



DB AutoTech Research

New Paradigm for the Auto Industry

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What does it cost to drive your car? It depends...

	Top 20 MSAs	Nationwide
variable cost (\$/mile)		
fuel cost	0.09	0.09
maintenance	0.11	0.11
depreciation	0.24	0.24
tires	0.01	0.01
variable cost per mile	0.45	0.45
fixed cost (\$/year)		
insurance	923	841
license, registration, taxes	665	665
parking	1,205	723
traffic tickets	75	75
finance cost	878	878
	3,746	3,182
miles traveled	8,324	12,000
fixed cost per mile	0.45	0.27
cost of ownership per mile	0.90	0.71

Cost of car ownership:

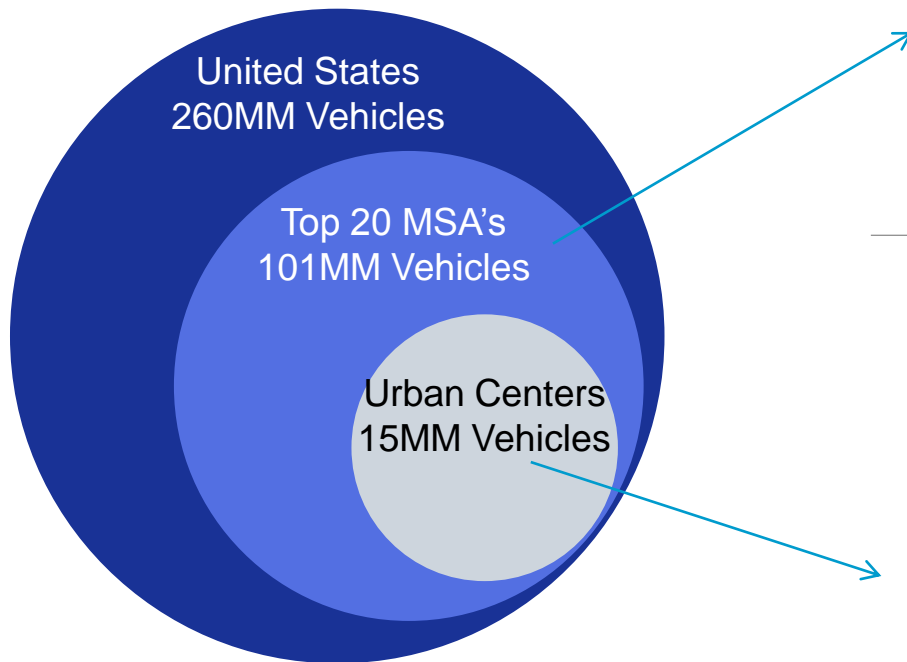
- Atlanta: \$0.70 per mile
- Chicago: \$0.99 per mile
- Dallas: \$0.74 per mile
- NYC: \$3.10 per mile
- San Francisco: \$1.06 per mile
- St. Louis: \$0.67 per mile

For comparison, we estimate uberX averages \$1.54 per mile within Urban Centers

Source: Deutsche Bank, Industry Experts, AAA, Census, NHTS

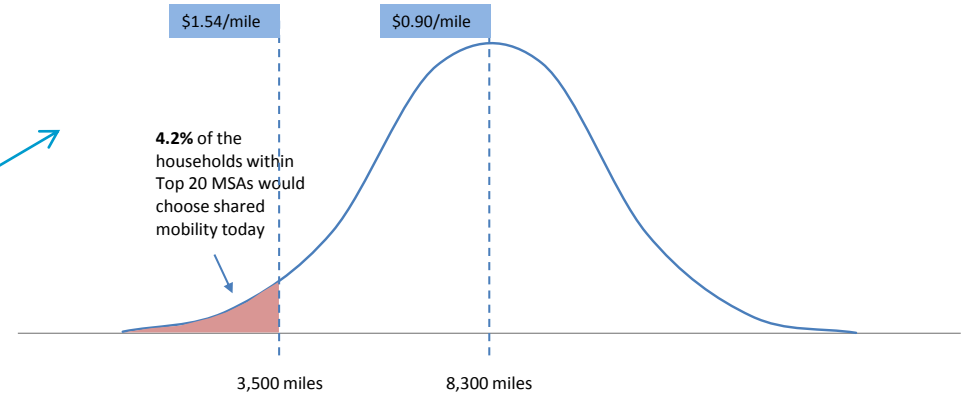


Sizing the shared mobility opportunity

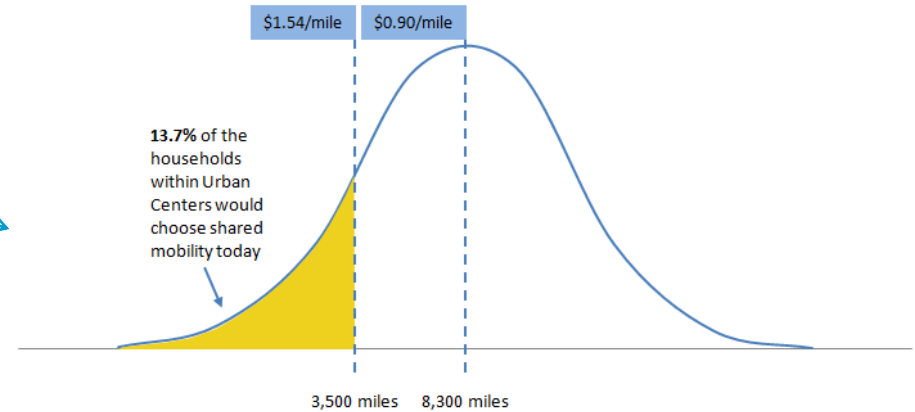


Cost of Ownership per Mile Today

Distribution of Miles Driven and Corresponding Cost per Mile Across Top 20 MSAs



Distribution of annual miles driven



Distribution of annual miles driven

Source: Deutsche Bank, AAA, Census, NAIC, Colliers, Industry Experts



But interesting things start to happen when you model the cost of autonomous vehicles...

	nationwide
driverless vehicle price	\$ 50,000
miles driven	
average driverless miles driven per hour	11.5
miles traveled annually	70,000
<i>utilization on trip</i>	<i>85%</i>
revenue miles	59,500

	nationwide
variable cost (per mile)	
mapping and data services	0.01
fuel cost	0.09
maintenance	0.11
depreciation (straight line, no residual)	0.24
tires	0.01
operating cost per mile	0.46
fixed cost (per year)	
insurance	3,000
license, registration, taxes	665
taxi comission inspection	105
finance cost	552
	4,322
annual cost of operation	36,284
annual cost of operation per mile	0.52

Source: Deutsche Bank, Industry Experts, AAA, Census, NAIC, NYC TLC



An On Demand Autonomous Network should be able to generate a 20% ROIC at \$0.89 per mile

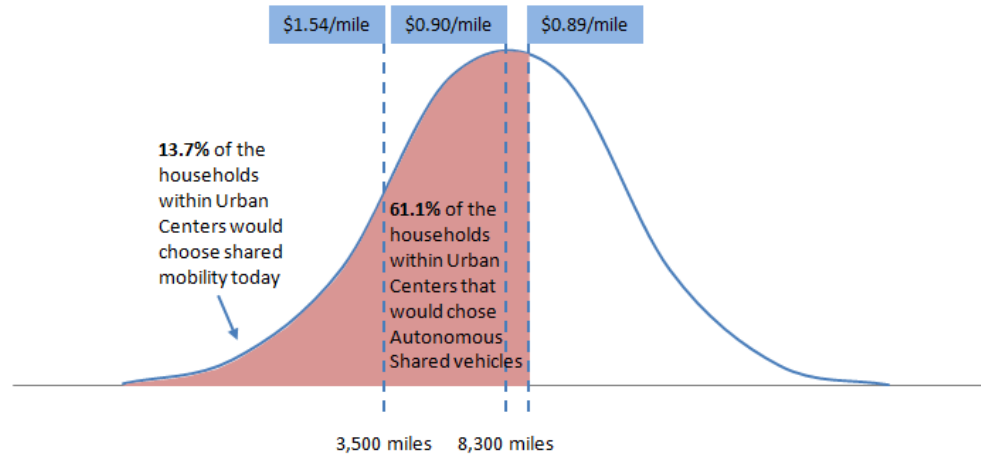
per mile	nationwide	% of Revenue
revenue	0.89	
COGS	0.52	58%
gross margin	0.37	42%
SG&A/R&D @13% of revenue	0.12	13%
EBIT	0.26	29%
taxes, @35%	0.09	
NOPAT	0.17	19%
implied cost per mile to consumer	0.89	

Source: Deutsche Bank, Industry Experts, AAA, Census, NAIC, NYC TLC



On Demand Autonomous vehicles could work for up to 61% of households in Dense Urban Centers

Distribution of Miles Driven and Corresponding Cost per Mile Across Dense Urban Centers



Distribution of annual miles driven

US Vehicle Parc - 260 MM Vehicles	
Cost of ownership	\$0.70 / mile
Cost of on-demand mobility (driver)	\$1.54 / mile
Largest 20 MSA's - 100 MM Vehicles	
Cost of ownership	\$0.90 / mile
Cost of on-demand mobility (driver)	\$1.54 / mile
High Density Urban Centers - 15 MM Vehicles	
Cost of ownership	\$0.90 / mile
Cost of on-demand mobility (driver)	\$1.54 / mile
Cost of on-demand mobility (driverless)	\$0.89 / mile
Vehicles Replaced by On Demand Mobility - 8 MM Vehicles	
Cost of on-demand mobility (driver)	\$1.54 / mile
Cost of on-demand mobility (driverless)	\$0.89 / mile



OEM Business Model

	Ford	GM
NA Wholesale Volume (thousands)	3,073	3,558
Share of Volume Directed to On-Demand Autonomous	1%	1%
On-Demand Autonomous Volume (thousands)	31,000	36,000
Revenue per vehicle (\$)	53,068	53,068
EBIT per vehicle (\$)	15,385	15,385
On Demand Vehicles in Service After 3 years of Allocating 1%/year	93,000	108,000
Steady State* NA Profit Improvement (\$MM)	1,400	1,700

* assuming 3 year lifecycle for autonomous shared vehicles

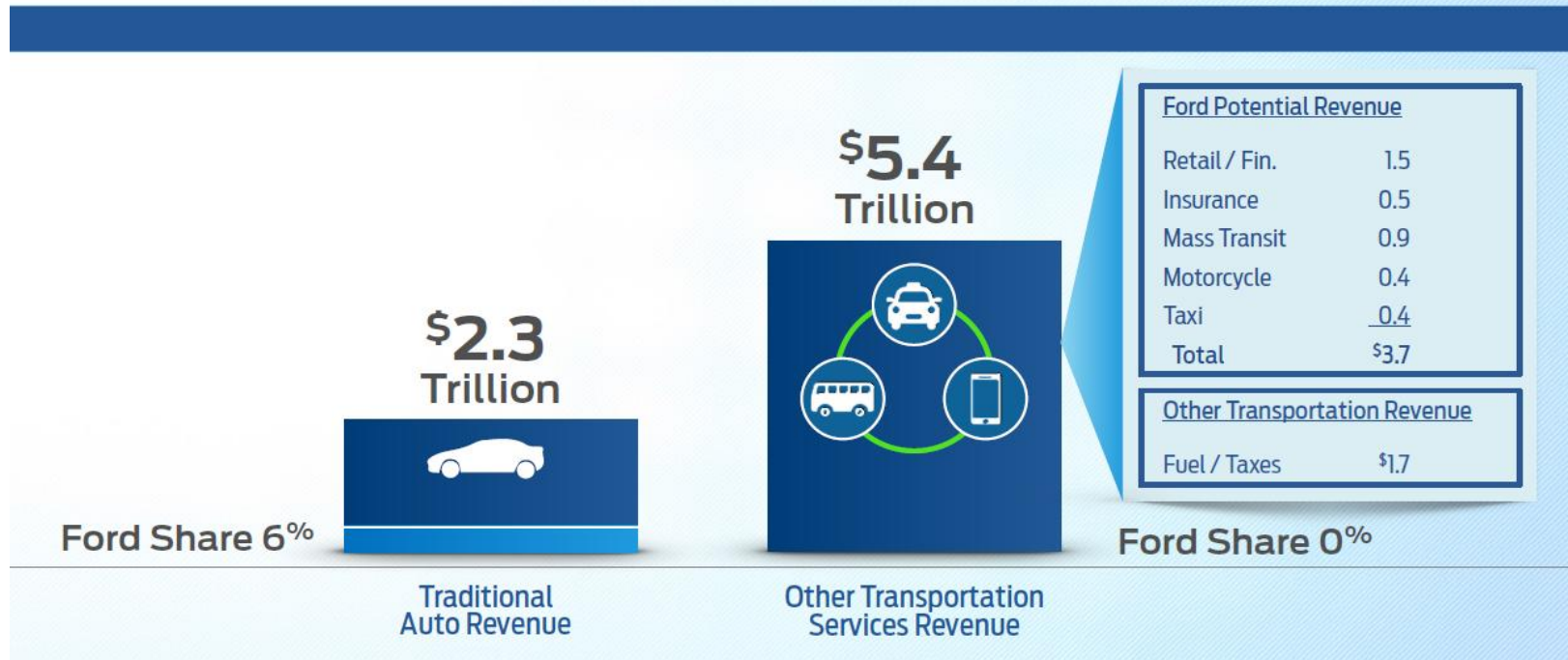
Positives

- Less cyclical
- Higher profitability from recurring revenue (aftermarket, service)
- “Fixes” today’s underperforming segments



Fixing the Business Model

Transforming to auto and mobility company allows significant revenue growth potential



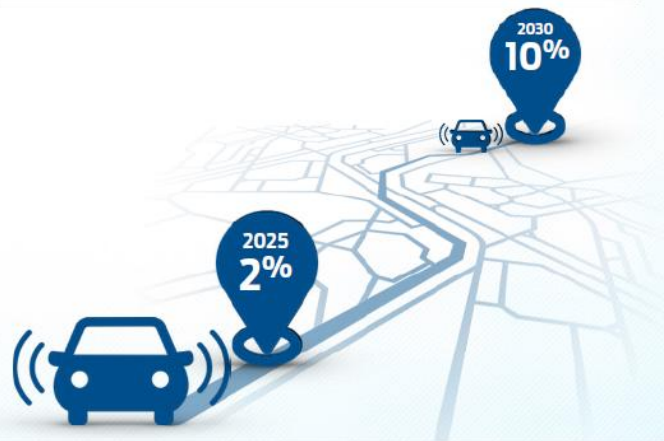


When, exactly will this happen?

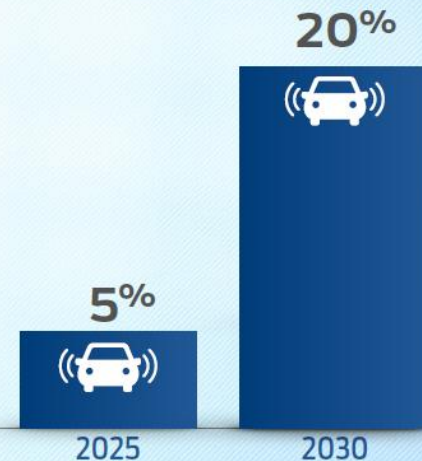
Autonomous vehicles might account for up to one in 10 miles traveled and one in five sales



U.S. Autonomous Miles Traveled
(Percent of Total)



U.S. Autonomous Annual Sales
(Percent of Total)



24



How large will the market be for Suppliers?

30% of 110 MM sold globally will likely have semi-autonomous capabilities

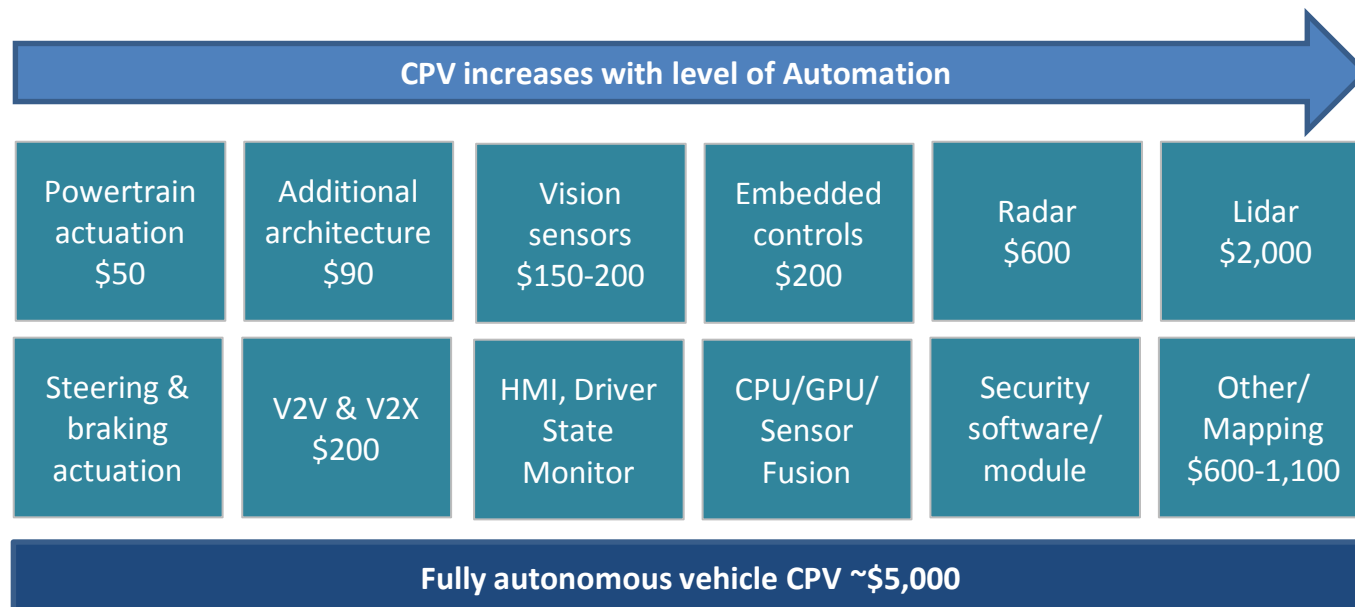
- 33 MM units at \$1,000 per vehicle implies a \$33 bn market

15% of global sales will likely be fully autonomous

- 15 MM units at \$5,000 per vehicle implies a \$82 bn market

Remaining 55% will likely have significant active safety content

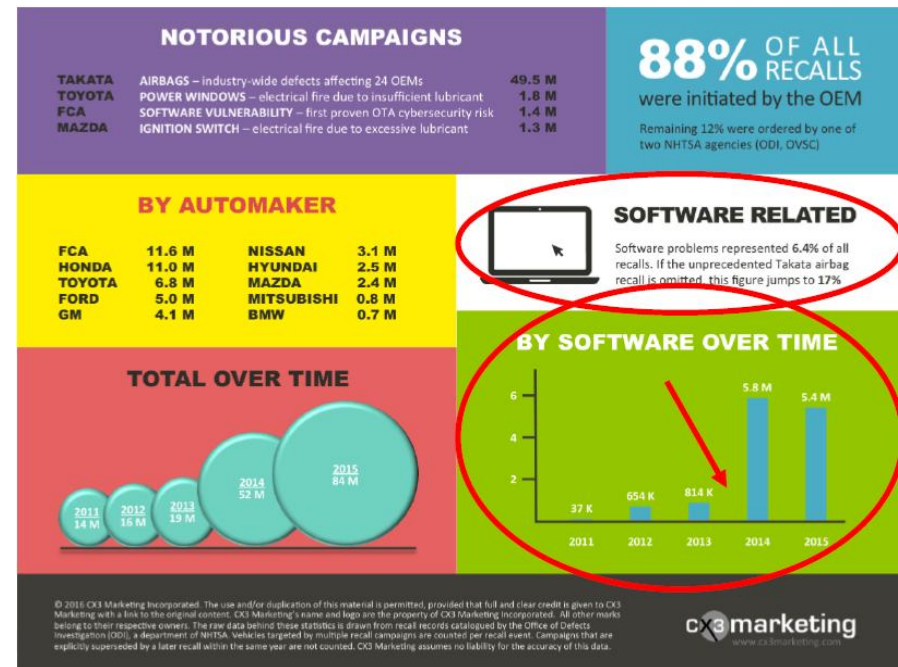
- \$200-\$300 per vehicle this implies an additional \$11 bn





OTA Capability – Will Help OEM's Make Money, Save Money

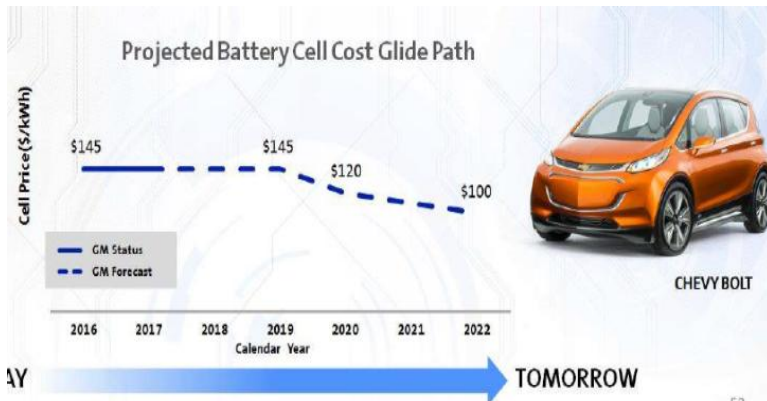
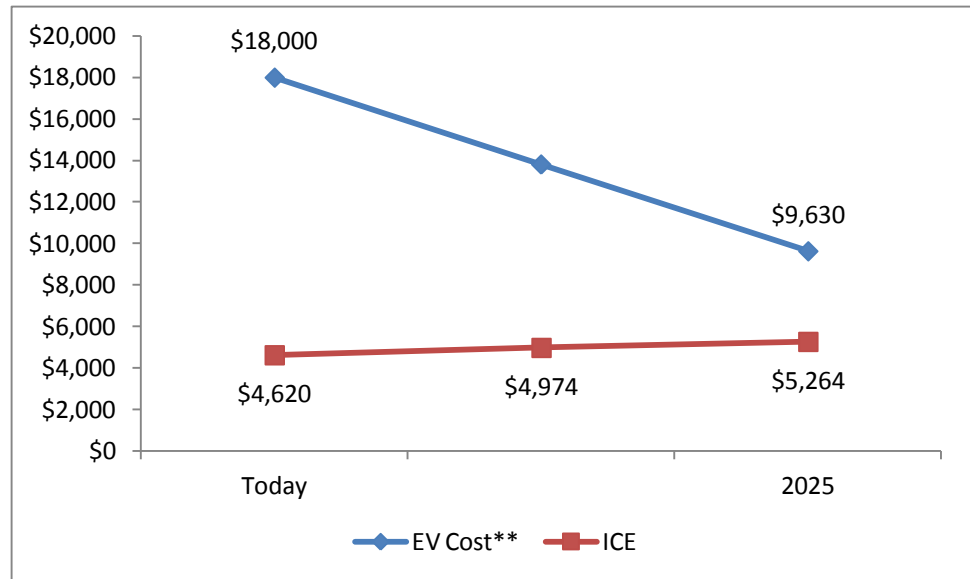
- Avg Car Contains 100MM lines of code
- Suppliers estimate 5-20 flaws per 1,000 lines of code
- Many of these flaws result in campaigns and recalls.
- Ex the Takata recall, 5.4 MM recalls for software problems in 2015, 17% of all U.S. recalls
- On Avg, OEM pays \$6 for every 10 minutes of dealer warranty service.
- 80% of all vehicles produced worldwide will likely have connected infotainment by early in the next decade.





EV costs are declining, but OEMs are still pursuing advanced ICE...

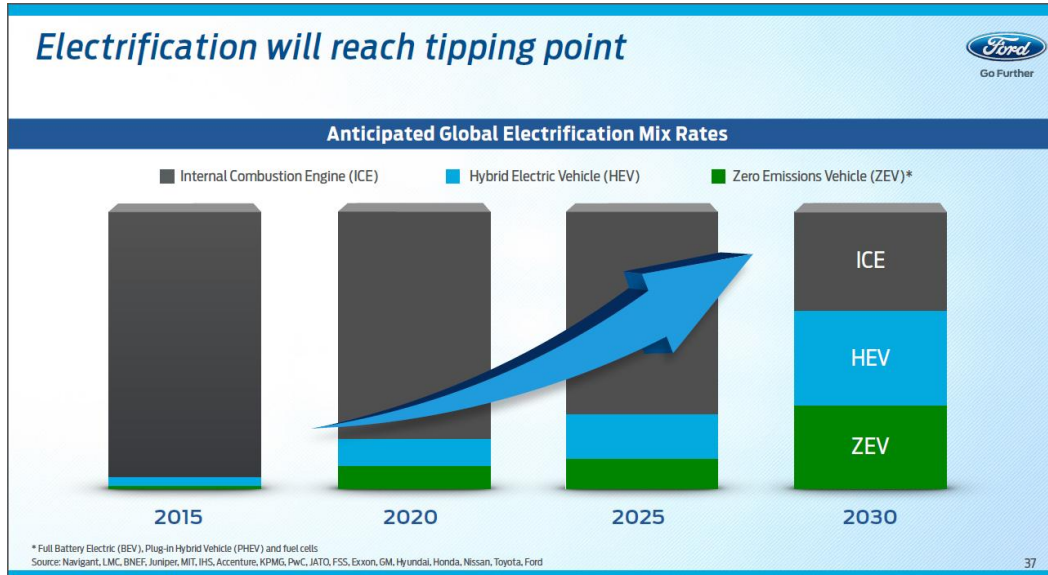
Projected BEV battery cell cost at scale



200 Mile Range EV Powertrain	Today	2025	Notes
60kWh Battery	\$13,500	\$6,000	Today at \$225/kWh; 2025 at \$100/kWh
Motor/transmission	\$1,100	\$730	
Electrical Architecture	\$1,400	\$1,200	EA is \$900 more than ICE
Power Electronics	\$2,000	\$1,700	Power Electronics is \$1,500 more than ICE
Total	\$18,000	\$9,630	



Many expect Electrification to grow rapidly...



Germany Votes for EU Ban on Sales of Internal-Combustion Vehicles by 2030

OCTOBER 10, 2016 AT 12:48 PM BY BOB SOROKANICH | PHOTOGRAPHY BY GETTY IMAGES

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Members of the German government have just passed a resolution to ban the sale of internal-combustion engines in the European Union by 2030. Only zero-emissions vehicles would be allowed on the market after that time, according to the resolution.

OEM/Country	EV Plans/Expectations
F	EV will exceed gasoline-powered vehicles within next 15 years
VW	25% of volume by 2025
Mercedes	25% of volume by 2025
China	NEV's reach 950k units/yr by 2020 w/proposed carbon credit scheme
Germany	Votes for EU ban on sales of ICE by 2030



We are anticipating a somewhat less aggressive BEV trajectory. But there should still be significant growth in Electrification...

Powertrain Mix

Type	Efficiency	Cost	2016	2020	2025
Gas	22%	\$3,500	47%	23%	13%
Turbocharged	24%	\$4,250	31%	47%	39%
Diesel	26%	\$7,500	20%	17%	12%
Adv Gas	28%	\$4,750	1%	1%	4%
48V	30%	\$5,300	0%	6%	22%
HEV	33%	\$7,500	0%	1%	1%
PHEV	60%	\$8,500	1%	3%	5%
BEV	80%	\$9,500	1%	2%	4%
Wtd. Avg. efficiency			24.0%	26.6%	29.5%
Wtd avg. cost			\$4,620	\$4,974	\$5,264



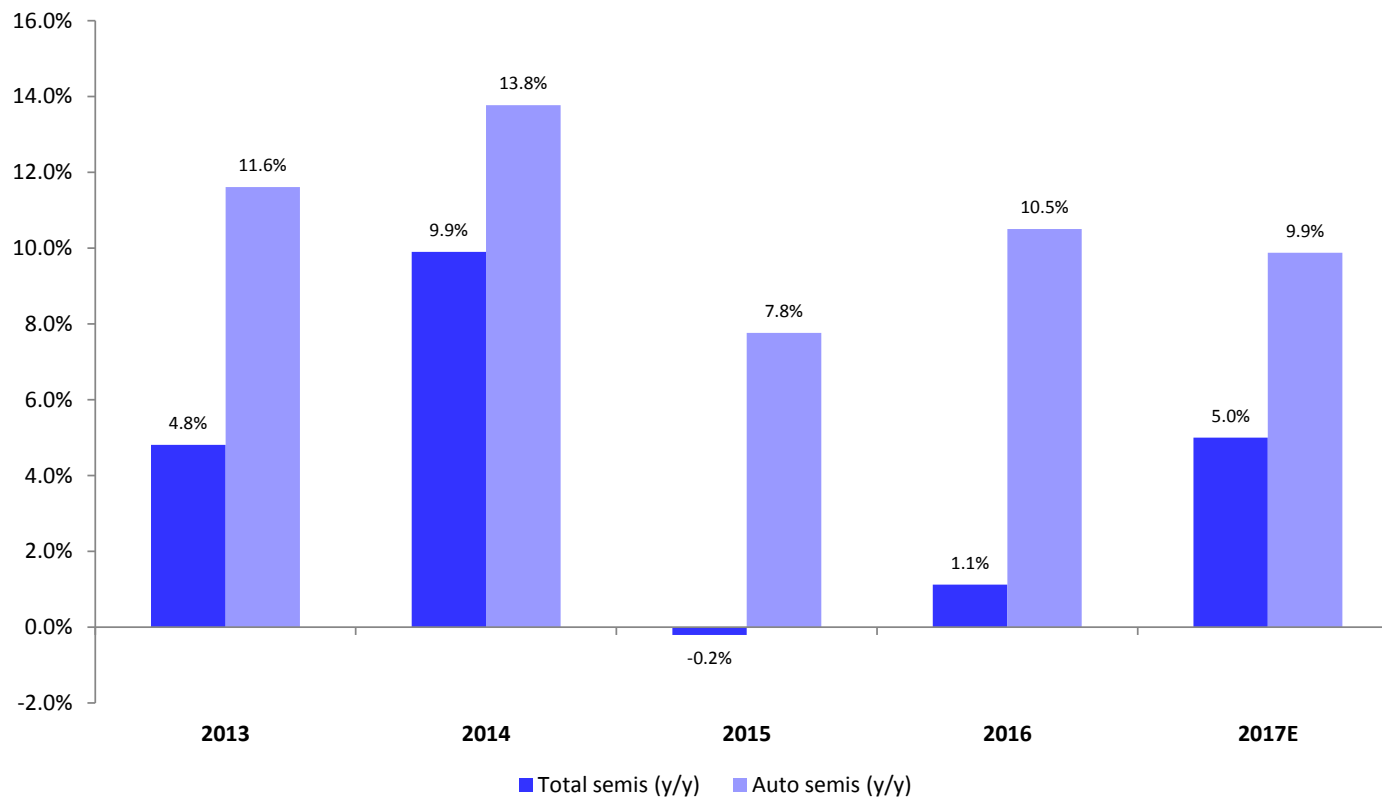
And we see significant growth in Power Electronics and Electrical/Electronic Architectures...

48V Micro Hybrid	Total Cost
Small Lithium Iron Phosphate Battery	\$300
Electrical Architecture	\$650
Power Electronics	\$950
P2 Motor/Clutch System	\$900
Total	\$2,800

200 Mile Range EV Powertrain	Today	2025
60kWh Battery	\$13,500	\$6,000
Motor/transmission	\$1,100	\$730
Electrical Architecture	\$1,400	\$1,200
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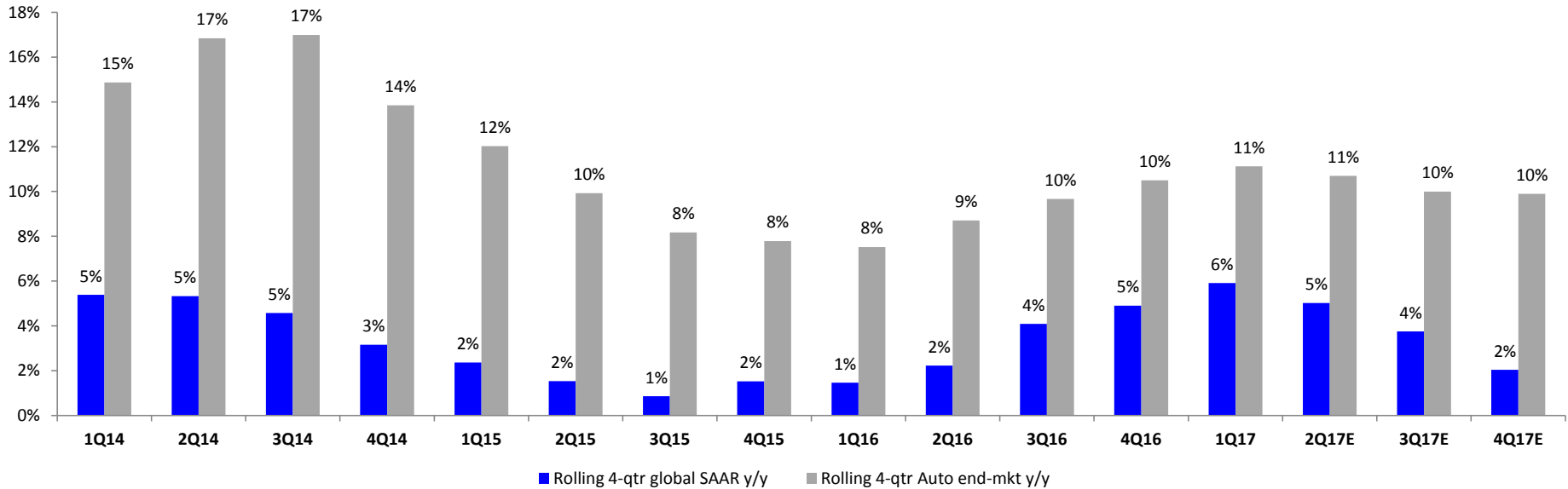
	E/EA	Powertrain	Total
ICE	\$500	\$650	\$1,150
48V	\$650	\$950	\$1,600
HEV	\$800	\$1,700	\$2,500
PHEV	\$1,400	\$2,000	\$3,400
EV	\$1,400	\$2,000	\$3,400

Auto a bright spot in maturing semi market



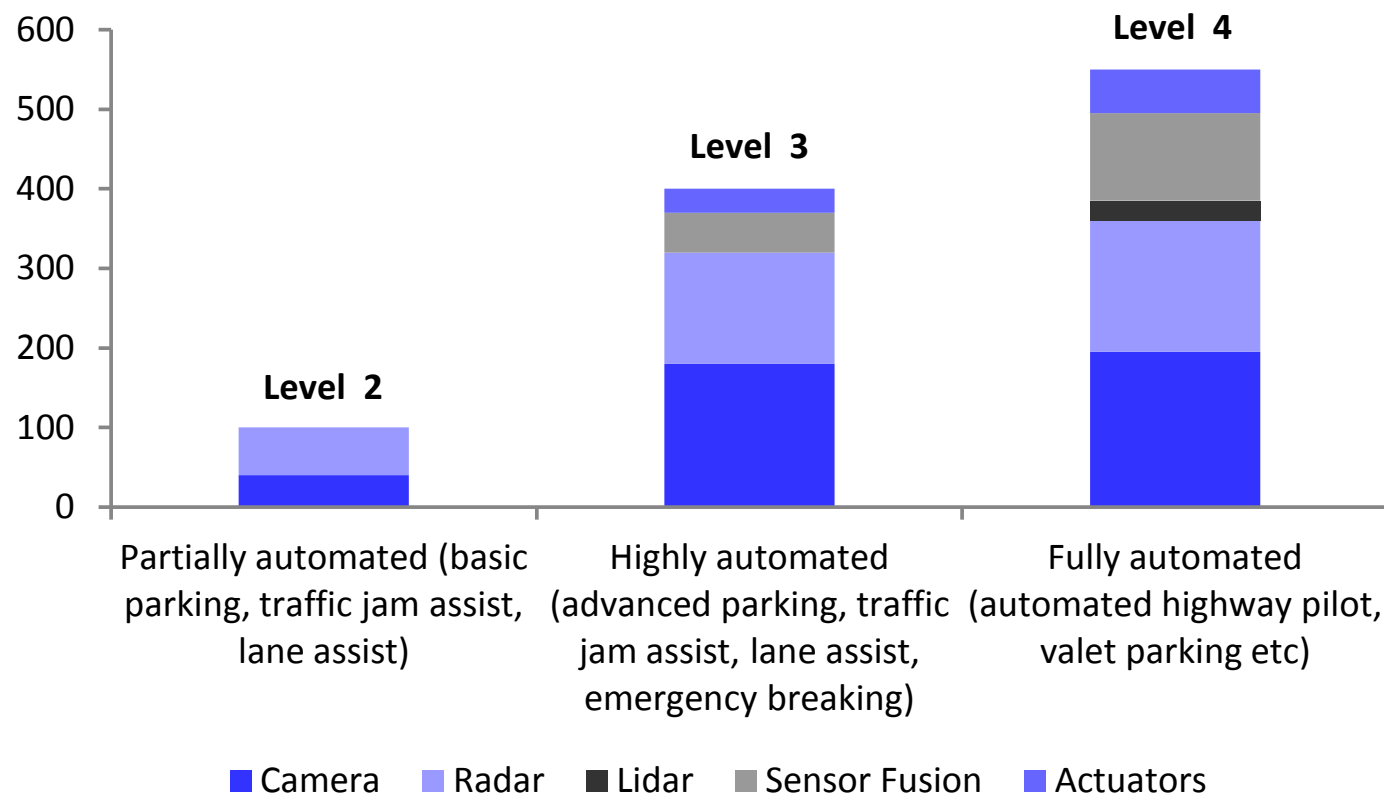
- Auto ~10-15% of semi industry revenues (SIA, DB estimates)
- Outgrowing industry by average of ~7ppts since 2013
- Growth largely from increased electronic vehicle content (e.g., infotainment, H/EV, ADAS)

Growth largely content-driven



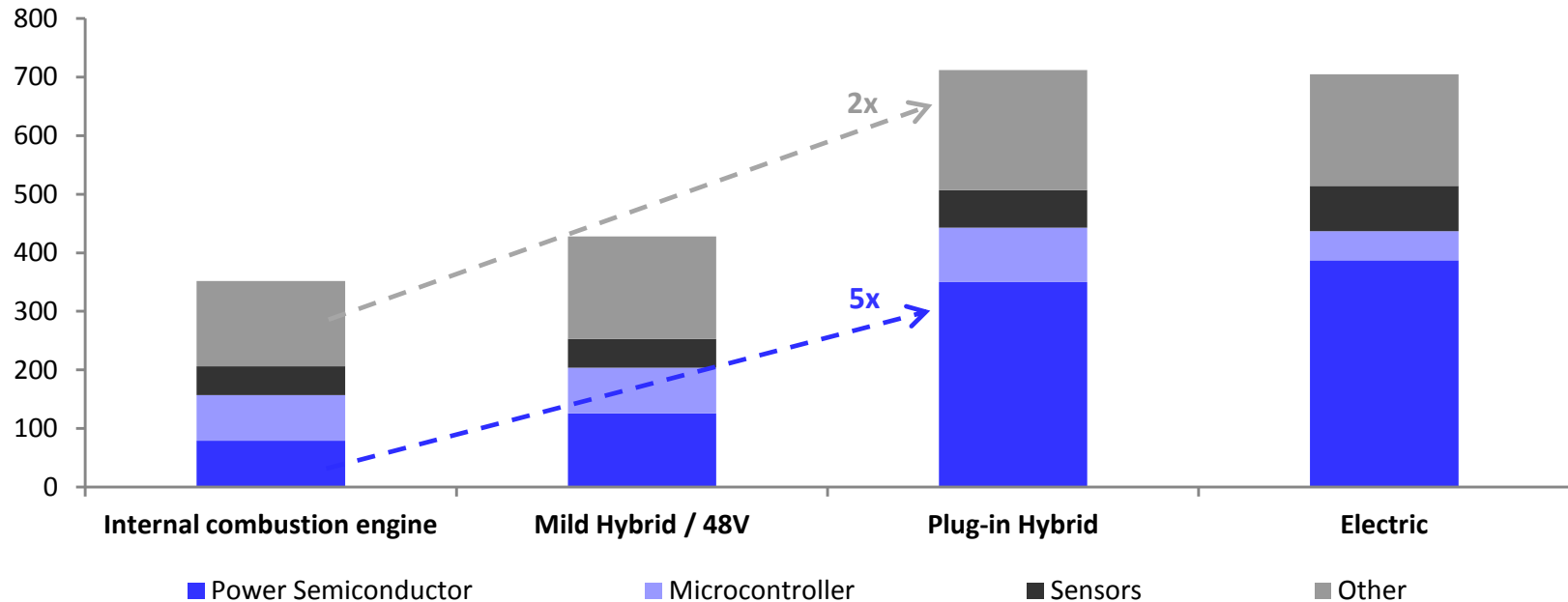
- Historical Auto semi growth roughly +11% y/y on avg, projected +11% y/y in 2017
- Historical SAAR growth roughly +3% y/y on avg, projected +2% y/y in 2017
- Implies high-single-digit semi content growth y/y

ADAS content a meaningful tailwind



- Current average semi content per car ~\$350 (per industry sources & DB estimates)
- Possible addition of up to \$600 (\$400 from semi-autonomous/Level 3 automation)

Potential EV content increases



- Roughly 5x increase in power management semiconductor content from internal-combustion-engine to plug-in hybrid power
- Approximately 2x increase in general other semi content



Sector Valuation and Risks

Our target prices generally utilize EV/EBITDA methodology (P/E in some cases) supported by DCF analysis.

Key upside risks would be potential for global economic recovery to drive higher-than-expected automotive demand. Key downside risks include increased trade protectionism (such as the implementation of BTAs in the U.S.), a reduction in credit availability, pricing deterioration, sustained increase in fuel prices and/or negative pension returns.



Appendix 1

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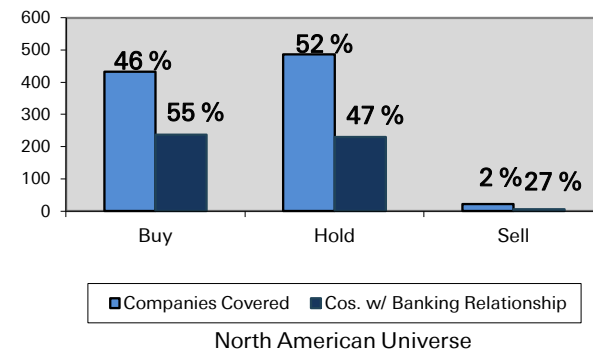
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