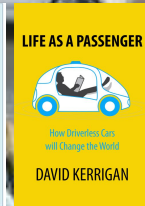
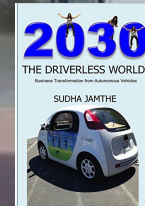
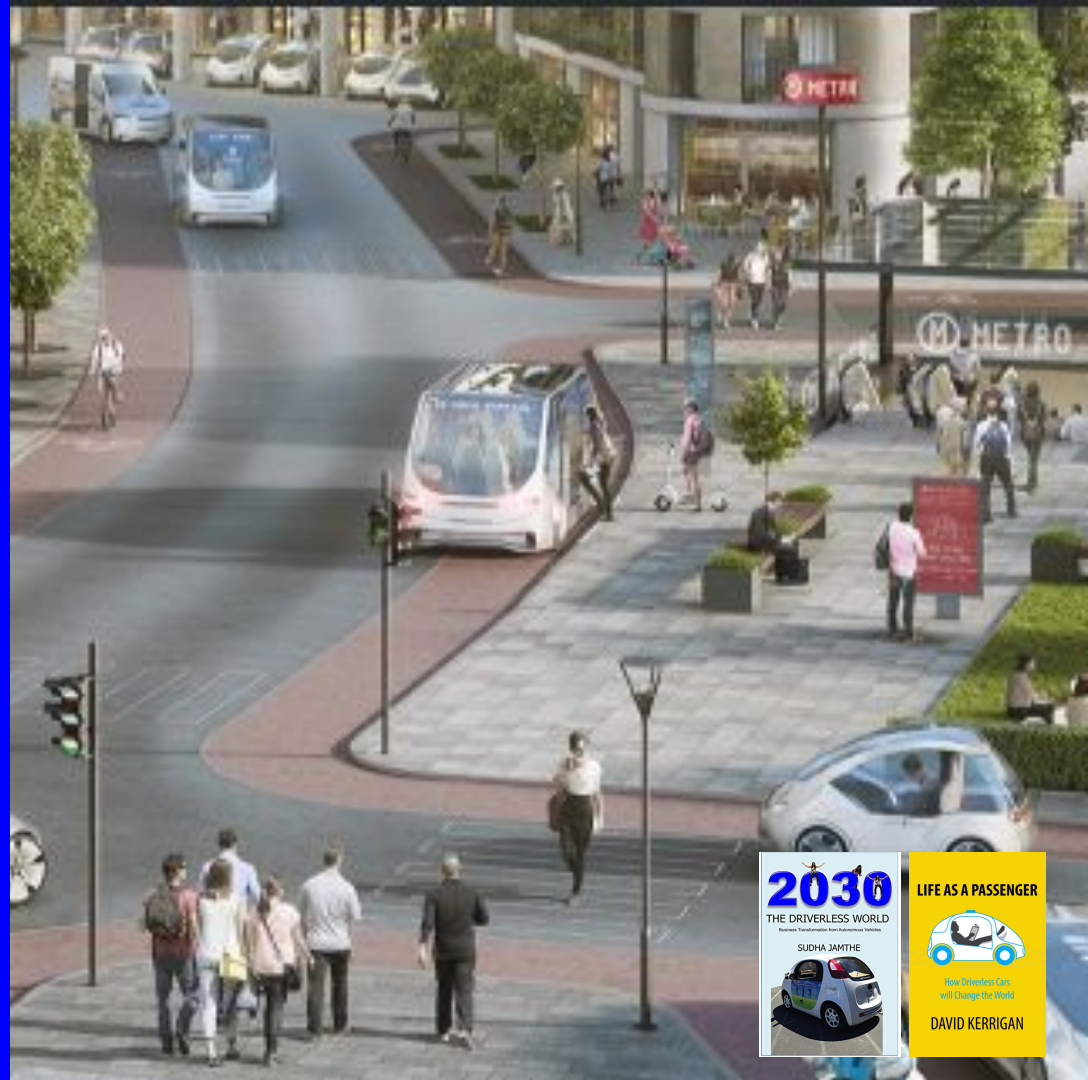


# AV Masterclass

## Week 4: AV Business Drivers

Sudha Jamthe & David Kerrigan  
Driverless World School

May 2020

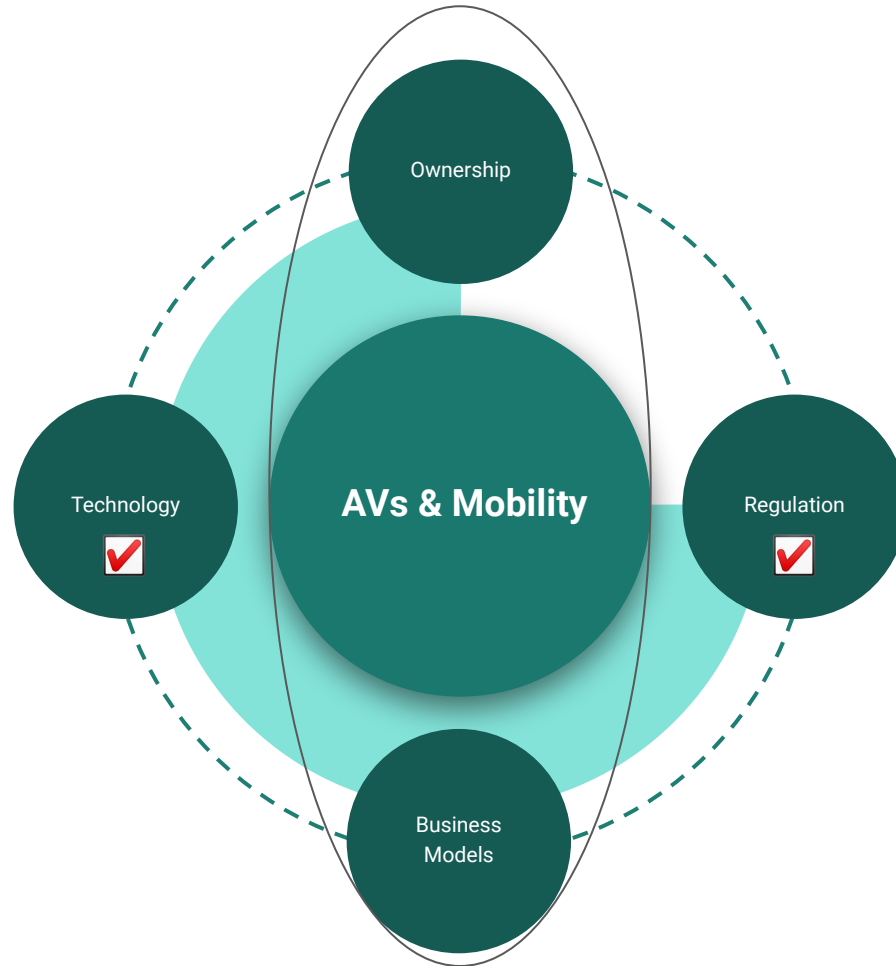




**Welcome Back!**

We're (still) here to help

# AV Masterclass Week 4: Business Drivers



# Technology Getting to Level 5



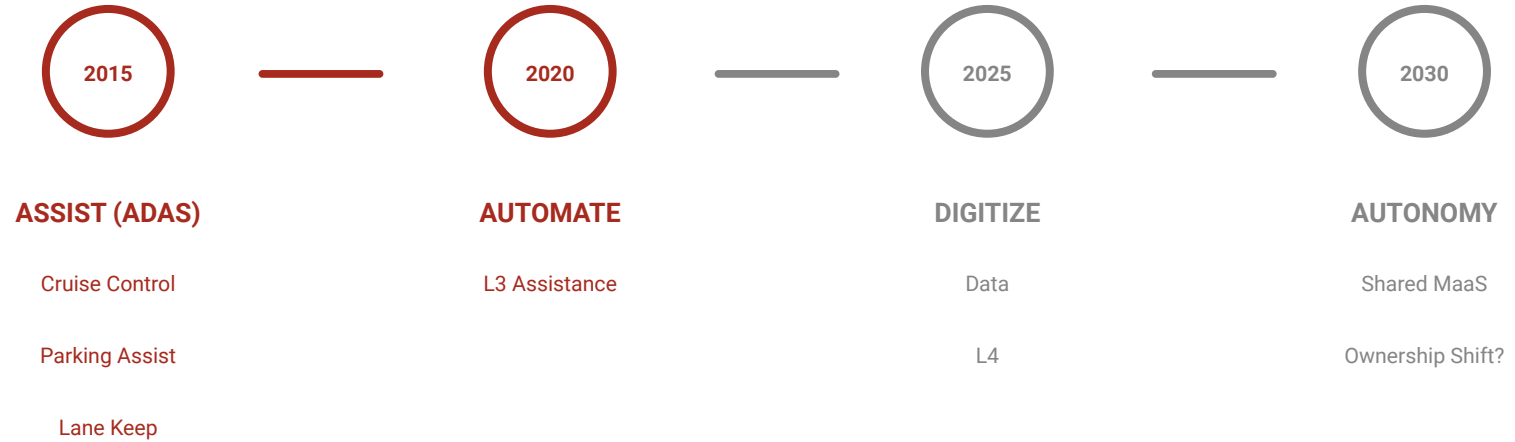
## SAE J3016™ LEVELS OF DRIVING AUTOMATION

	SAE LEVEL 0	SAE LEVEL 1	SAE LEVEL 2	SAE LEVEL 3	SAE LEVEL 4	SAE LEVEL 5
What does the human in the driver's seat have to do?	You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You are <b>not</b> driving when these automated driving features are engaged – even if you are seated in “the driver’s seat”		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
What do these features do?	These are driver support features			These are automated driving features		
	These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/acceleration support to the driver	These features provide steering AND brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	<ul style="list-style-type: none"> <li>• automatic emergency braking</li> <li>• blind spot warning</li> <li>• lane departure warning</li> </ul>	<ul style="list-style-type: none"> <li>• lane centering OR</li> <li>• adaptive cruise control</li> </ul>	<ul style="list-style-type: none"> <li>• lane centering AND</li> <li>• adaptive cruise control at the same time</li> </ul>	<ul style="list-style-type: none"> <li>• traffic jam chauffeur</li> </ul>	<ul style="list-style-type: none"> <li>• local driverless taxi</li> <li>• pedals/steering wheel may or may not be installed</li> </ul>	<ul style="list-style-type: none"> <li>• same as level 4, but feature can drive everywhere in all conditions</li> </ul>

For a more complete description, please download a free copy of SAE J3016: [https://www.sae.org/standards/content/J3016\\_201806/](https://www.sae.org/standards/content/J3016_201806/)

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# What Do You Think?



# Everybody thinks Level 5 is long term

## Deployment Timeline

Automated Driving Systems (SAE J3016 Levels 3-5)



- AV firms keep extending their estimates
- Some think level 2 & 3 are dangerous
- Some think 4 is still years away but is required for MaaS
- Incumbents like level 2 & 3 as people will still buy private cars
- Timing is an important context for debates about ownership

Opinion

# Owning a Car Will Soon Be as Quaint as Owning a Horse

The shift away from private vehicles will happen faster than we think.



By Kara Swisher

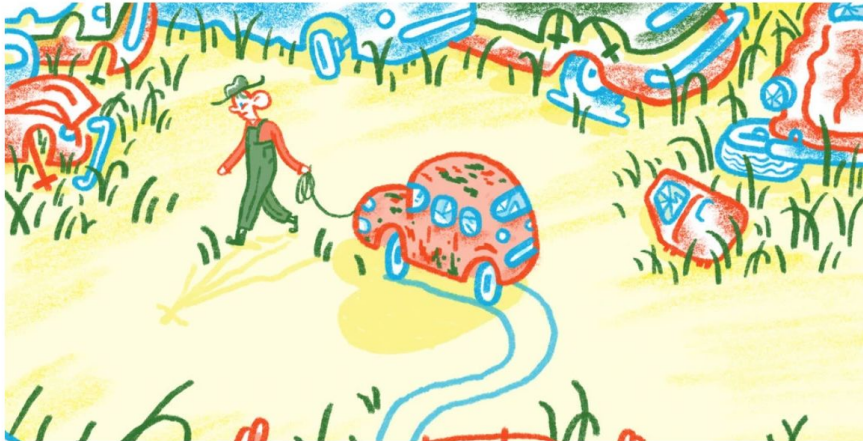
Ms. Swisher covers technology and is a contributing opinion writer.

March 22, 2019



What does “soon” mean?

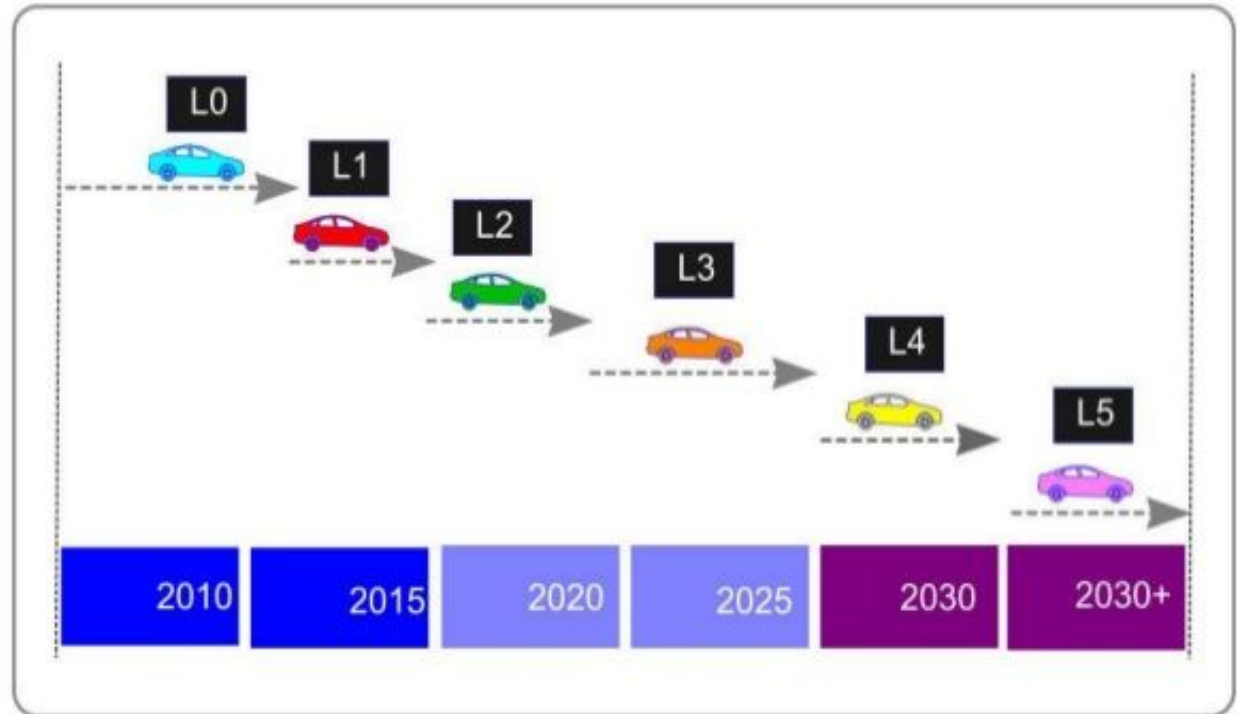
Ownership & Business Models



# Timeline for deployment

## Another View

Less Optimistic?

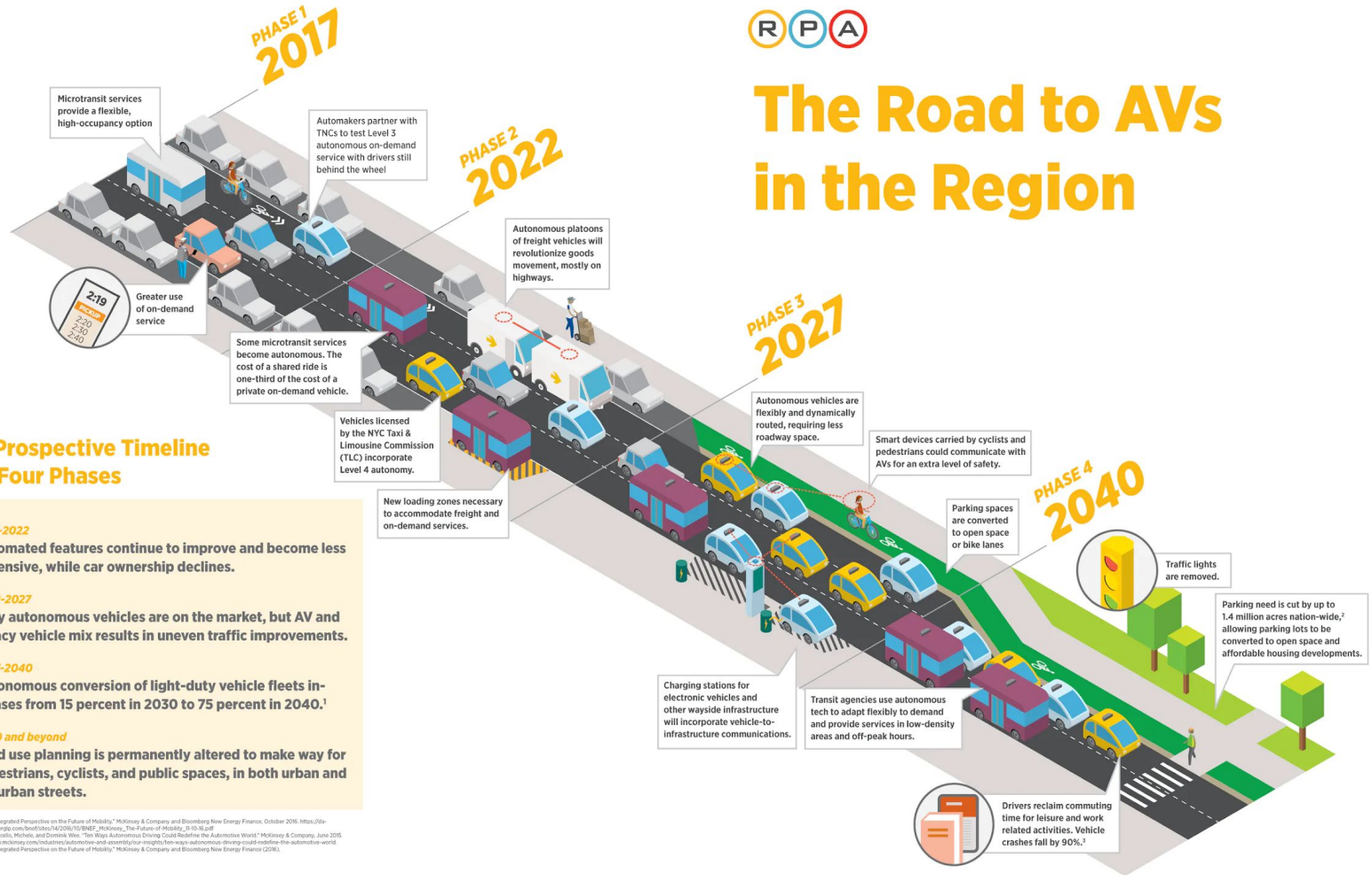


Each level of autonomy requires increased "intelligence" and computational power





# The Road to AVs in the Region



## A Prospective Timeline in Four Phases

- 2017-2022**  
Automated features continue to improve and become less expensive, while car ownership declines.
- 2022-2027**  
Fully autonomous vehicles are on the market, but AV and legacy vehicle mix results in uneven traffic improvements.
- 2027-2040**  
Autonomous conversion of light-duty vehicle fleets increases from 15 percent in 2030 to 75 percent in 2040.<sup>1</sup>
- 2040 and beyond**  
Land use planning is permanently altered to make way for pedestrians, cyclists, and public spaces, in both urban and suburban streets.

1. "An Integrated Perspective on the Future of Mobility," McKinsey & Company and Bloomberg New Energy Finance, October 2016. <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/an-integrated-perspective-on-the-future-of-mobility>  
 2. Bertozzi, Michele, and Daniela Wess. "Ten Ways Autonomous Driving Could Redefine the Automotive World," McKinsey & Company, June 2016. <http://www.mckinsey.com/industries/automotive-and-assembly/our-insights/ten-ways-autonomous-driving-could-redefine-the-automotive-world>  
 3. "An Integrated Perspective on the Future of Mobility," McKinsey & Company and Bloomberg New Energy Finance (2016).

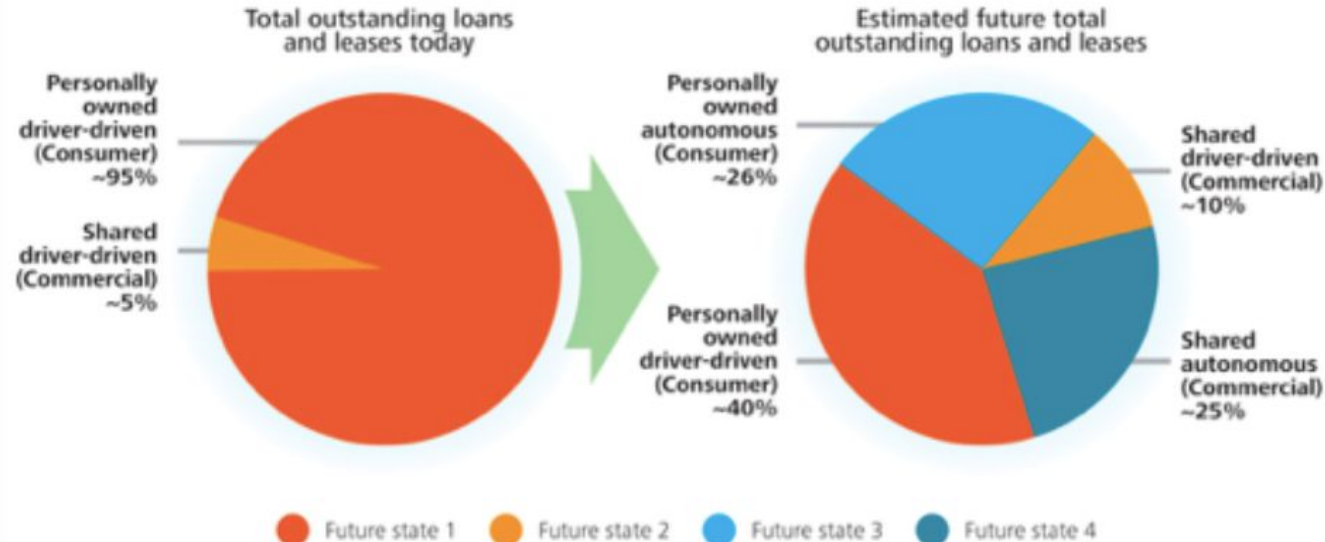
# Auto Finance is Big Business

## Shift in Ownership Creates Opportunity

Primarily Owned



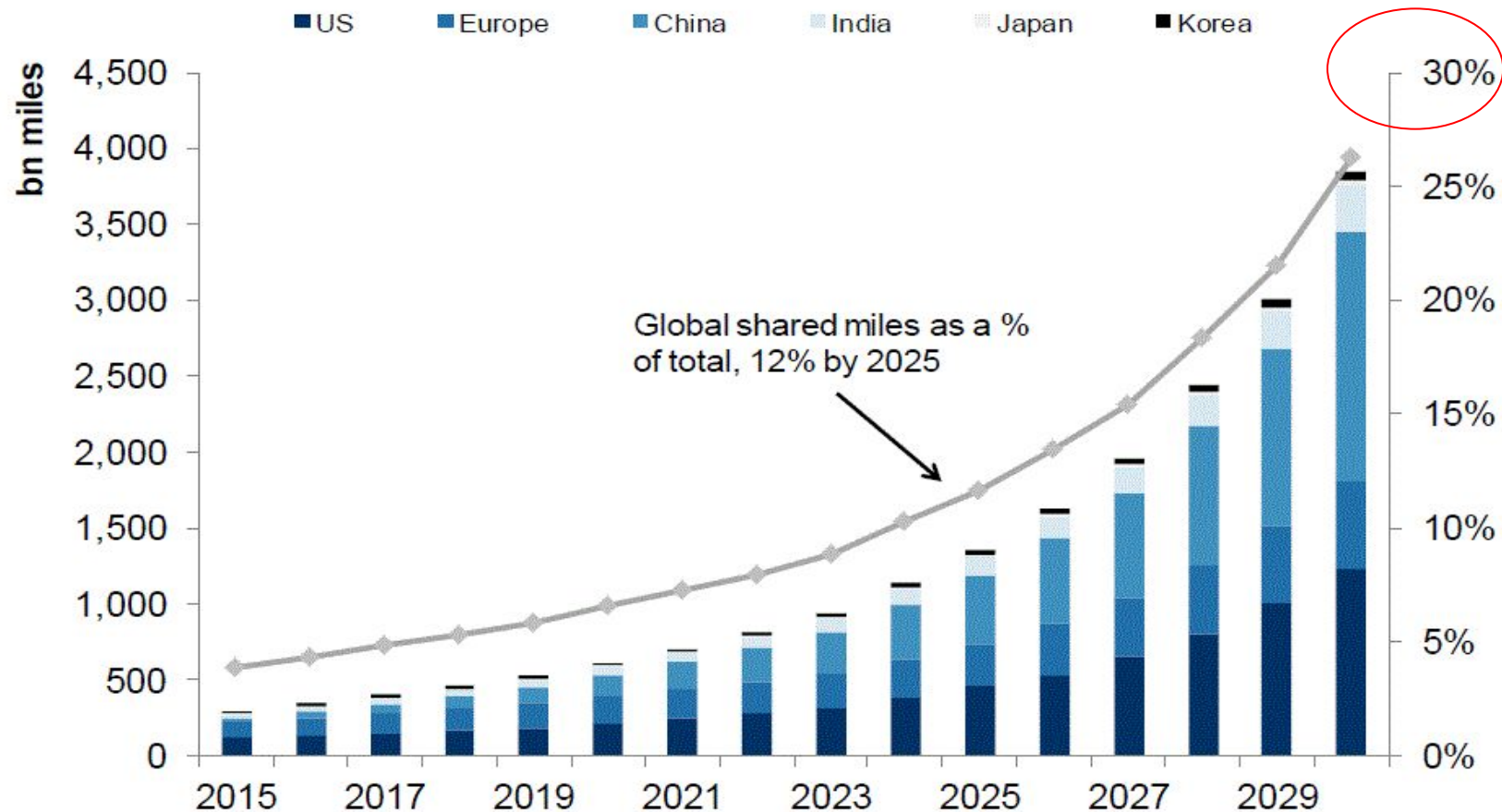
Commercial Ownership Increases



Note: Percentages may not sum to 100% due to rounding.  
Source: Deloitte preliminary analysis.

## Timing of Shared Mobility

% of Global Miles Travel (Shared)



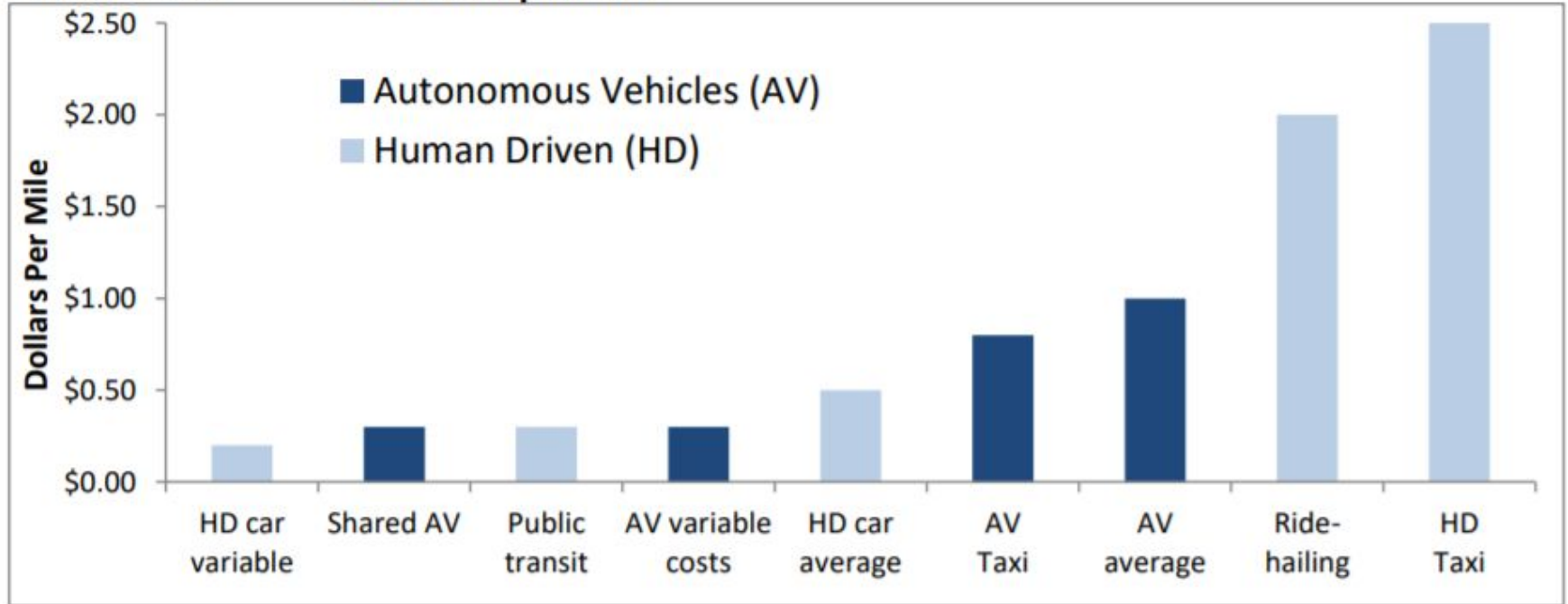
# Ownership Shifts: Timing & Costs

- Optimistically, autonomous vehicles will be safe and reliable by 2025, and may be commercially available in many areas by 2030
- If they follow the pattern of previous vehicle technologies, during the 2030s and probably the 2040s, they will be expensive and limited in performance, sometimes unable to reach a desired destination or requiring human intervention when they encounter unexpected situations (Level 4)
- Early customers will include affluent high-annual-mileage motorists and fleets. For the foreseeable future most moderate- and low-income households will continue to own human-operated vehicles
- Shared autonomous vehicles (self-driving taxis) and rides (micro-transit services) may be widely available by the 2030s

# VTPI Report: Economics Impact Ownership & Business Models

**Exhibit ES-1**

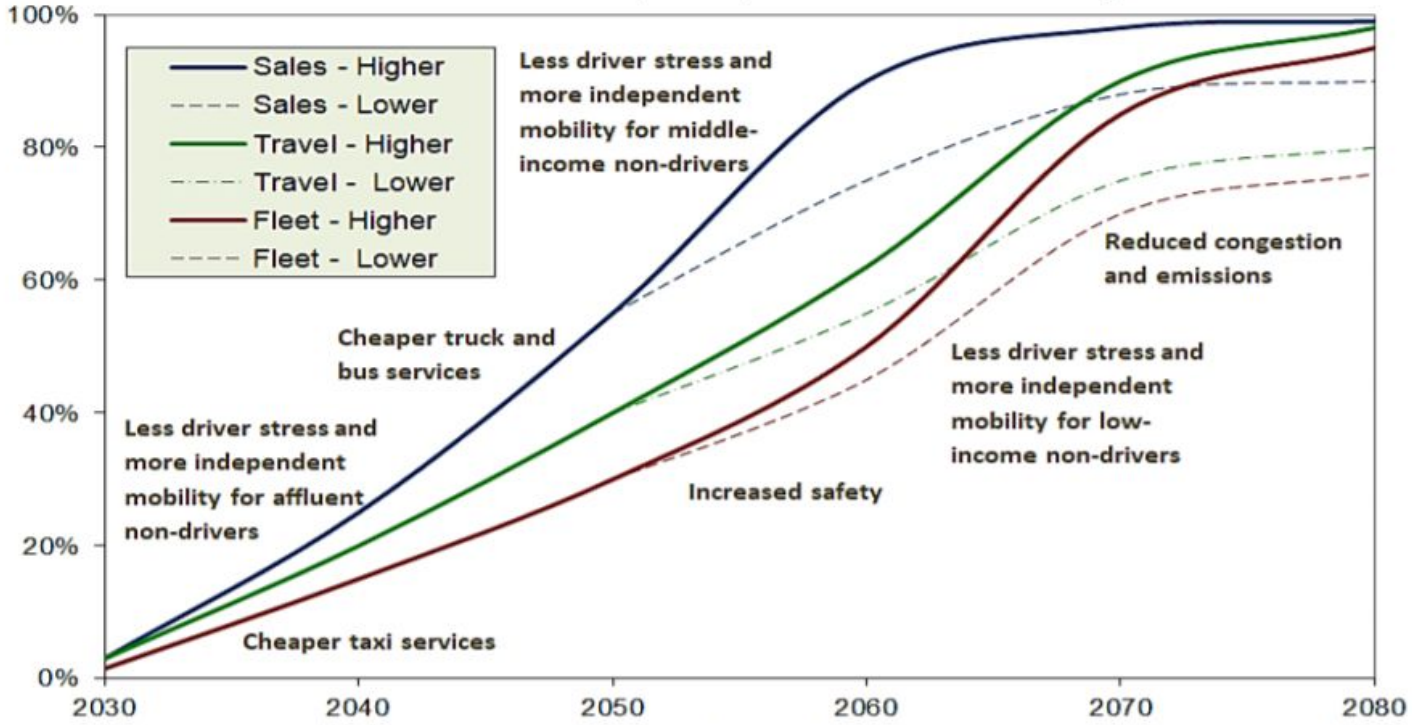
**Cost Comparison**



*Autonomous vehicles (AVs) are likely to cost more than human-driven private vehicles (HVs) and public transit, but less than human-driven taxis and ridehailing services.*

# Transition: Sales vs Miles Travelled vs Proportion of Fleet

**Exhibit 26** Autonomous Vehicle Sales, Fleet, Travel and Benefit Projections



*This analysis suggests that it will be at least 2045 before half of new vehicles are autonomous, and 2060 before half of the vehicle fleet is autonomous. Significantly faster deployment will require scrapping many otherwise functional vehicles that lack self-driving ability. Some benefits, such as reduced driver stress and*

# AV as the new norm? Ownership, Timing & Business Models

**Exhibit 19 Autonomous Vehicle Market Penetration Projections**

Stage	Decade	New Sales	Fleet	Travel
Development and testing	2020s	0%	0%	0%
Available with large price premium	2030s	2-5%	1-2%	1-4%
Available with moderate price premium	2040s	20-40%	10-20%	10-30%
Available with minimal price premium	2050s	40-60%	20-40%	30-50%
Standard feature included on most new vehicles	2060s	80-100%	40-60%	50-80%
Saturation (everybody who wants it has it)	2070s	?	?	?
Required for all new and operating vehicles	?	100%	100%	100%

*Autonomous vehicle will probably take several decades to penetrate new vehicle sales, fleets and travel.*

# If decisions were rational trade-offs...

**Exhibit 8 Costs Compared**

	Private Human-driven Vehicle	Private Autonomous Vehicle	Shared Autonomous Vehicle	Shared Autonomous Ride
<b>Financial costs</b>	Low fixed costs (particularly used cars), moderate variable.	High fixed costs, low variable costs.	Minimal fixed costs, moderate variable costs.	Minimum fixed costs, low variable costs.
<b>Convenience</b>	High. A private vehicle is available any time.	High. A private vehicle is available any time. Provides vehicle travel to non-drivers.	Moderate. Vehicles will often require several minutes to arrive. Provides door-to-door service.	Moderate. Collecting passengers will often take several minutes. Does not provide door-to-door service.
<b>Comfort</b>	Low to moderate, depending on driving conditions.	High. Users have their own vehicles with chosen amenities.	Moderate. Shared, vehicles may be abused.	Lowest. Travelers share vehicles with strangers.
<b>External costs (congestion, facilities, crashes and pollution)</b>	Moderate to high.	High. Likely to increase total vehicle travel which will increase external costs.	Moderate. May increase total vehicle travel in some circumstances and reduce it in others.	Lowest. Can reduce total vehicle travel and associated costs
<b>Most appropriate uses</b>	Moderate- and low-income suburban and rural residents.	Affluent suburban and rural residents	Suburban and urban travelers.	Urban travelers.

*Vehicle types vary in their costs, convenience and comfort, and therefore their impacts on total vehicle travel.*



# Not all trips are the same

**Exhibit 13 Autonomous Vehicle Impacts on Various Travel Demands**

Travel Type	Autonomous Vehicle Impacts	Portion of Travel
Freight trucks	Particularly suitable for long-haul freight travel, due to its high labor costs and limited routes, mostly on grade-separated highways.	10%
Small commercial (trades and deliveries)	Trades (plumbers, computer technicians, etc.) carry equipment in their vehicles, so they are likely to own autonomous vehicles. Delivery companies can use autonomous vehicles to reduce costs. This may increase total vehicle travel.	5%
Public transport	Particularly suitable for public transit, due to its high labor costs. Allows micro-transit with frequent and demand-response services.	Currently 2%, but could increase.
Longer-distance (> 50 mile) personal trips	Particularly suitable for longer-distance personal trips, due to tedium. May increase longer-distance travel.	Currently 20%, but could increase.
Local suburban and rural	Affluent suburban and rural residents are likely to purchase private autonomous vehicles and increase total vehicle travel. Lower-income residents are likely to continue driving private vehicles or use shared autonomous vehicles, which could reduce their total vehicle travel.	50%
Local urban trips	Many are likely to shift from private cars to shared autonomous mobility services, which is likely to reduce their total vehicle travel.	20%
Non-drivers	Non-drivers are likely to increase their vehicle travel.	2-4% but increasing.

*Autonomous vehicle travel impacts will vary by types of trips.*

# Technology, Timing & Ownership

**Tech:** Level 4 technologies (vehicles able to operate autonomously in limited conditions) are currently available, but reliable Level 5 operation may be available in five years or may require another 25 years.

**Regulation:** Testing and approval standards are currently under development, but several more years may be required for these standards to be agreed, adopted and implemented.

**Costs:** For the foreseeable future autonomous operation will only be available in relatively expensive new vehicles

**Policy:** Currently, most North American households live in automobile-dependent communities and own private vehicles. Implementation could be accelerated if public policies encourage AV development, if road and parking pricing, and roadway management favor shared vehicles, if highway lanes are dedicated to autonomous vehicle platooning, or if governments support scrapping a major portion otherwise functional vehicles because they lack autonomous driving capability.

**Consumer Acceptance:** May be reduced by safety fears, privacy concerns, or preferences, resulting in a significant portion of vehicle travel remaining human-driven even after market availability

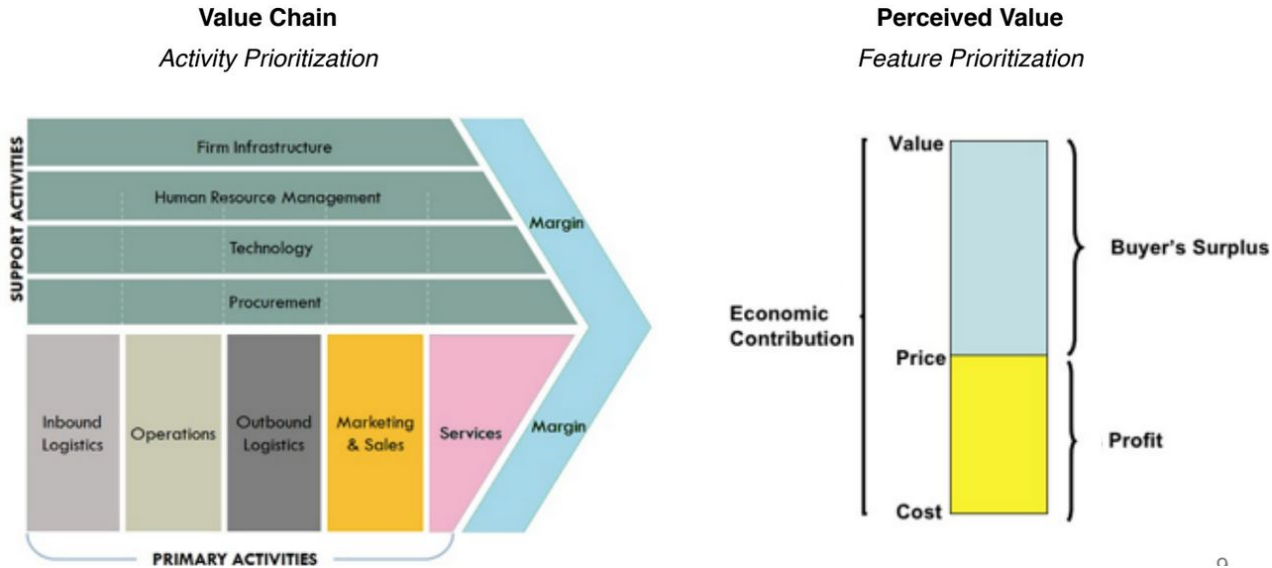


**What are  
OEMs  
doing?**

What this is? Which OEM made this? Clue: It is called CarrE

# OEM VALUE CHAIN IS SHIFTING

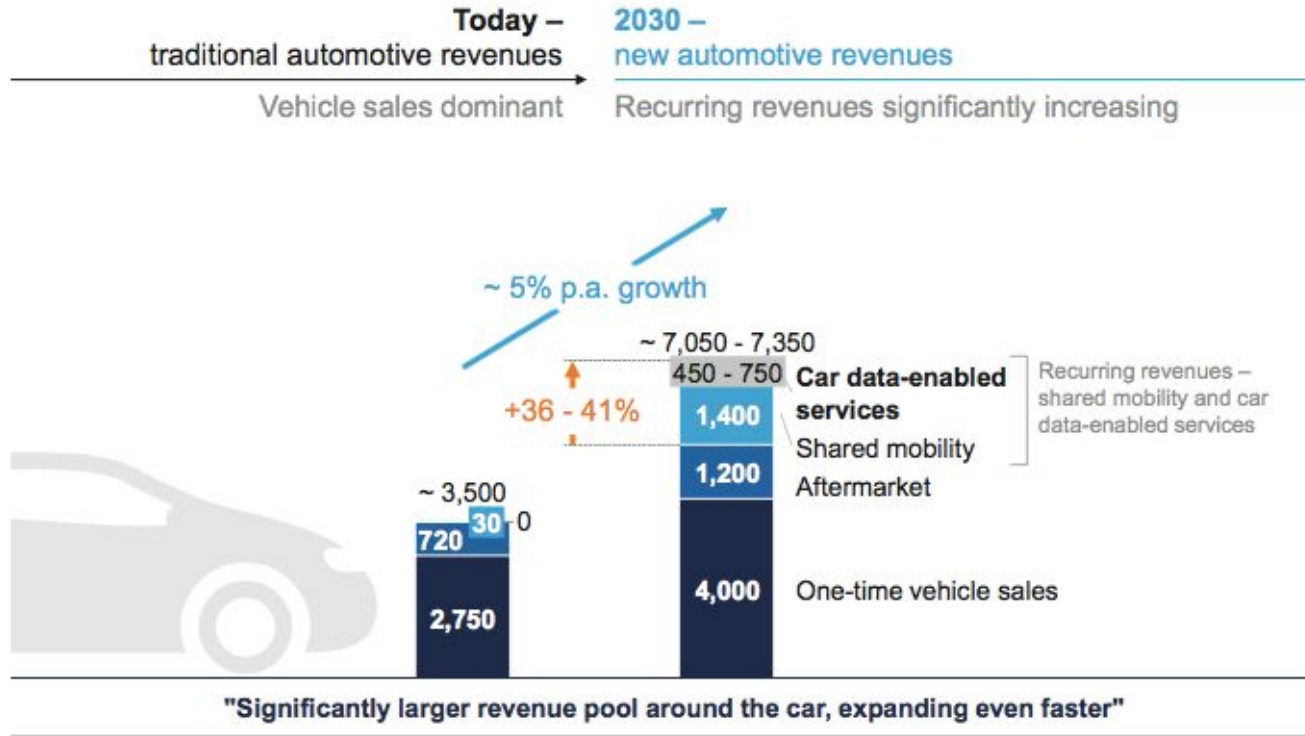
## Value Chain VS. Perceived Value



Credit: Kyle Columbus, Mercedes-Benz

# Car-generated data may become a USD 450 - 750 billion market by 2030

USD billions



SOURCE: McKinsey



CONNECTED  
TRANSPORT



# MOBILITY PLATFORM

Car  
Sharing

Ride  
Hailing

Payment

Fleet Management

Identity Management

[DriverlessWorldSchool.com](http://DriverlessWorldSchool.com)

@sujamthe

# Reference Links

- Micro-Mobility Business calculator <https://canikickit.biz/>
- BMW + Daimler Joint Venture for Mobility <https://www.your-now.com/>
- Open motors (Open source modular design)  
<https://www.youtube.com/watch?v=tJhKDxy5FPg>
- Faraday Future <https://www.youtube.com/watch?v=SAXoVSXnNTg>
- Volvo CMA Compact Modular Architecture  
<https://www.youtube.com/watch?v=O-z1Tz5H0f8>