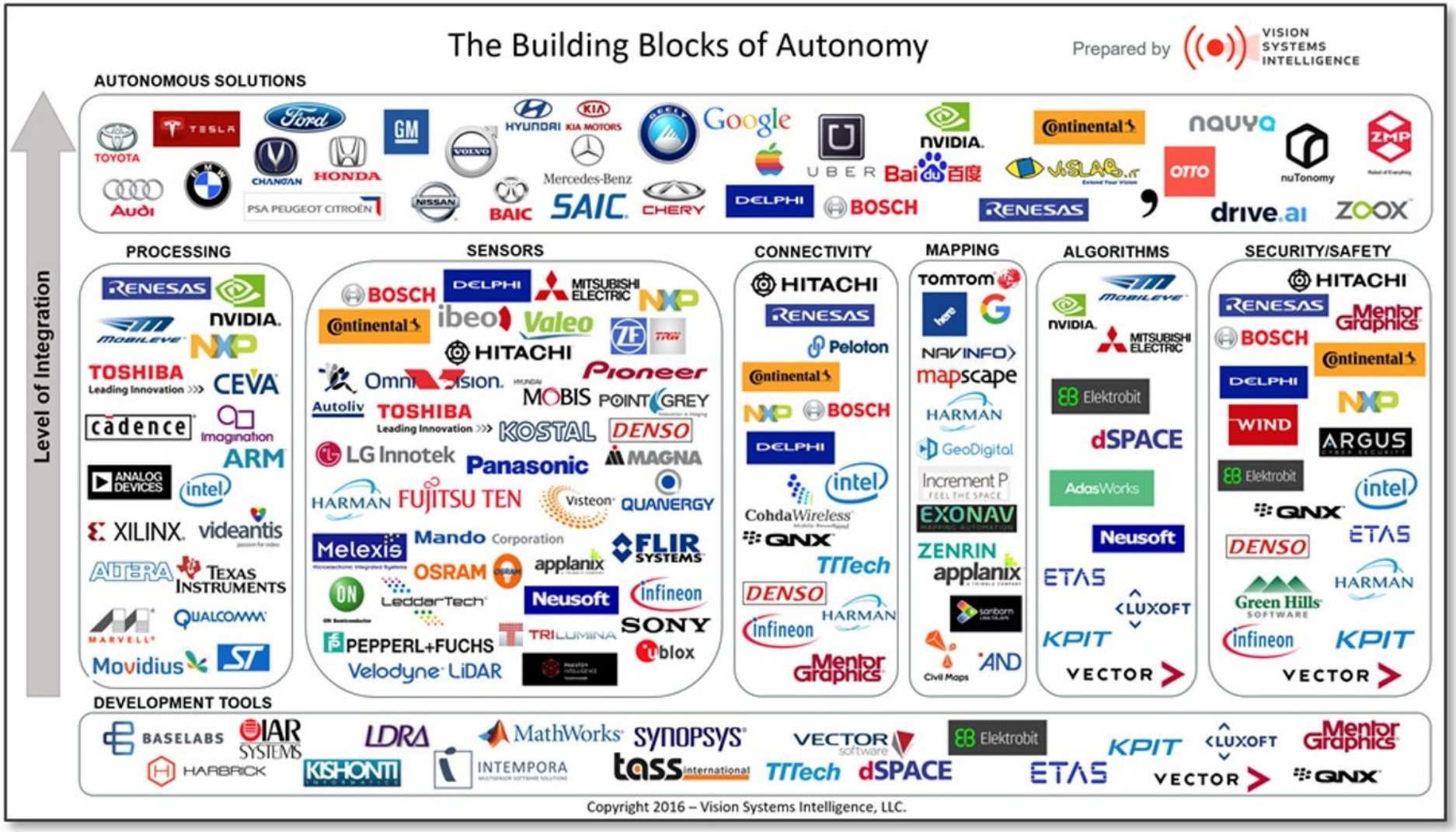
Impact on Auto Sector

- The auto sector will change more in the next 5-10 years than it has in the last 50
  - *Mary Barra, CEO, General Motors*
- ACES will be highly disruptive
- Market for personally-owned cars will decrease substantially in 2020s
- Substantial growth in the transportation ***service*** sector

Impact on Auto Sector (2)

- By 2030, most – maybe all – new cars will be electric
  - Far fewer moving parts
- Trend towards micro factories
  - Additive printing, i.e. 3D printing of many car parts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CNN

- U.S. auto boom that fueled record sales and profits is winding down
- Radical transformation that could threaten the survival of some automakers.
- Challenge posed by electric and self-driving cars is far more fundamental than 2008 crisis
- Automakers investing billions to develop these new vehicles

CNN (2)

- OEMs facing tremendous competitive threat from upstarts like Tesla, Uber, Google, Apple
- The nature of the vehicles will be different
- The models by which we acquire transportation could be completely different

Very Bullish View: Tony Seba

- By 2025:
  - No more gas or diesel cars, buses, or trucks will be sold anywhere in the world within eight years
- By 2030:
  - All new mass-market vehicles will be electric and fully or semi-autonomous
  - Self-driving cars will shrink the new car market by 80%
  - The concept of individual car ownership will be obsolete.
  - The car insurance industry will be disrupted.
  - People will adapt to vehicles on demand

Very Bullish View: Tony Seba (2)

- People will switch en masse to self-drive electric vehicles:
  - 10x cheaper to run than fossil-based cars
  - Near-zero marginal cost of fuel
  - Expected lifespan of 1 million miles
- Gasoline:
  - Will be obsolete
  - Collapse of oil prices and demise of the oil industry as we have known it for a century
- Infrastructure:
  - Up to 80% of highways will be redundant.
  - Up to 80% of parking spaces will be redundant

Very Bullish View: Tony Seba (3)

- It will be harder to find a gas station, spares, or anybody to fix the 2,000 moving parts that bedevil the internal combustion engine
- Dealers will disappear by 2024.
- Cities will ban human drivers once the data confirms how dangerous they can be behind a wheel
  - Will spread to suburbs and then beyond
  - A “mass stranding of existing vehicles”

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Conclusions

- AVs will lead to huge, disruptive changes to our personal lives and society
  - Key benefit: computers will be much better drivers than humans
  - Changes to our world will start in 2020
  - Our world will be very different by 2030
- Substantial impact on auto, tech sectors: opportunities and challenges
- Now is the time to start planning

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Follow-up

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- www.cavcoe.com
  - Latest issue of ***AV Update***, a free monthly newsletter with news on AVs from around the world
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