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THE FUTURE OF ELECTRIC AND AUTONOMOUS VEHICLES

iCRMH0922U/S-2415786-1/23

Lessons from the horses to horsepower transition

For illustrative use only

DISPENSE WITH A HORSE

and save the expense, care and anxiety of keeping it. To run a motor carriage costs about ½ cent a mile.

THE WINTON MOTOR CARRIAGE

is the best vehicle of its kind that is made. It is handsomely, strongly and yet lightly constructed and elegantly finished. Easily managed. Speed from 3 to 20 miles an hour. The hydrocarbon motor is simple and powerful. No odor, no vibration. Suspension Wire Wheels. Pneumatic Tires. Ball Bearings. ☞ *Send for Catalogue.*

Price $1,000. *No Agents.*

THE WINTON MOTOR CARRIAGE CO., Cleveland, Ohio.

From 1905–1930 the number of horse-drawn carriages fell

93%

Source: International Monetary Fund (IMF) Riding the Energy Transition, May 2017.

The road is paved for EV and AV growth

66m

EV sales projection for 2040 [1]

$7T

Global AV market in 2050 [2]

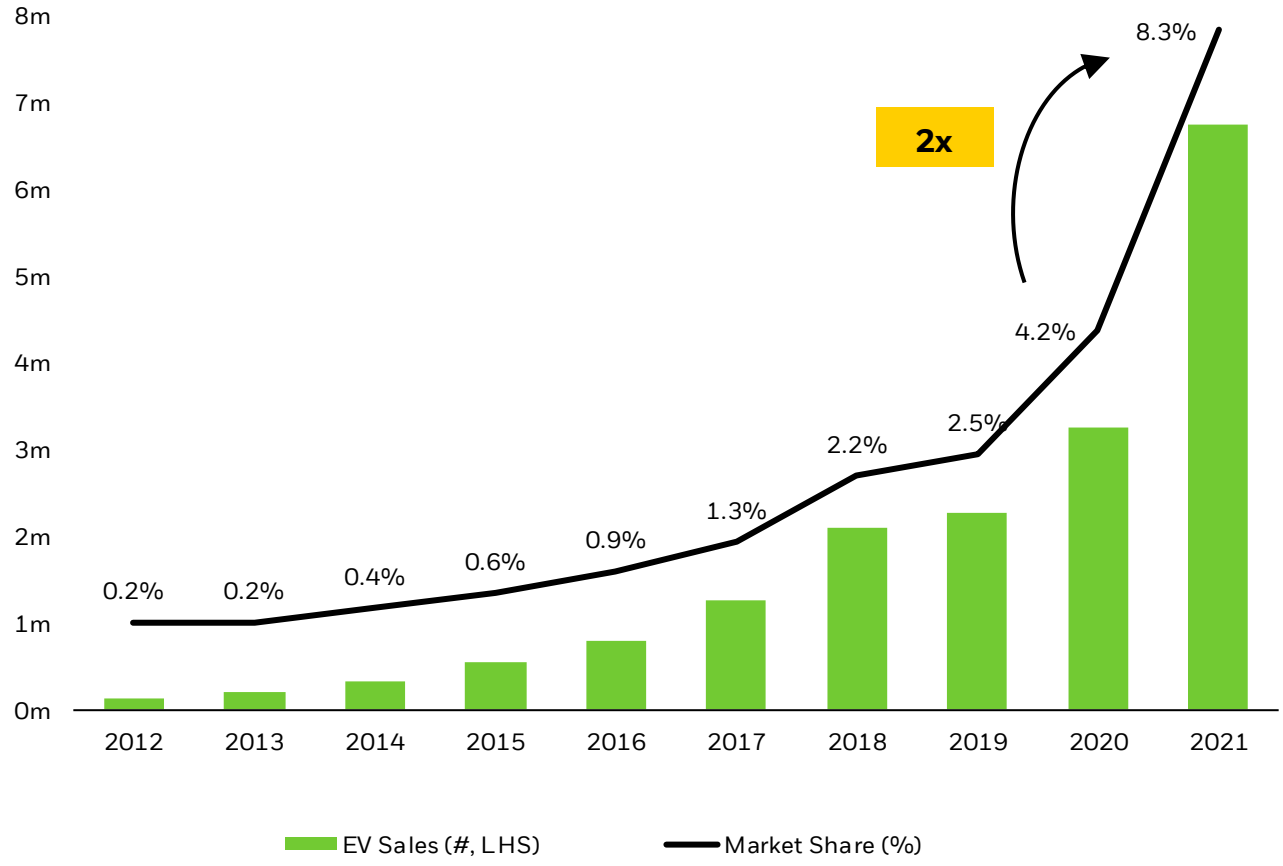
~9x

EV battery market growth by 2030 [3]

Sources: **1** Bloomberg, Bloomberg NEF Transition Scenario, 2021 **2** Strategic Analytics, Accelerating the Future: The Economic Impact of the Emerging Passenger Economy, 2017 **3** The Lithium-Ion (EV) battery market and supply chain: Market drivers and emerging supply chain risks, Avicenne Fraunhofer, HIS Markit, Roland Berger, April 2022. No guarantee these forecasts come to pass.

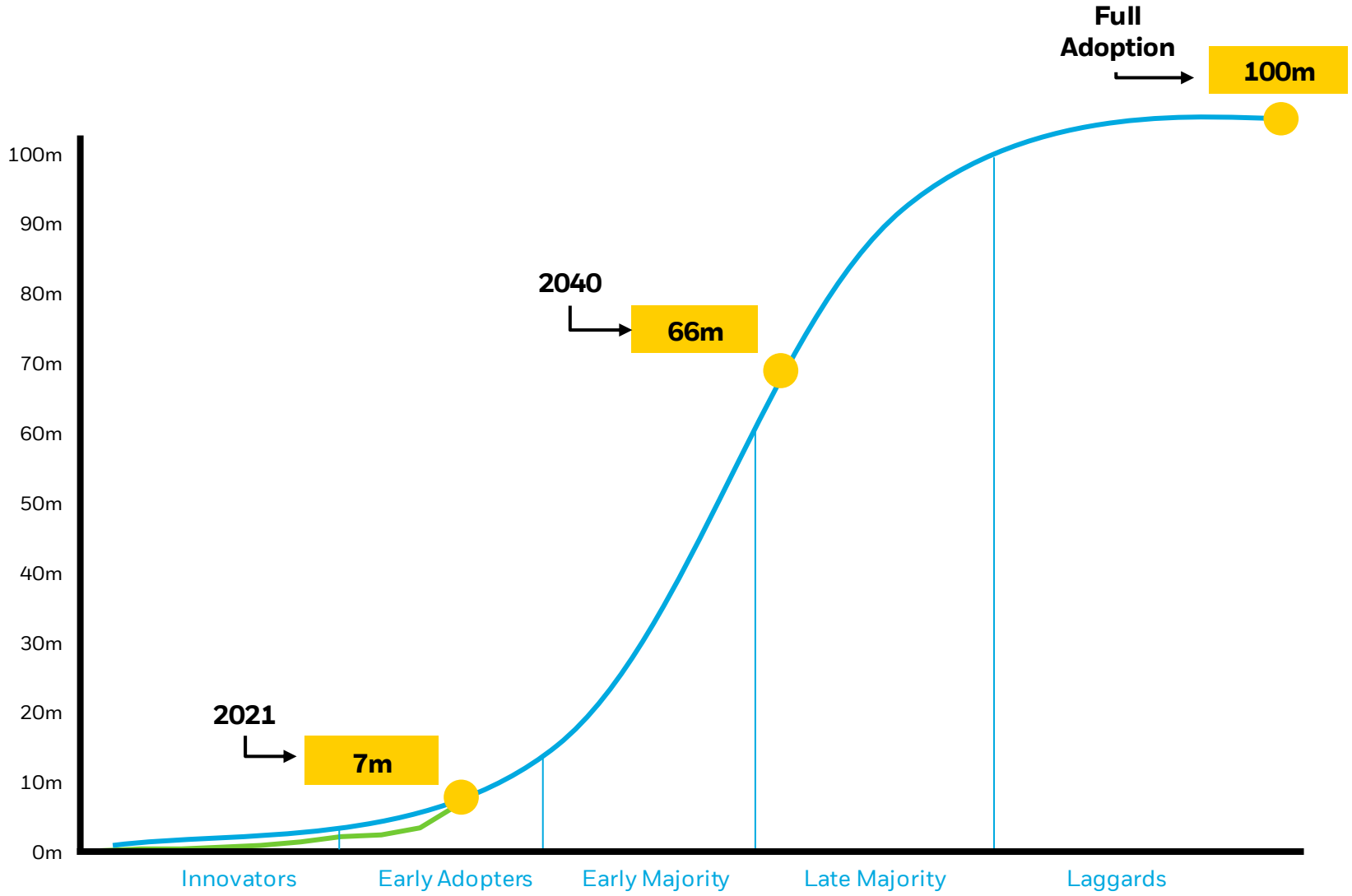
EVs are the fastest growing auto segment

EVs are capturing market share over traditional combustion engine counterparts (ICEs) at an accelerating pace



Source: EV-Volumes.com, Global EV Sales for 2021,2022

EV adoption is surging ahead on the S Curve



Sources: **1** Bloomberg, Bloomberg NEF Transition Scenario, 2021 **2** EV-Volumes.com, "Global EV Sales for 2021," 2022

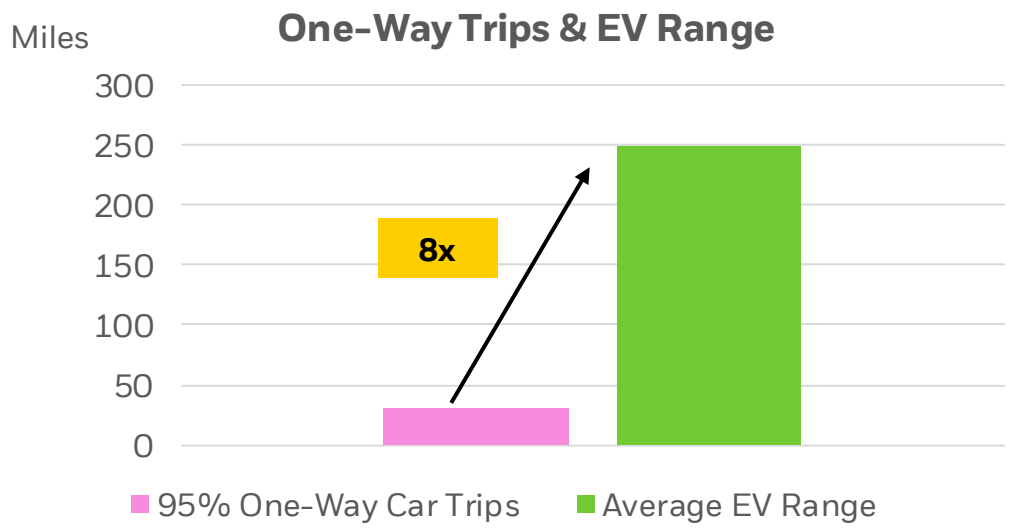
EVs vs ICEs

While price parity is anticipated as early as 2025, what are the key differences today?

EVs	Vs.	ICEs
	PRICE	✓
✓	LIFETIME COST	
✓	CO2 EMISSIONS	
	RANGE	✓
	STATION PROXIMITY	✓
✓	FUEL COST	

Putting EV adoption in gear

The vast majority of driving is within EV range



...But consumer adoption hinges on range and infrastructure as well as price [3]

55K

U.S. charging stations [4]

145K

U.S. gas stations [5]

500K

USG target for new EV stations [6]

Sources: One-Way Trips & EV Range Chart: **1** Department of Energy, FOTW#1042, August 13, 2018: In 2017 Nearly 60% of All Vehicle Trips Were Less Than Six Miles, 2018 **2** Department of Energy, FOTW#1167, January 4, 2021, Median Driving Range of All-Electric Vehicles Tops 250 Miles for Model Year 2020; **3** AAA, Owning an Electric Vehicle is the Cure for Most Consumer Concerns, 2020 **4** IEA, Trends in charging infrastructure – Global EV Outlook, 2022 **5** API, Service Station FAQs, 2022 API | Service Station FAQs **6** IEA, Global Electric Vehicle Outlook, 2022

Broader electrification is continuing full throttle

195m
China's two-wheel fleet [1]

40%
India's three-wheelers are EVs [2]

$5b
U.S. investment to electrify school buses [3]

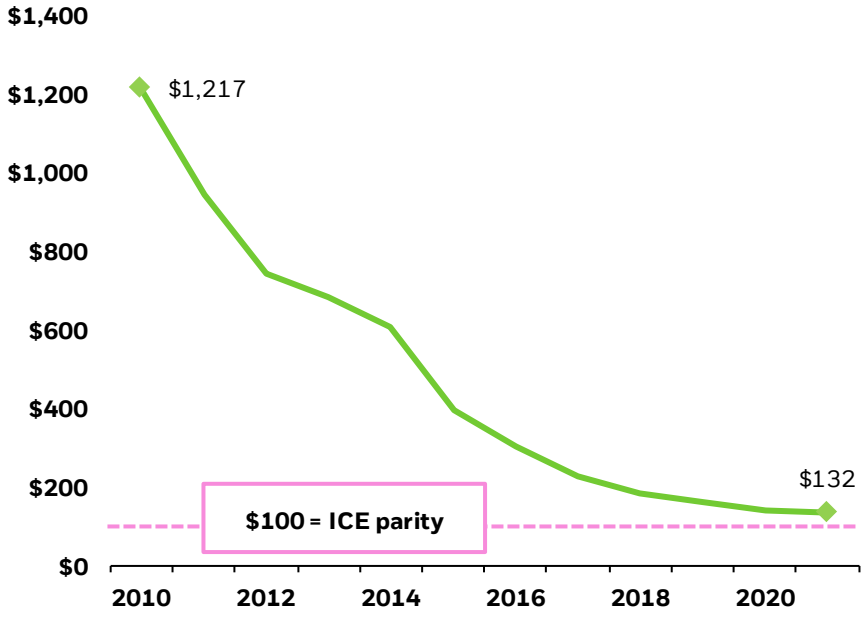
100%
Norway's 2030 commitment for zero emissions heavy-duty vehicle sales [4]

Sources: **1, 2** Bloomberg, Bloomberg New Energy Finance EV Outlook, 2022 **3** EPA, Biden-Harris Administration Makes $500 Million Available for Clean School Buses Through EPA, 2022 **4** IEA, Global Electric Vehicle Outlook, 2022

Battery prices have declined, demand is rising

EV batteries are significantly cheaper than in the past

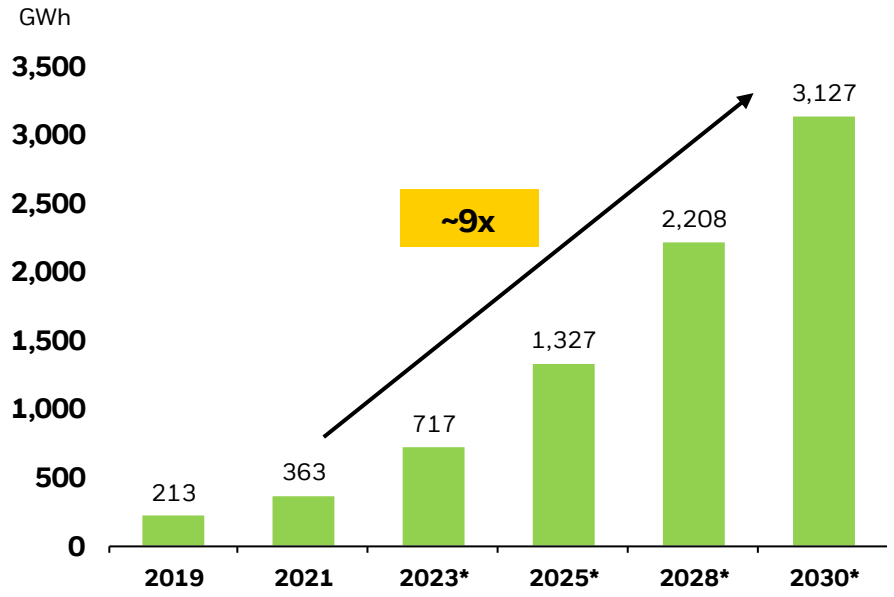
Lithium-ion battery packs cost (2021 $/kWh)



Source: Bloomberg, November 2021.

Global demand for Lithium-ion batteries is growing rapidly

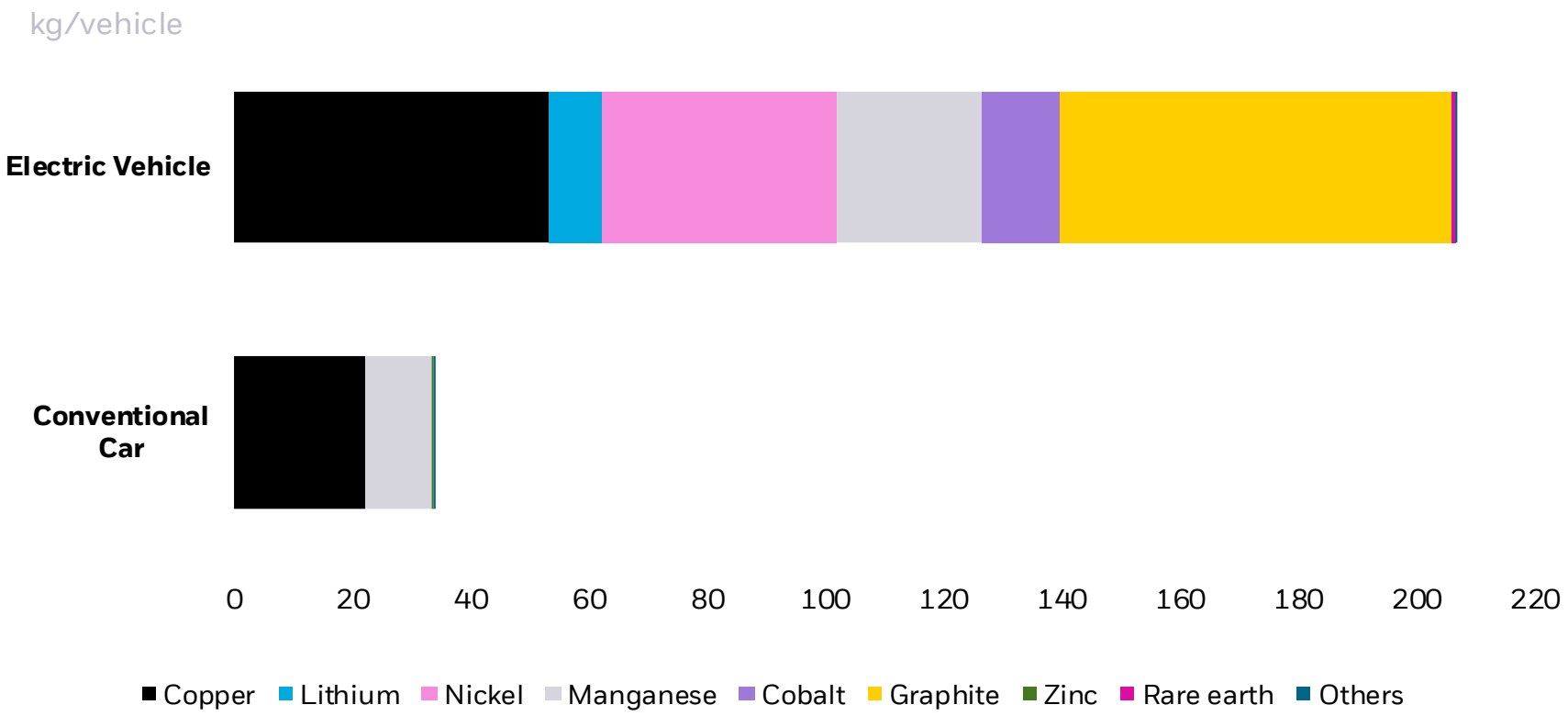
Market demand for Lithium-ion batteries (in GWh)



*Forecast.

Source: Avicenne Fraunhofer, HIS Markit, Roland Berger, 2022.

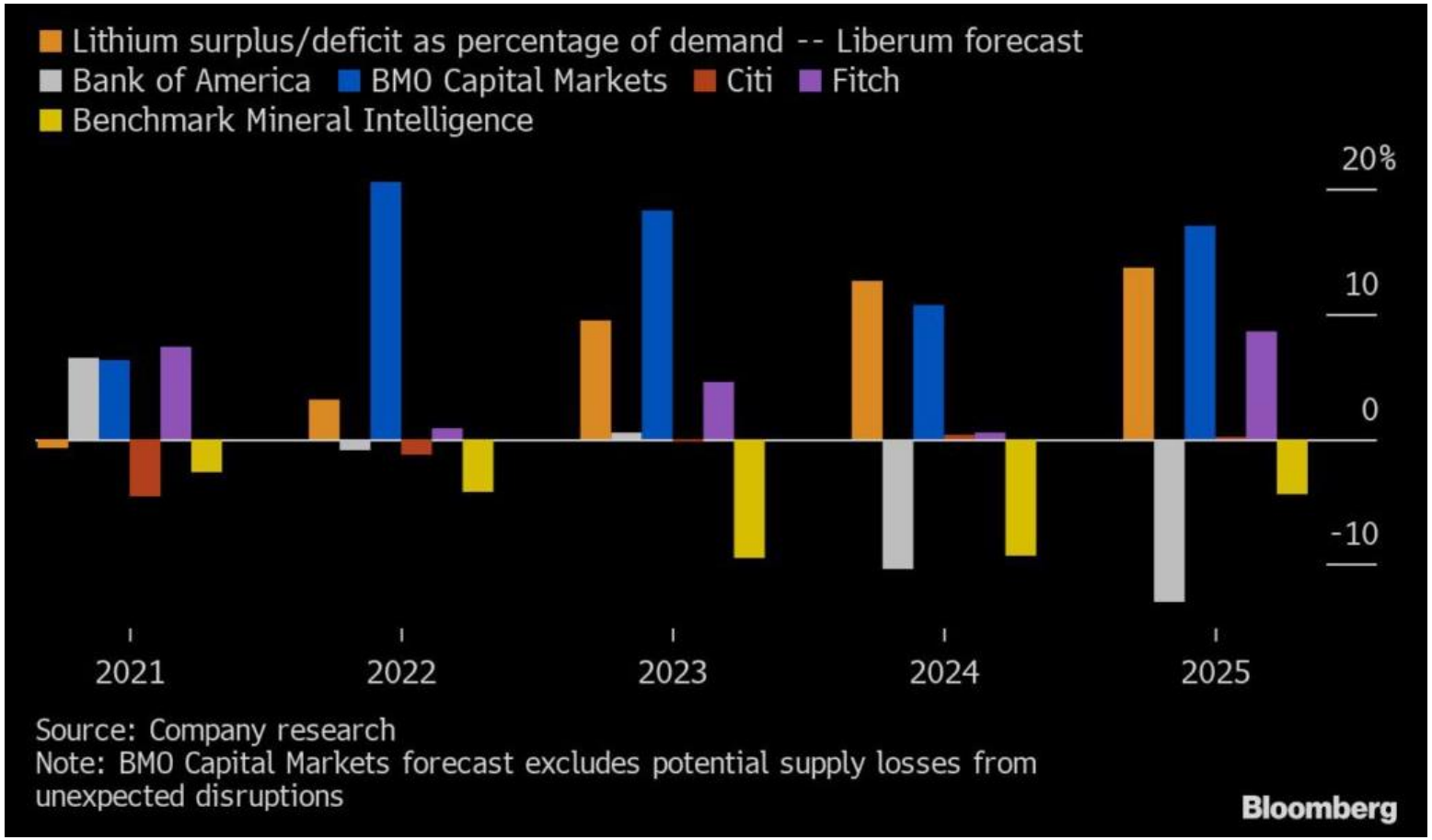
EVs use 6x the raw materials



Source: IEA, The Role of Critical Minerals in Clean Energy Transitions, 2021

Will this result in a lithium deficit?

Top analysts are split on whether lithium is heading for surpluses or deficits



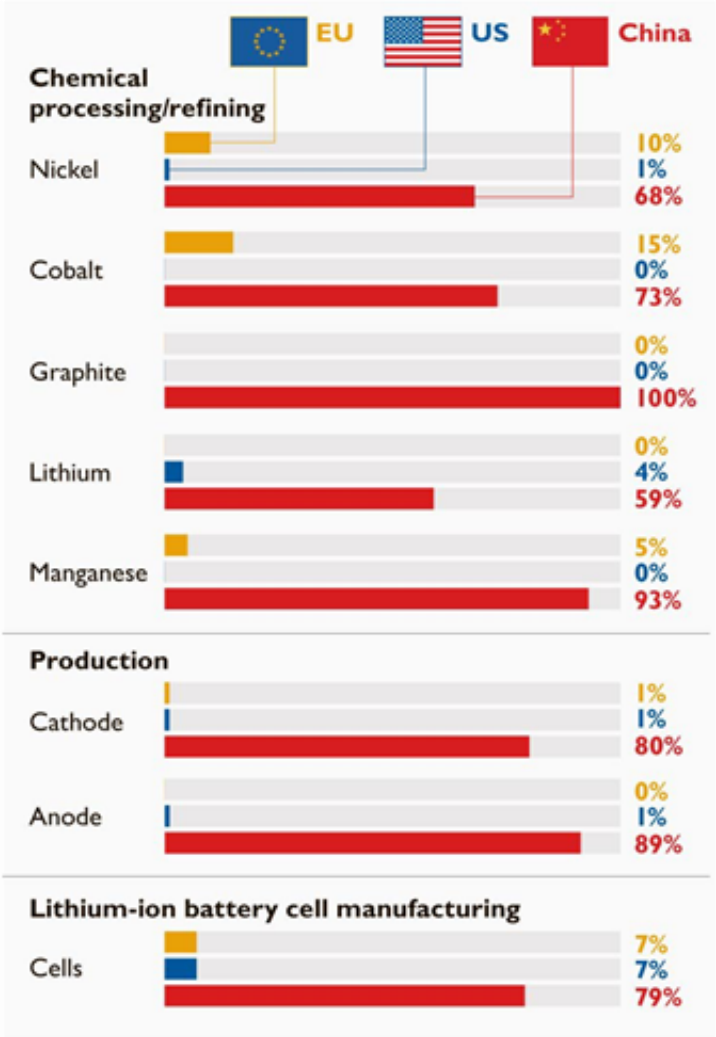
Source: Bloomberg, How Much Lithium Will the World Need? It Depends Who You Ask, Mark Burton, 2022. There is no guarantee these forecasts come to pass.

China dominates today's EV supply chain

China accounts for **59% to 100% of processing** for key minerals required in EV manufacturing

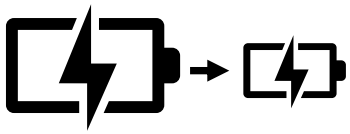
China also accounts for **79% to 89% of production** for Lithium-ion batteries

China leads processing for key EV minerals



Source: Benchmark Mineral Intelligence and The Times, Who Owns the Earth? The scramble for minerals turns critical, Jon Yeomans and Fred Harter, 2022

Paths to reducing EV battery cost

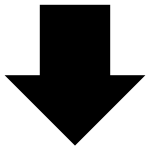


Make a Smaller Battery

- A **75 mile battery** is more than enough for **95% of car trips** 1
- Tesla Model 3 battery has **358 mile** range and currently **costs $10,800** 2
- Using this as proxy, **a 75 mile battery could cost ~$2300**.

Produce Batteries More Efficiently

- Tesla's next-gen 4680 battery pack for the Model Y is **$3600 less expensive** to produce than traditional Model Y 2170 battery pack
- Fewer cells and weld points and dry-coating are among the efficiencies that could help Tesla reach its goal of slashing battery costs 50% 3



Use Cheaper/ Fewer Materials

- **NMC** lithium-ion batteries dominate today's market at 85% but that may be changing 4
- **LFP** lithium-ion batteries **cost 20-30% less** than NMCs by using cheaper raw materials 5
- Last year **LFP demand more than doubled** to 15% from 7% in 2020; Tesla, Ford, and Volkswagen are those leading the surge in LFP 6

Sources: **1** Department of Energy, FOTW#1042, August 13, 2018: In 2017 Nearly 60% of All Vehicle Trips Were Less Than Six Miles, 2018 **2** Tesla Model 3, 2022 **3** Notebook Check, Tesla able to slash the Model Y price significantly with 4680 battery pack cost savings, Daniel Zlatev, 2022 **4** IEA, Global Electric Vehicle Outlook 2022 **5** Forbes, Ford Makes Major Commitment to CATL Lithium Iron Phosphate EV Batteries, Sam Abuelsamid, 2022 **6** IEA, Global Electric Vehicle Outlook 2022

Energy storage is charging ahead

Lithium-Ion batteries dominate the EV market

Alternative battery chemistries under development could be game changers

Hydrogen fuel cell technology is a promising alternative for some vehicles

Source: World Bank Group, Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition, 2020

US policy tailwinds: where the rubber meets the road

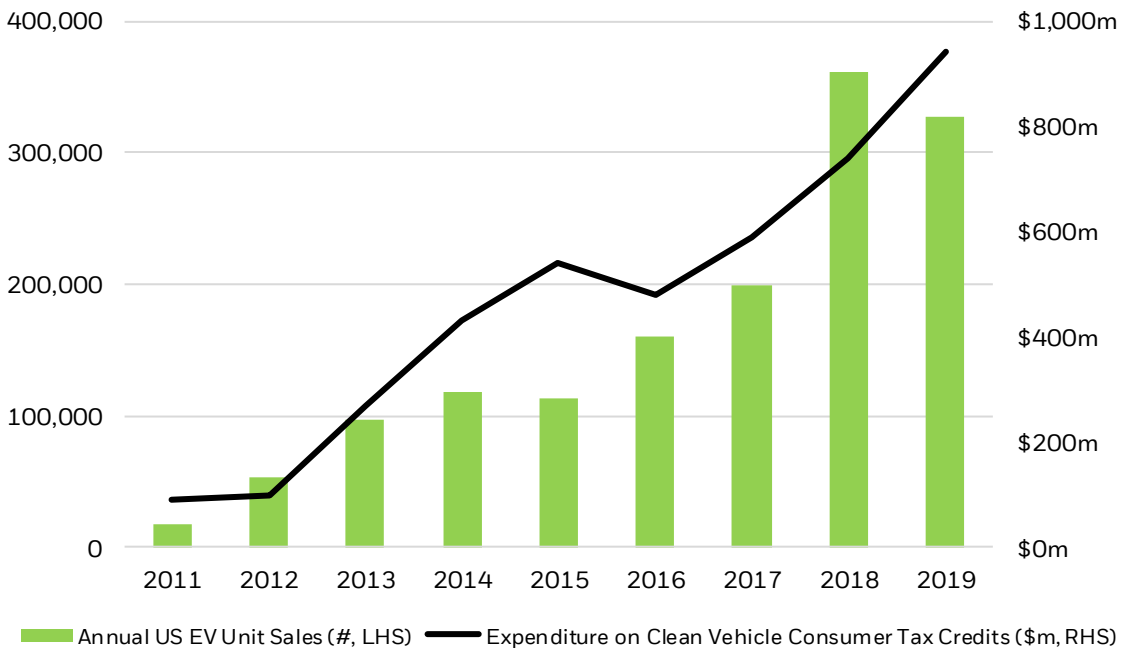
Inflation Reduction Act includes

- **$7,500** consumer tax credits for new EVs [1]
- **Manufacturing tax credits** for producing EVs and EV batteries, and building new manufacturing plants
- **$20b** in clean manufacturing loans, **$2b** in EV facilities grants, and **$4b** for zero-emissions public transit and postal fleet [2]

IIJA laid the foundation:

- **$7.5b** for EV charging network [3]
- **50% EV market share** goal for 2030 [4]
- Charging station **every 50 miles** on major transit corridor [1]

Consumer tax credits historically essential to US EV demand



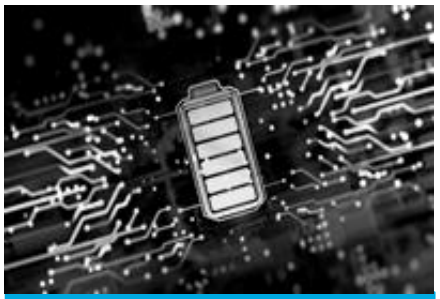
Note: Tax credit expenditures reflect federal budget estimates from nearest fiscal year total tax expenditure release

Source: US Department of the Treasury Annual Tax Expenditure Releases, 2012-2021; IEA, 2022.

Sources: **1** White House, FACT SHEET: President Biden Announces Steps to Drive American Leadership Forward on Clean Cars and Trucks, 2021 **2** U.S. Senate, Summary of the Energy Security and Climate Change Investments in the Inflation Reduction Act of 2022, 2022 **3** White House FACT SHEET: Biden-Harris Administration Proposes New Standards for National Electric Vehicle Charging Network 2022, **4** White House, FACT SHEET: President Biden Announces Steps to Drive American Leadership Forward on Clean Cars and Trucks, 2021 **5** Bloomberg, Biden's $5 Billion Plan for Half a Million of US Electric Car Charging Stations, David R. Baker and Kyle Stock, 2022

An electric future: paving the way

Raw Materials



Battery Production

EV Manufacturing

Charging Infrastructure

Electric Vehicle Value Chain

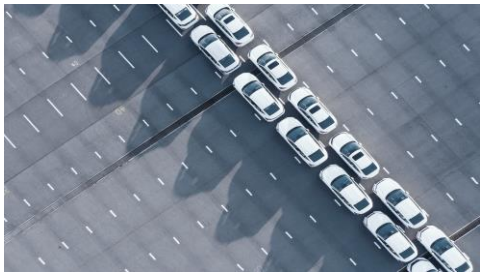
Where does autonomous driving tech stand?

Self-Driving System Level	Description	Fallback	Broad Commercial Availability?
1	**Driver Assistance** Automates either steering or acceleration, with human driver monitoring environment and controlling non automated functions	Human driver	
2	**Partial Automation** Automates both steering and acceleration, with human driver monitoring environment and performing dynamic driving tasks	Human driver	
3	**Conditional Automation** Automates all functions, but will sometimes request intervention from human driver	Human driver	Not yet!
4	**High Automation** Automates all functions in some conditions, without requiring human intervention	Driving system	
5	**Full Automation** Automates all functions in all environments, without requiring human intervention	Driving system	

Survey of auto execs said fully autonomous vehicles could reach streets as early as 2025 [2]

Source: **1** *Ahmed, H.U.; Huang, Y.; Lu, P.; Bridgelall, R. Technology Developments and Impacts of Connected and Autonomous Vehicles: An Overview. Smart Cities, 2022* **2** McKinsey, What's next for autonomous vehicles?, 2021.

AVs in action



In May, Mercedes-Benz began **commercial sales of a Level 3 AV** in Germany [1]

Waymo has logged well over **20m autonomous miles and now** offers **fully autonomous ride-hailing** services in the East Valley of Phoenix [2]

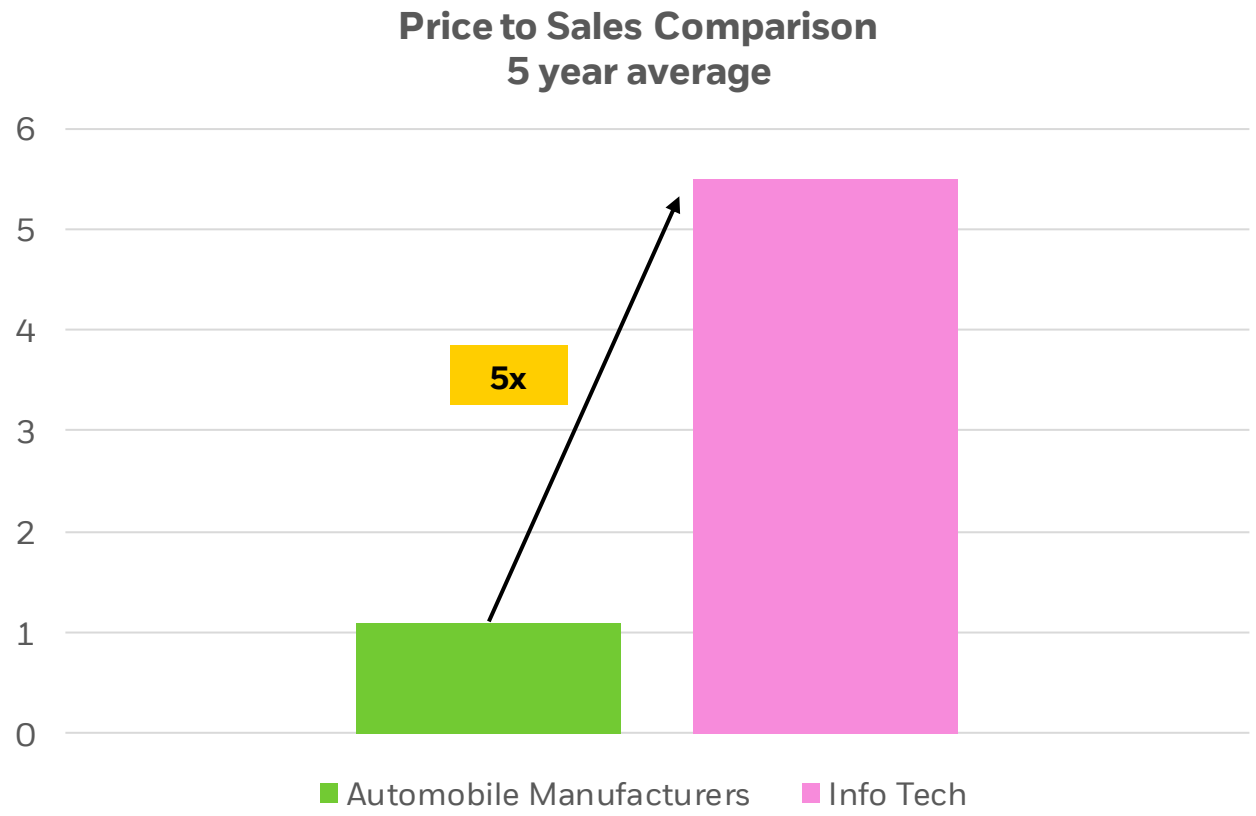
Lyft and Motional announced the 2023 launch of a **self-driving car service for the Las Vegas Strip** complete with safety drivers [3]

Broader AV adoption hinges on regulatory certainty, edge cases, and consumer confidence

Sources: **1** Inside EVs, Mercedes-Benz to Start Selling Level 3 DRIVE PILOT In Germany, Steven Loveday, 2022 **2** Waymo, FAQ, 2022 **3** NYTimes, Lyft Unveils Self-Driving Car Service in Las Vegas, Cade Metz, 2022

Is the race to AVs a stock story?

AV companies can close this gap and achieve valuation closer to tech



Tech Sector valuations are more than 5x those of auto manufacturers

Source: Bloomberg comparing 5-Year Average LTM P/S of S&P 500 Info Tech Sector Index and S&P 500 Automobile Manufacturers Index

What might change in a fully autonomous future?

Green Space

Parking spots are 1/3 land area in U.S. cities 1

Safety

1.35m fatalities from road traffic crashes worldwide each year 2

Financial Savings

Americans lose $88b a year to congestion. Car ownership costs $10,728 on average – that's 25% the median U.S. income 3, 4, 5

Free Time

Americans lose nearly 100 hours each year due to commuting in traffic 8

Cleaner Air & Less Waste

GHG emissions from transportation is 27% total U.S. emissions and ~3.5b gallons excess fuel used in congestion 6,7

1 Fast Company, America has eight parking spaces for every car. Here's how cities are rethinking that land, Daniel Baldwin Hess and Jeffrey Rehler, 2021 **2** WHO, Global status report on road safety, 2018 **3** INRIX, INRIX: Congestion Costs Each American Nearly 100 Hours, $1,400 A Year, 2020 **4** AAA, Annual Cost Of New Car Ownership Crosses 10K Mark, 2022 **5** U.S. Census, Income and Poverty in the United States: 2020, 2021 **6** EPA, Car Pollution from Transportation, 2022 **7** EPA, FOTW #1204, September 20, 2021: Fuel Wasted Due to U.S. Traffic Congestion in 2020 Cut in Half from 2019 to 2020, 2021 **8** INRIX, INRIX: Congestion Costs Each American Nearly 100 Hours, $1,400 A Year, 2020

We're far down the road to electric & autonomous vehicle adoption

Important Information

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The Dynamics Changing the Automobile Industry

CFA Society of Detroit - Sept 2022

Kevin Tynan, Global Director – Automotive
Bloomberg Intelligence

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135+ industries

2,000+ companies

15yrs avg. analyst experience

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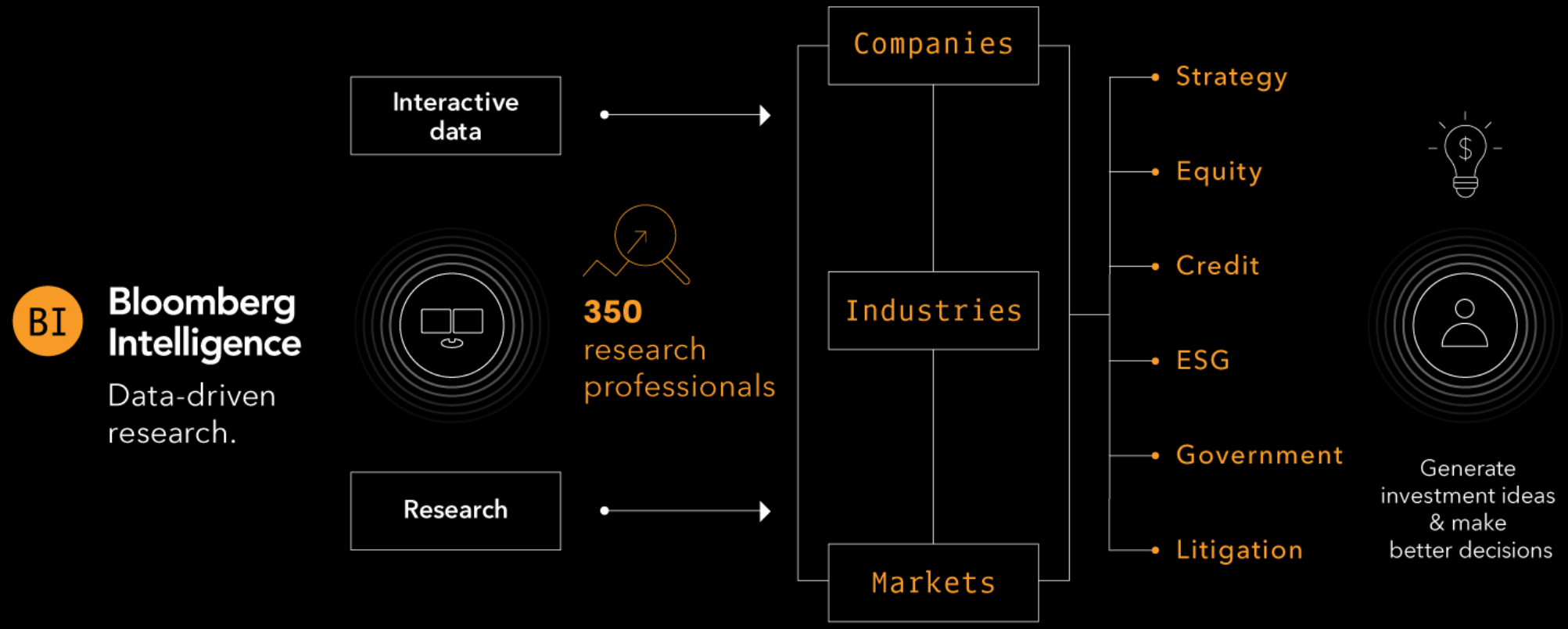


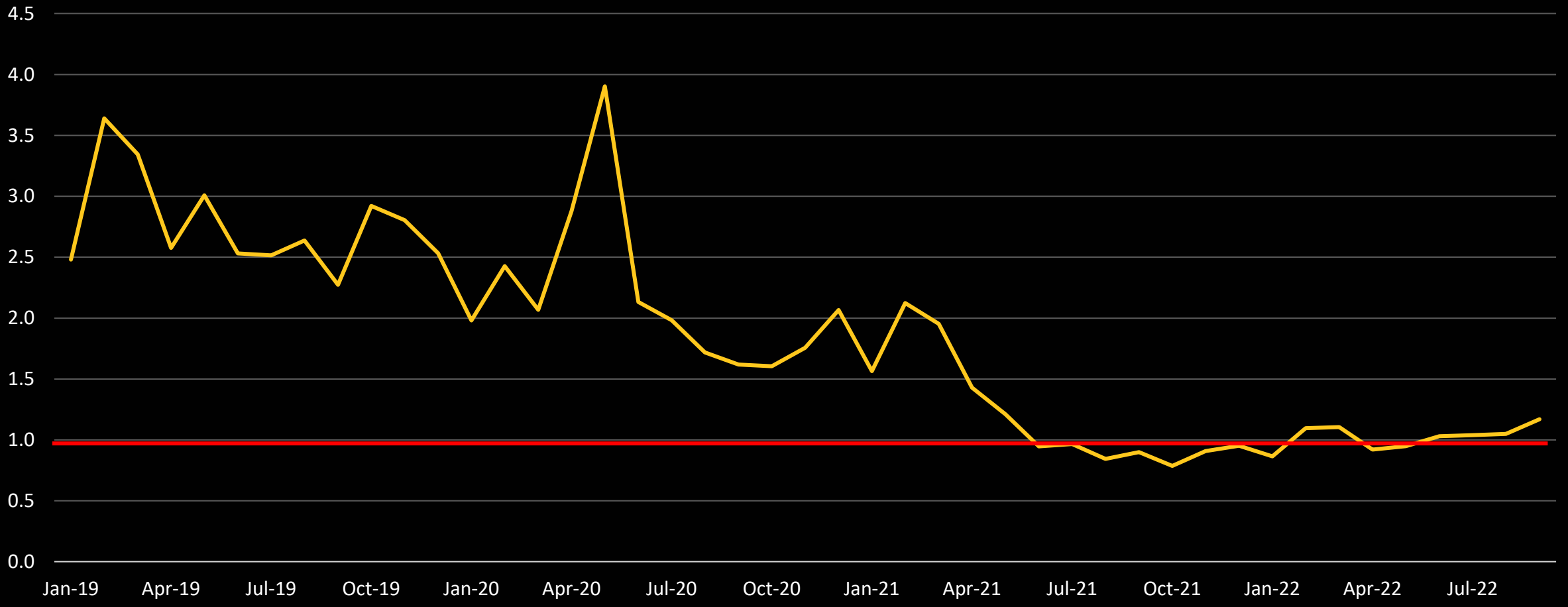
The New Normals

Inventory

Bloomberg Intelligence

US NEW VEHICLE INVENTORY-TO-SALES RATIO

total unit volume

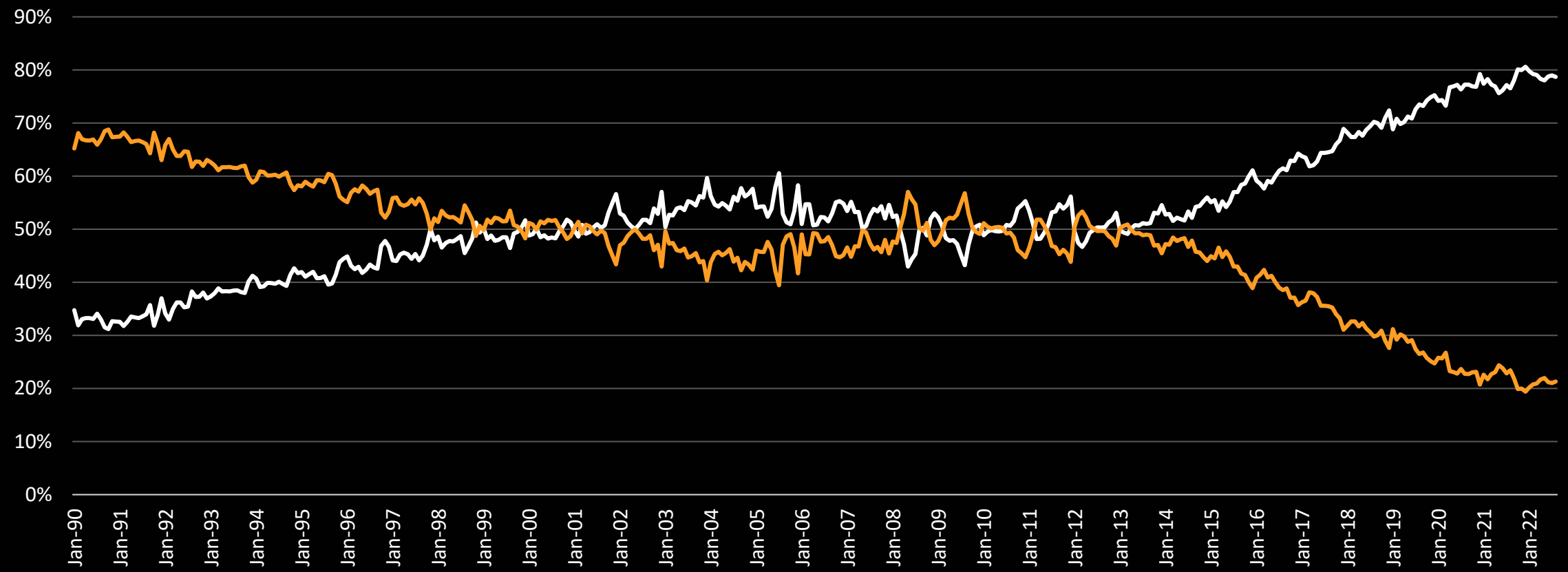


Bloomberg Intelligence BI

Source: Company Data, Crain Communications, LotLinx, Bloomberg Intelligence

US LIGHT TRUCK AND CAR SALES

As % of total volume

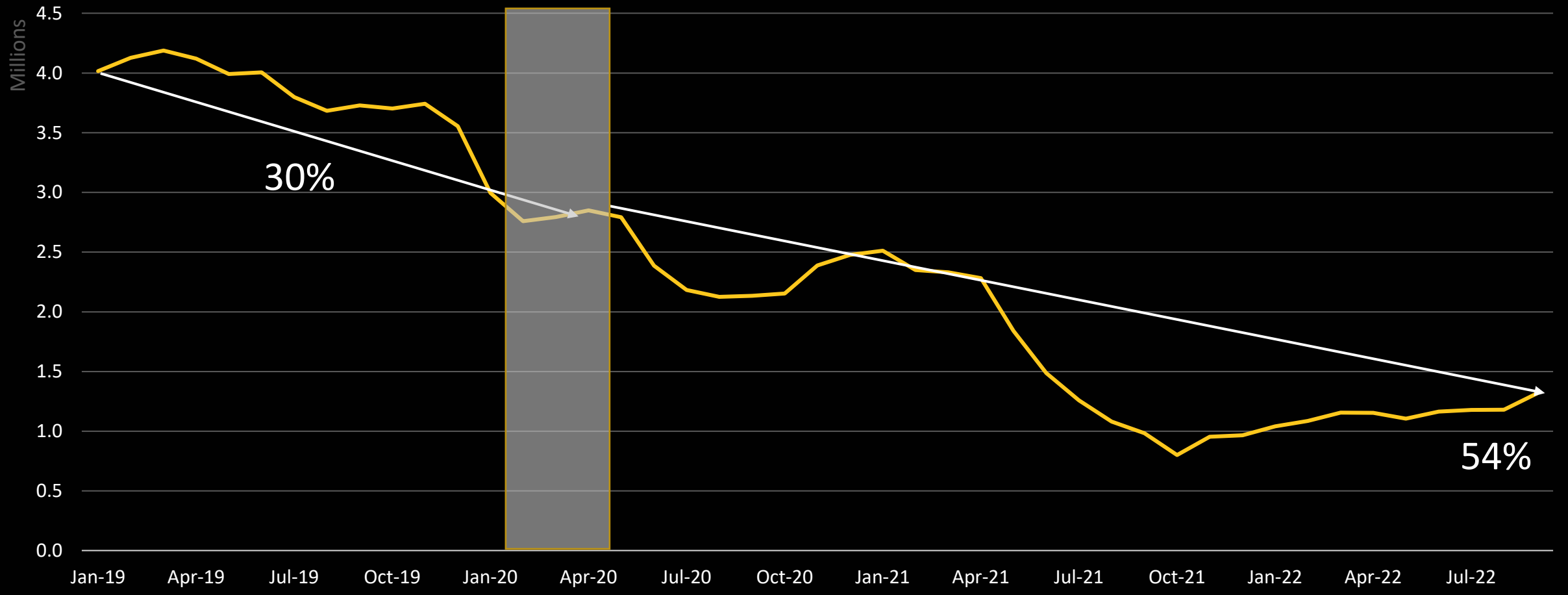


Bloomberg Intelligence BI

Source: Wards Auto

US NEW VEHICLE INVENTORY

total unit volume

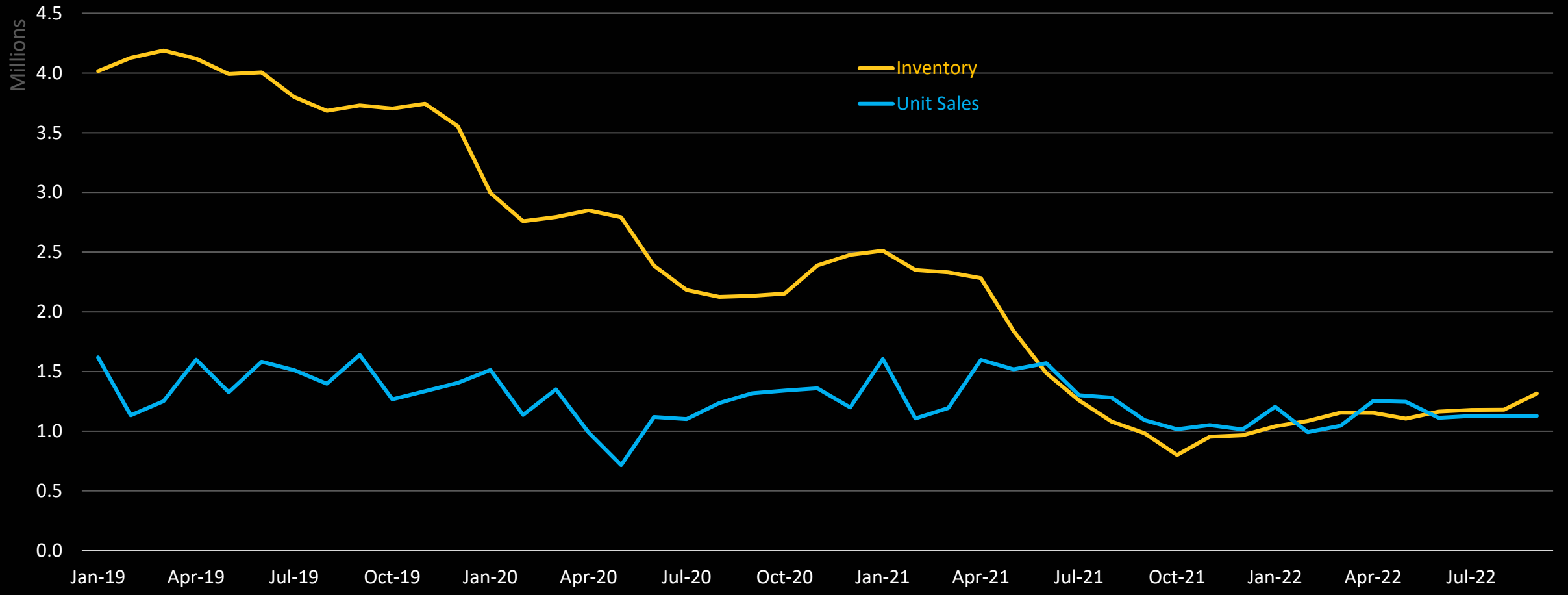


Source: Company Data, Crain Communications, LotLinx

Bloomberg Intelligence

US NEW VEHICLE INVENTORY

total unit volume

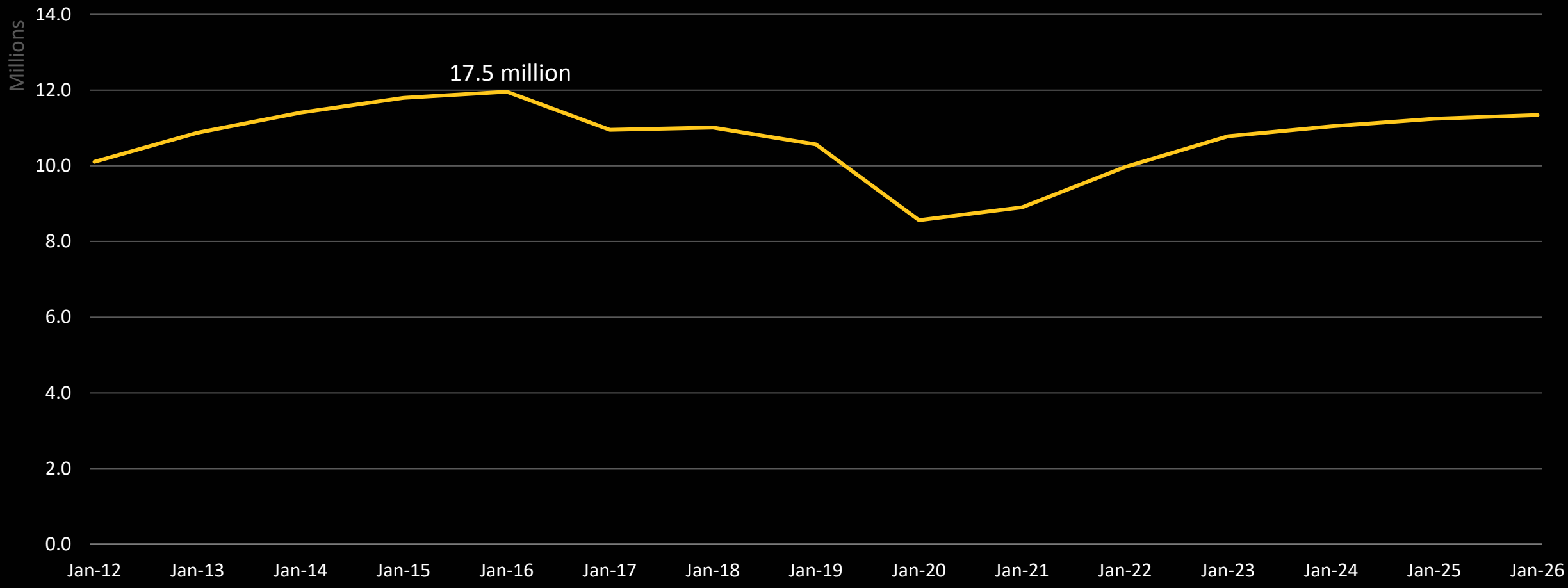


Bloomberg Intelligence BI

Source: Company Data, Crain Communications, LotLinx

US NEW VEHICLE PRODUCTION OUTLOOK

total unit volume



Bloomberg Intelligence BI

Source: Company Data, just-auto.com

NORTH AMERICA NEW VEHICLE PRODUCTION

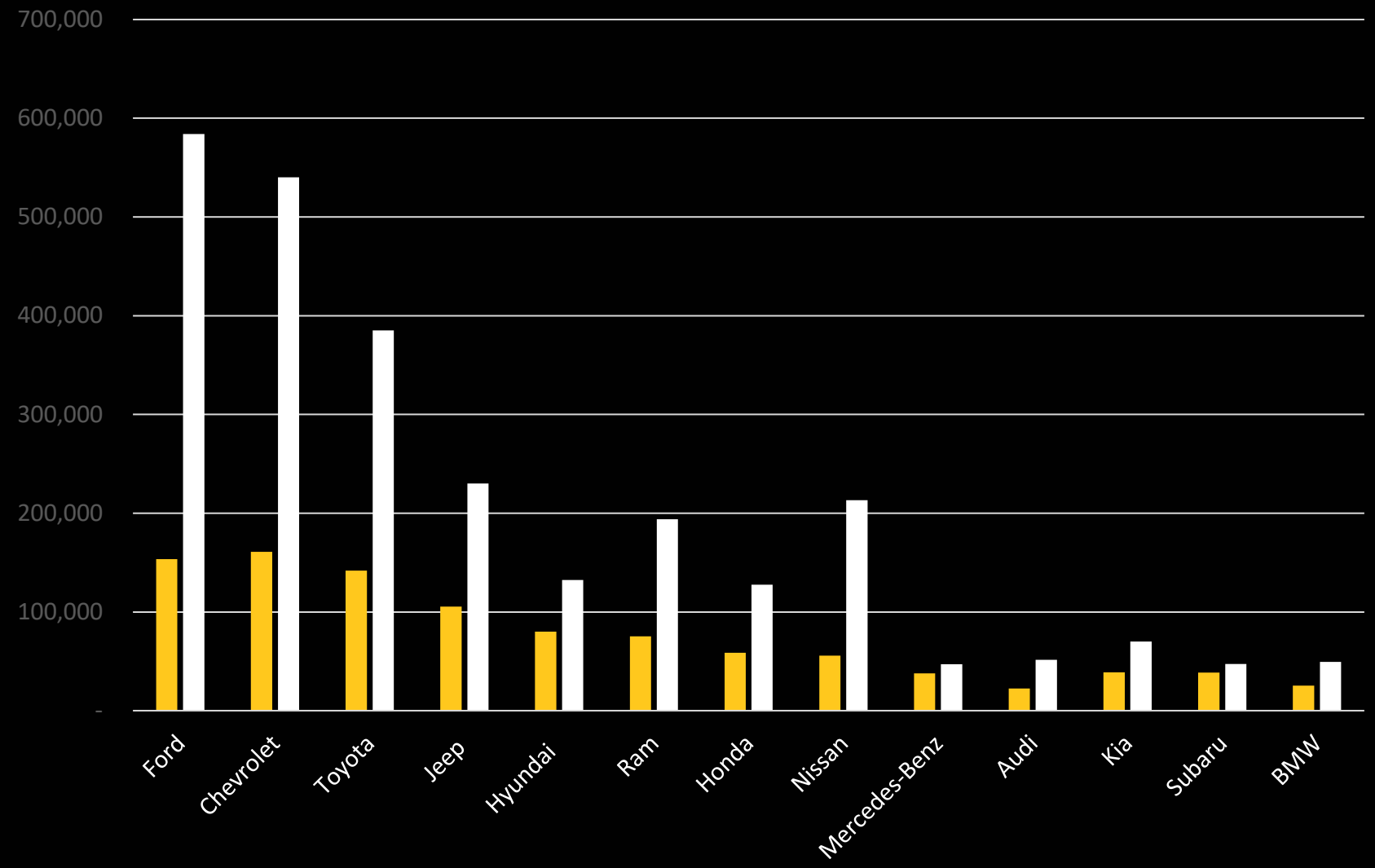
total unit volume

Source: Company Data, just-auto.com

Bloomberg Intelligence

US NEW VEHICLE INVENTORY SEPT 2019 vs. 2022

total unit volume



Source: Company Data, Crain Communications

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The New Normals

Pricing

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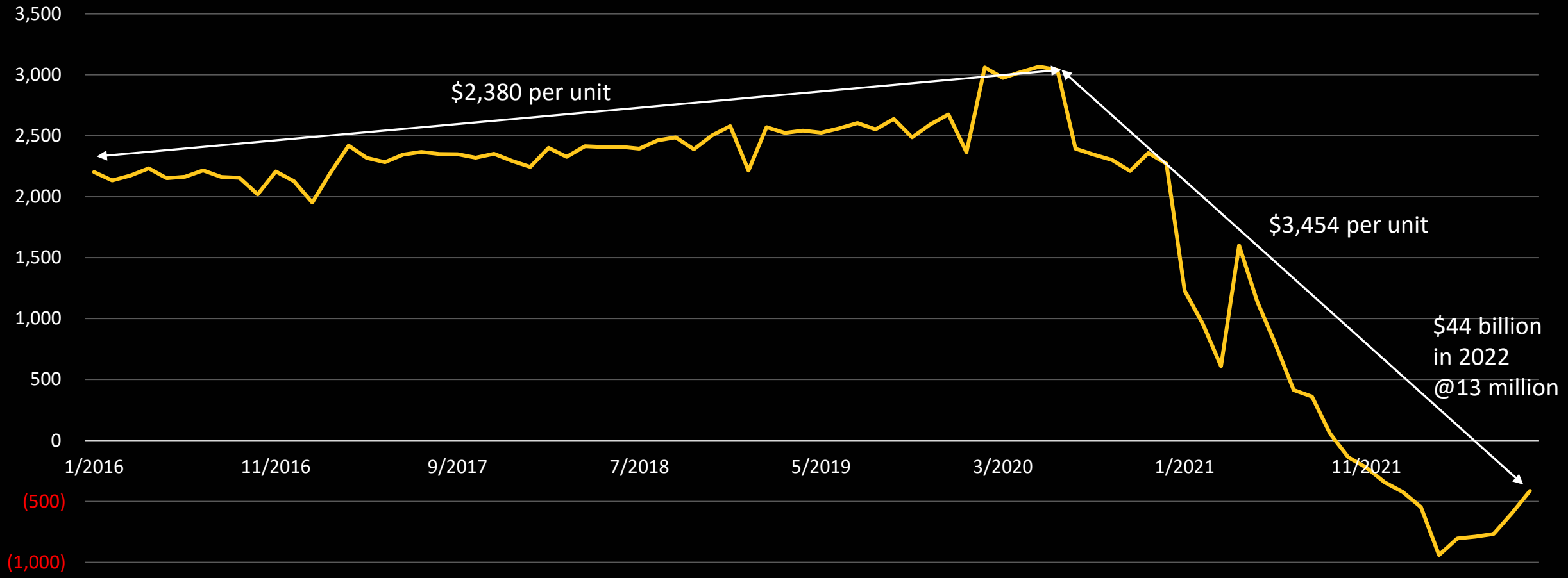
US NEW VEHICLE AVERAGE DISCOUNT

In USD



Source: Company Data, Edmunds.com, Bloomberg Intelligence

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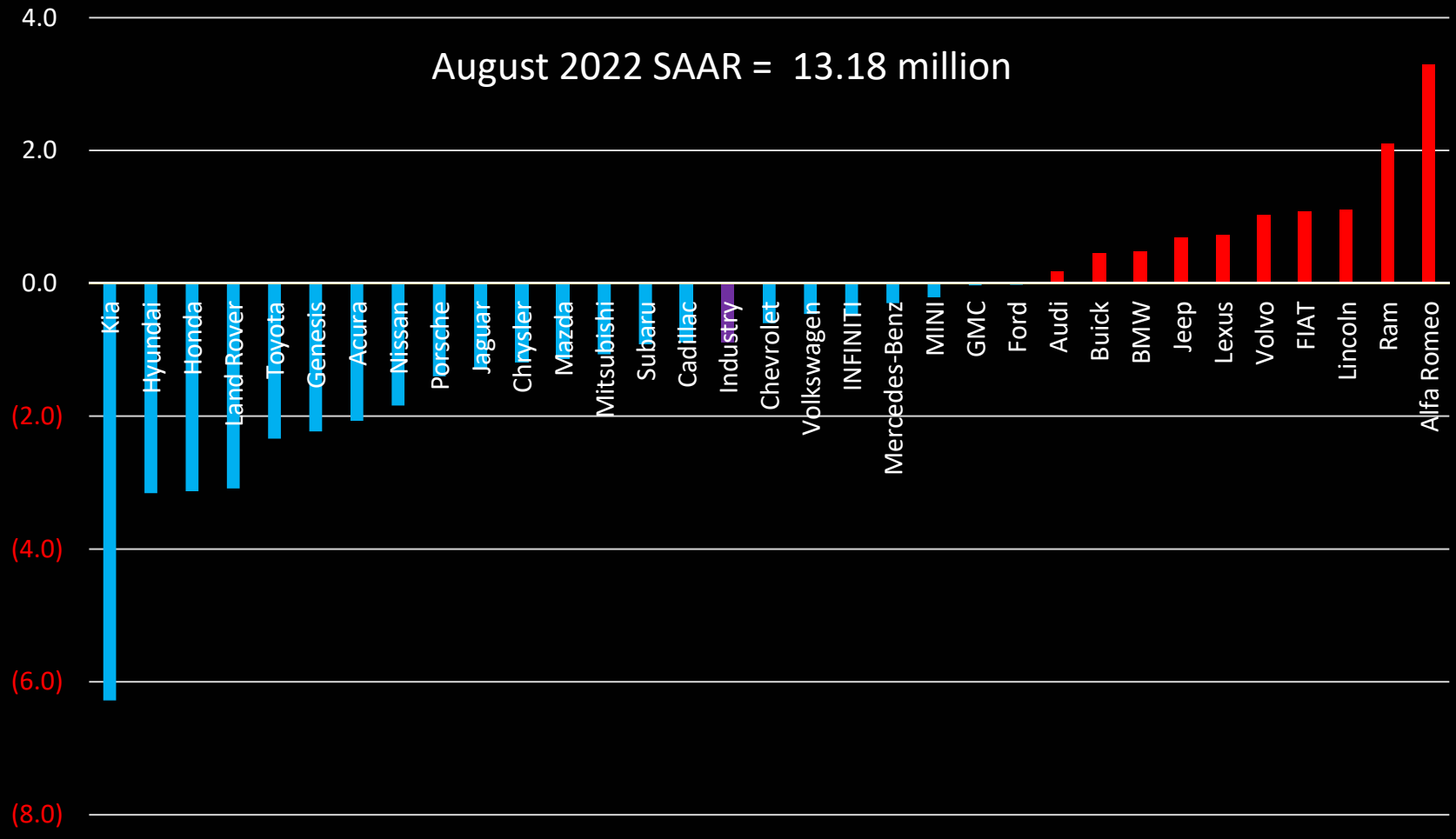
US NEW VEHICLE AVERAGE DISCOUNT - 2022

In %



Source: Company Data, Edmunds.com, Bloomberg Intelligence

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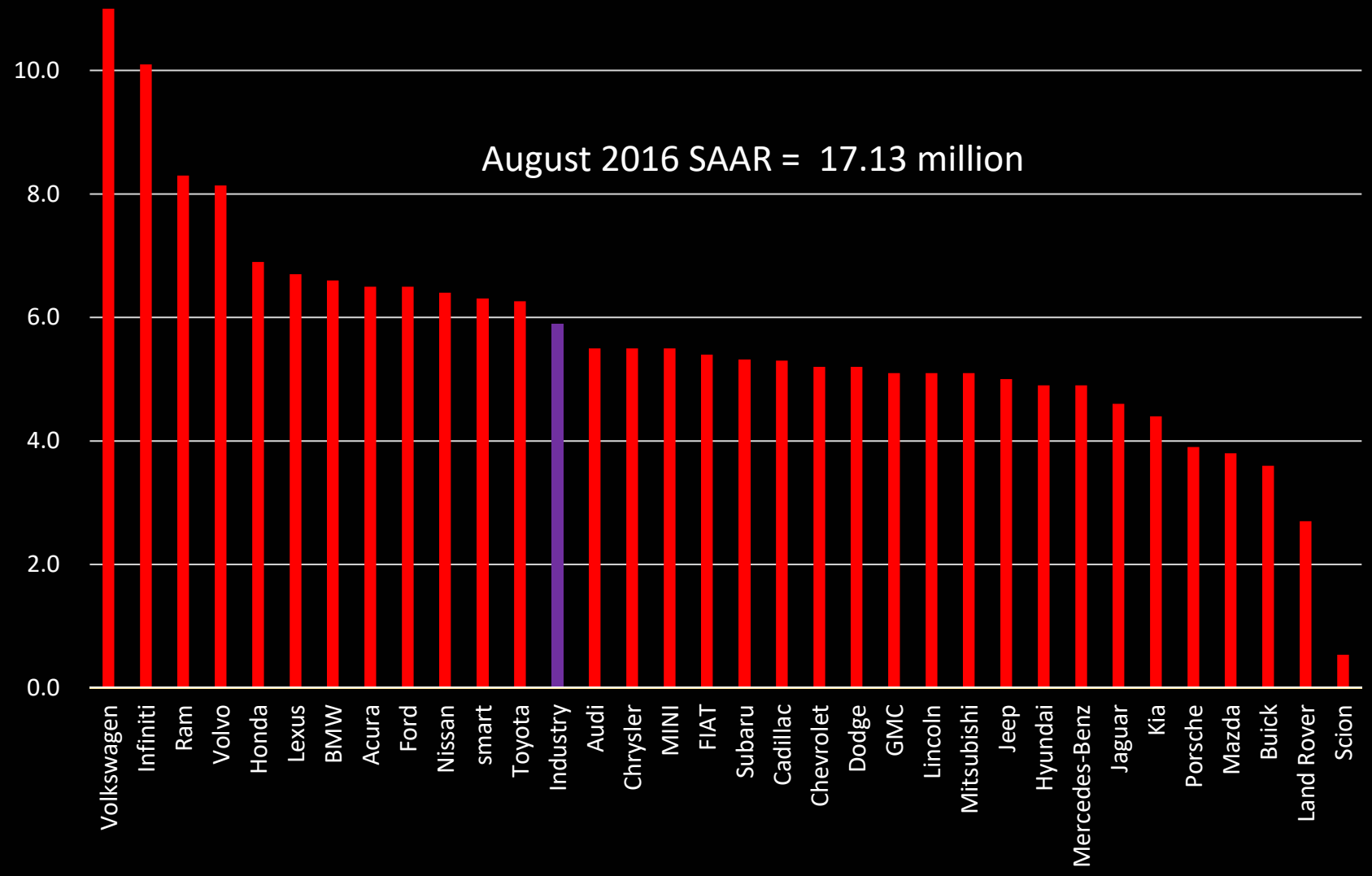
US NEW VEHICLE AVERAGE DISCOUNT - 2016

In %



Source: Company Data, Edmunds.com, Bloomberg Intelligence

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The New Normals

Volume

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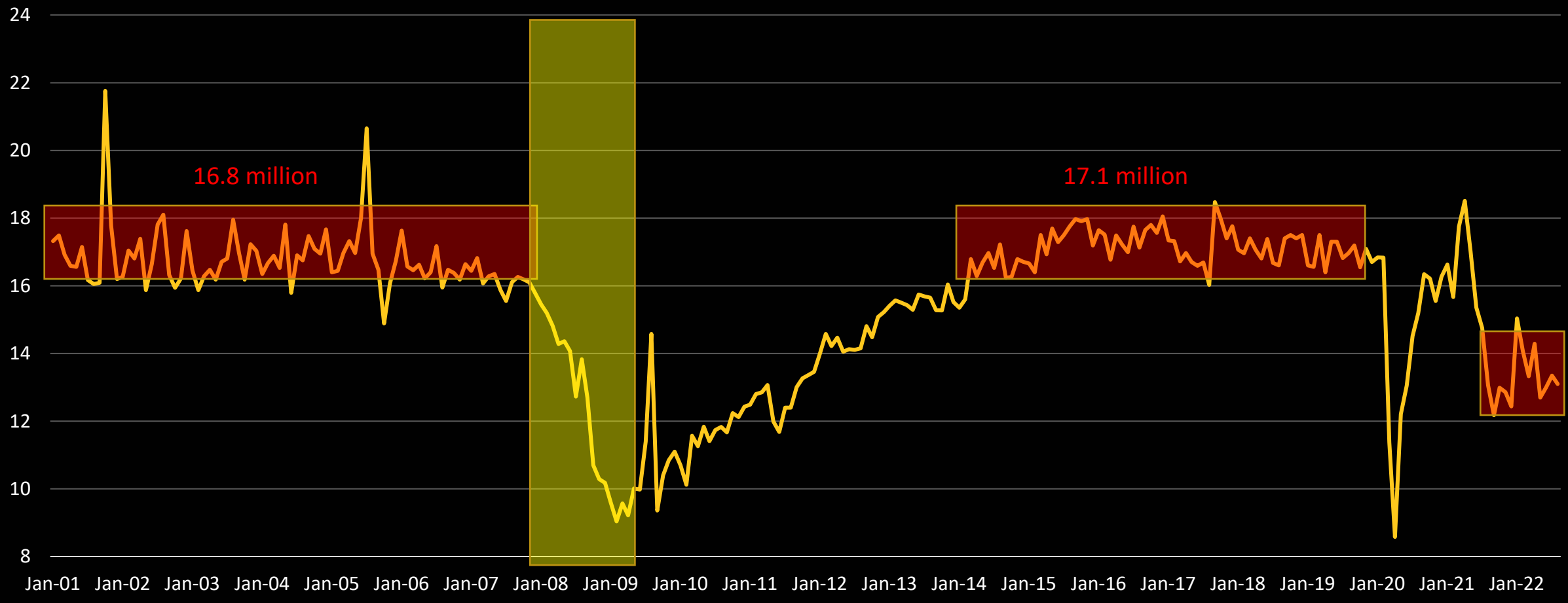
US NEW VEHICLE SEASONAL RATE

SAAR (in million units)

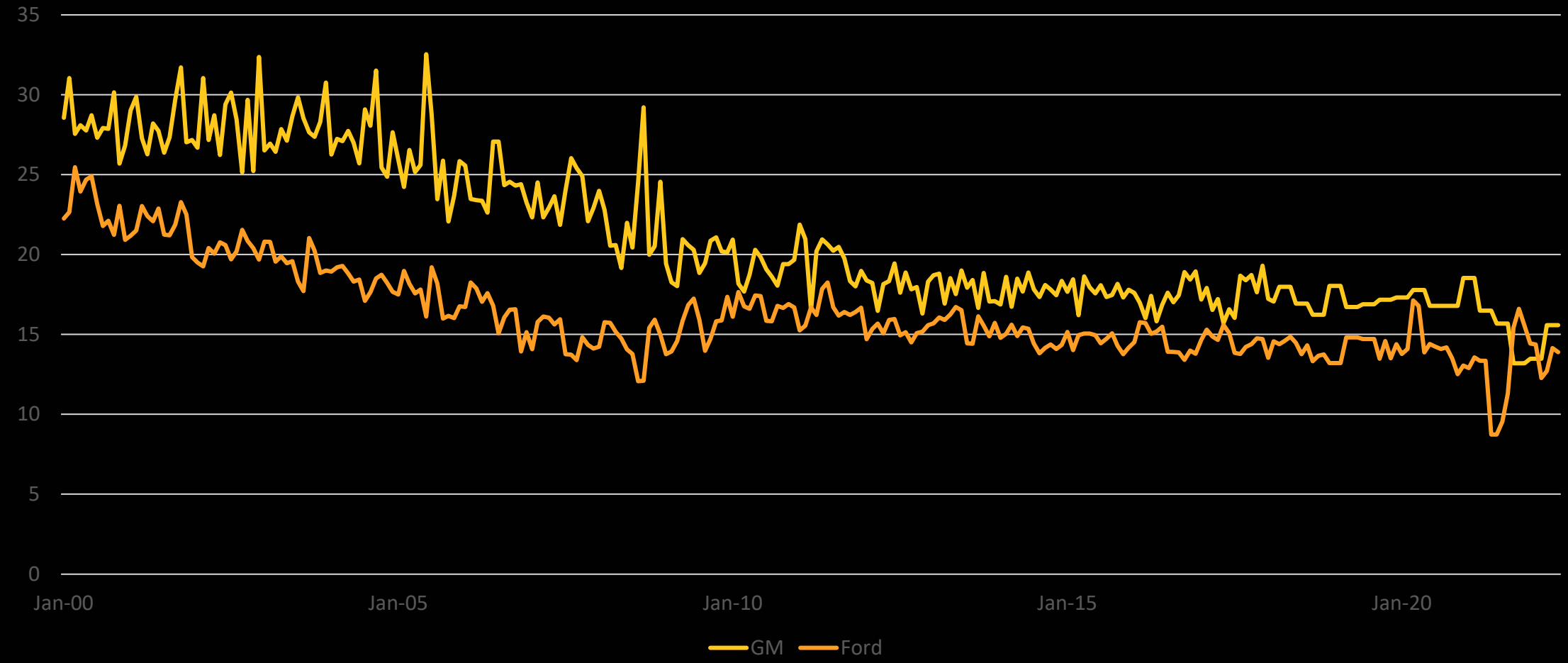


Bloomberg Intelligence BI

Source: Company Data, Wards Auto

US NEW VEHICLE MARKET SHARE

In %



Source: Company Data, Wards Auto

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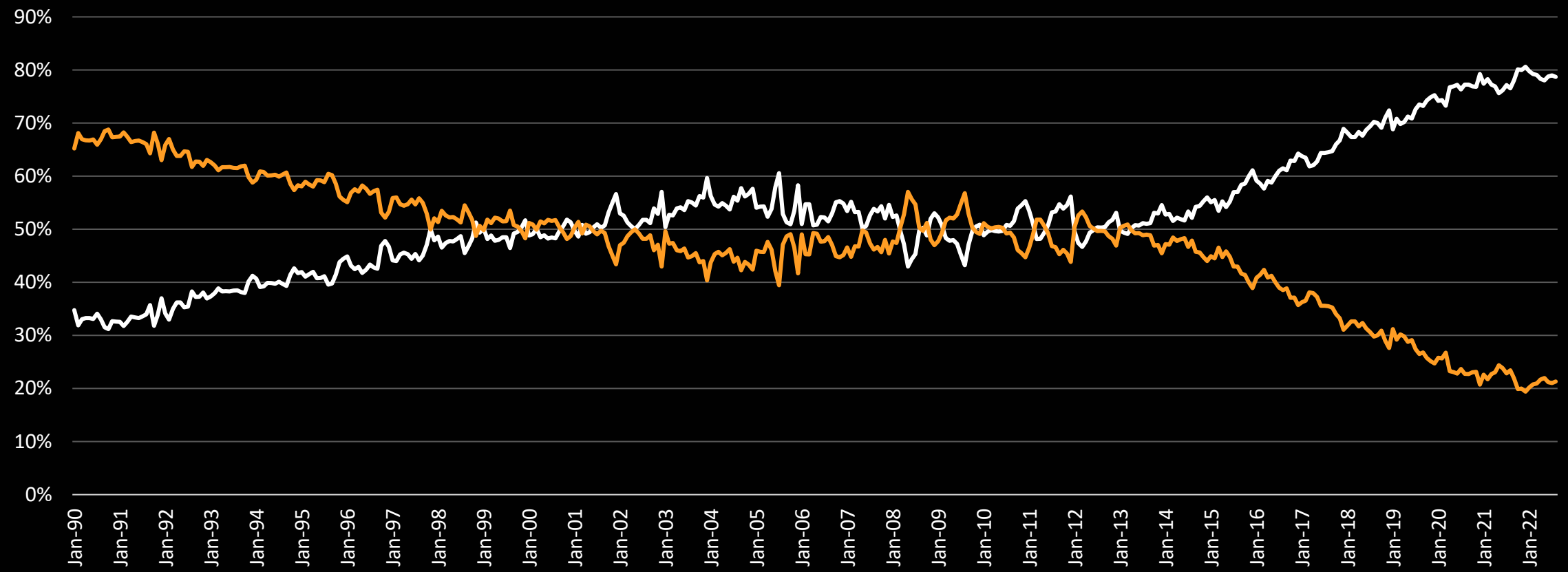
US Vehicle Mix

Supports Lower Volume

Bloomberg Intelligence

US LIGHT TRUCK AND CAR SALES

As % of total volume

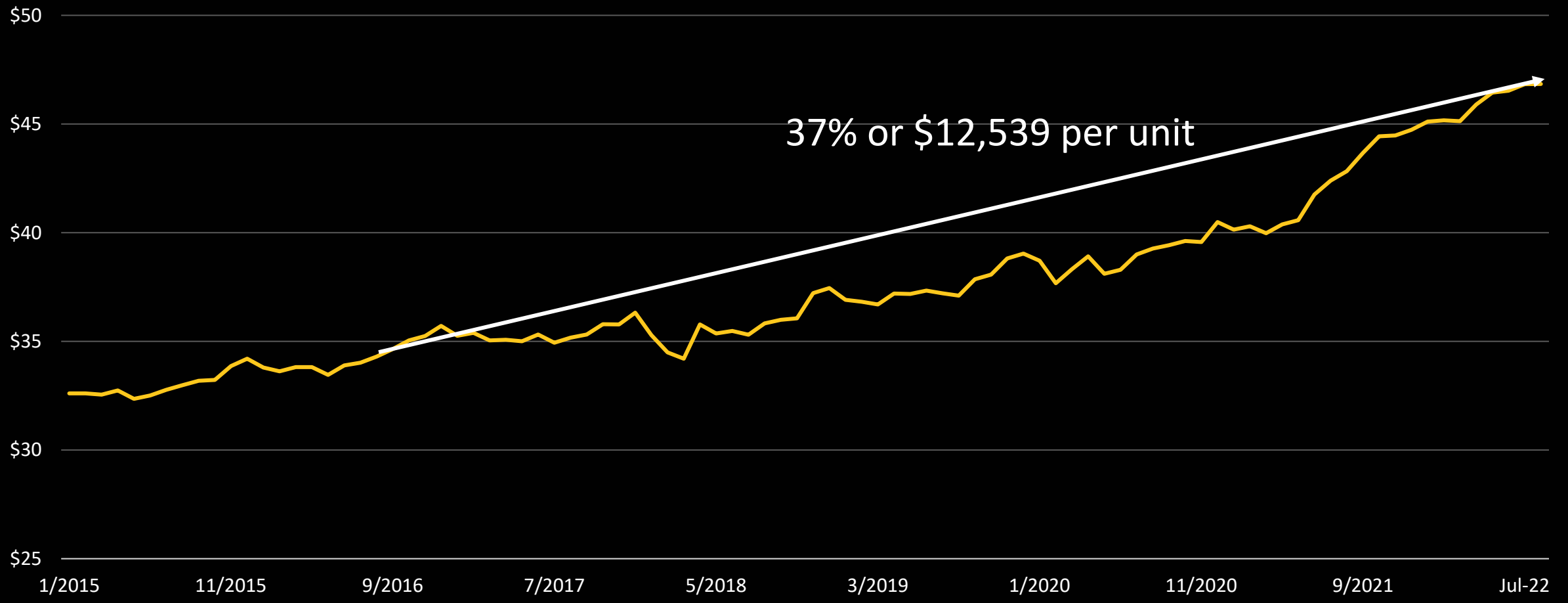


Bloomberg Intelligence BI

Source: Wards Auto

US NEW VEHICLE AVERAGE TRANSACTION PRICE

In 000s



Source: Company Data, Edmunds.com

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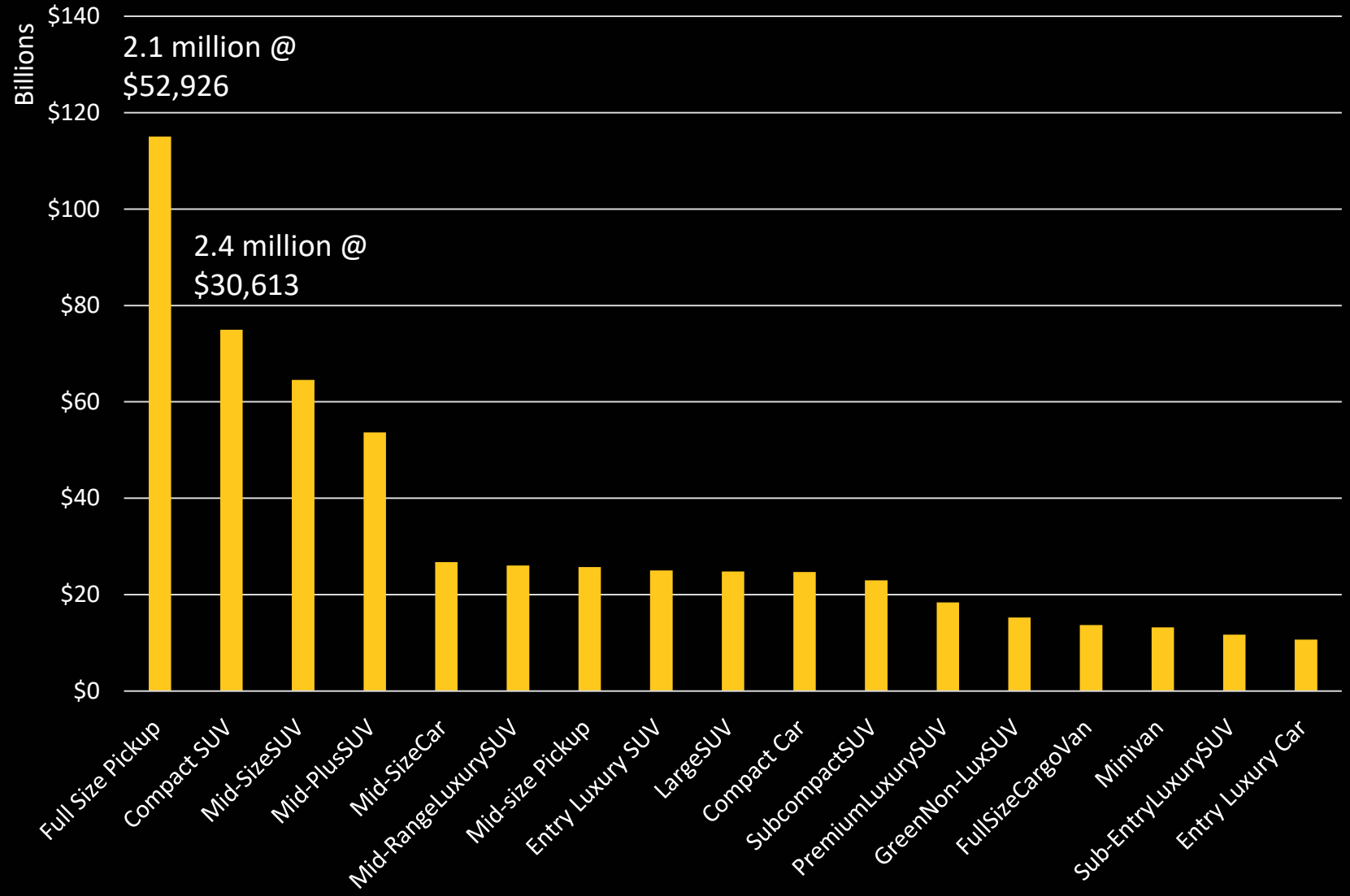
RETAIL REVENUE BY SEGMENT

FY2021

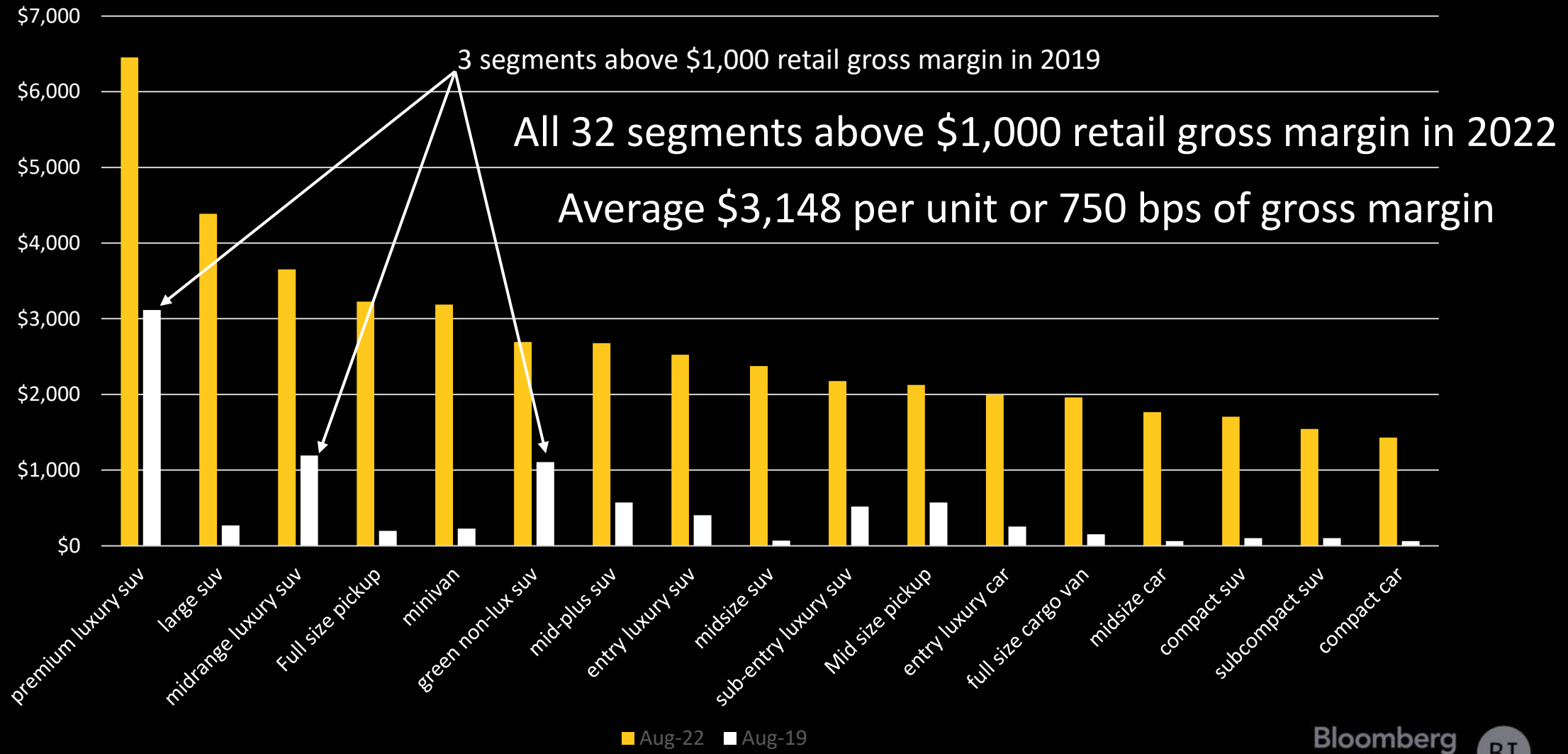


Source: Company Data, Edmunds.com, Bloomberg Intelligence

Bloomberg Intelligence BI

RETAIL MARGIN BY SEGMENT

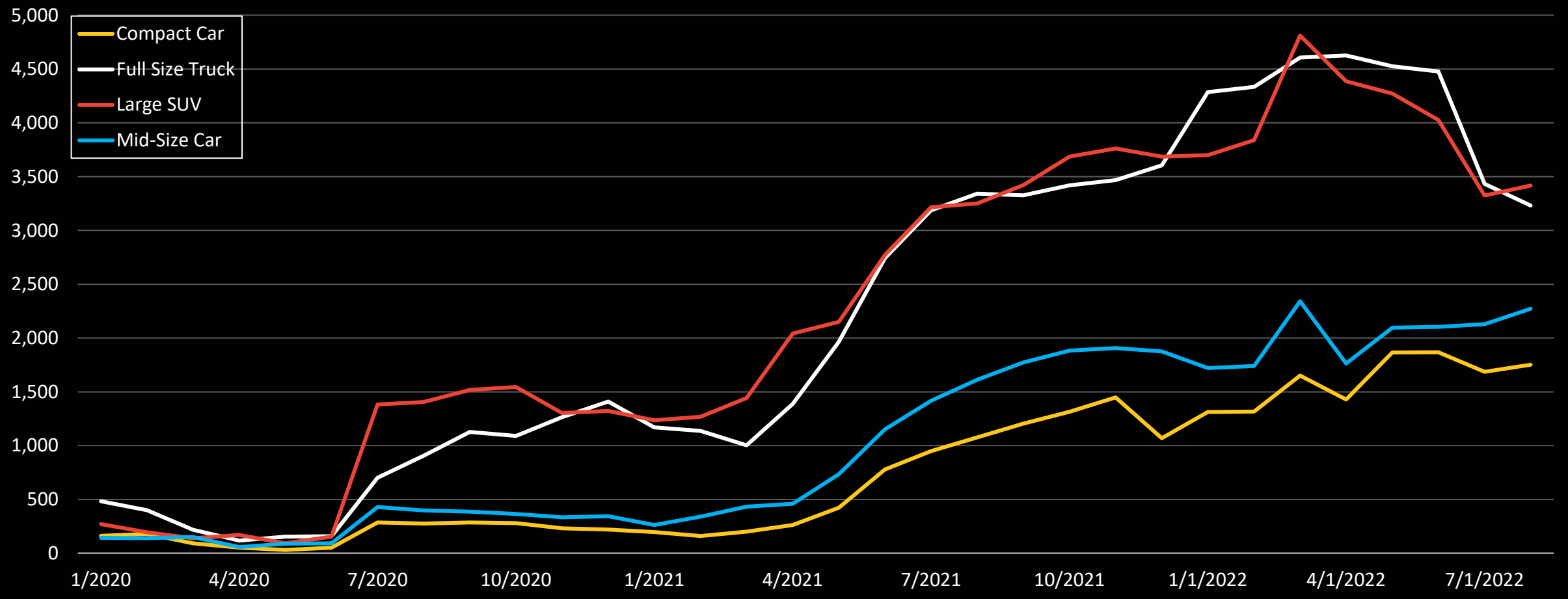
August Over August



Source: Company Data, Edmunds.com, Bloomberg Intelligence

Bloomberg Intelligence BI

RETAIL MARGIN CONTRIBUTION BY SEGMENT



Source: Company Data, Edmunds.com

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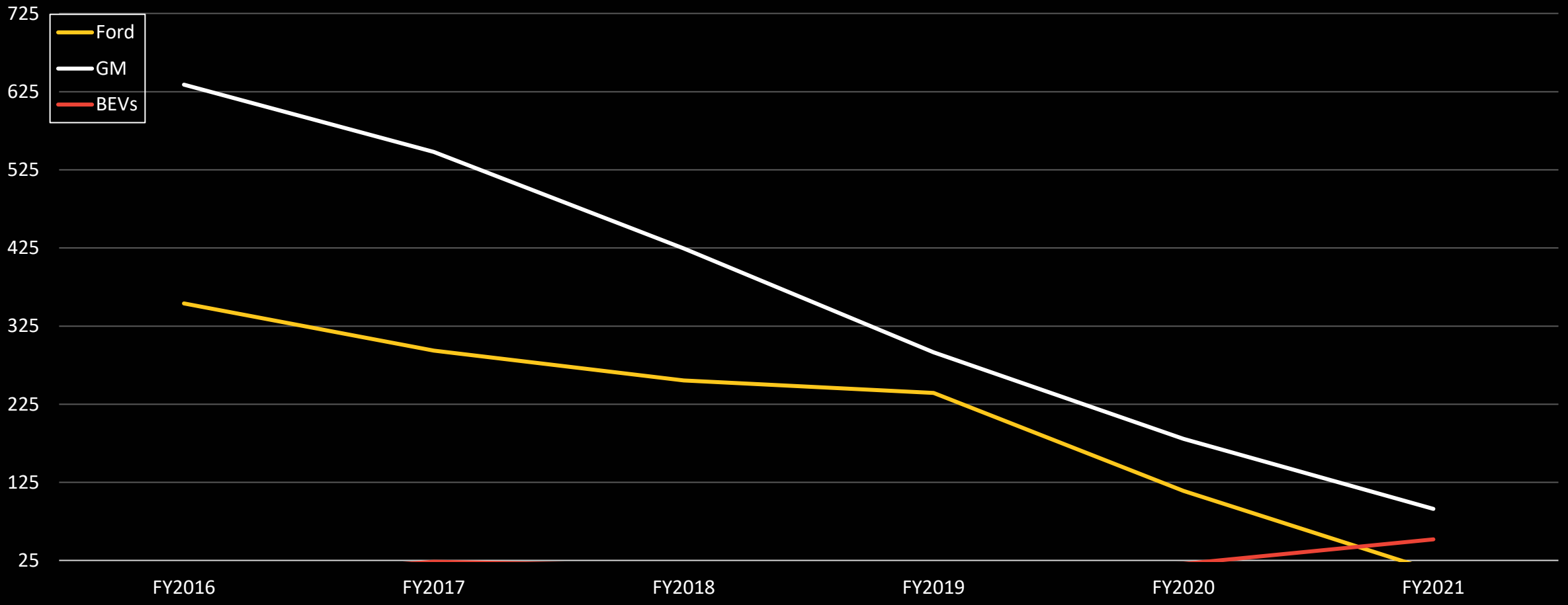
US NEW COMPACT AND MIDSIZE CAR VOLUME

In 000s

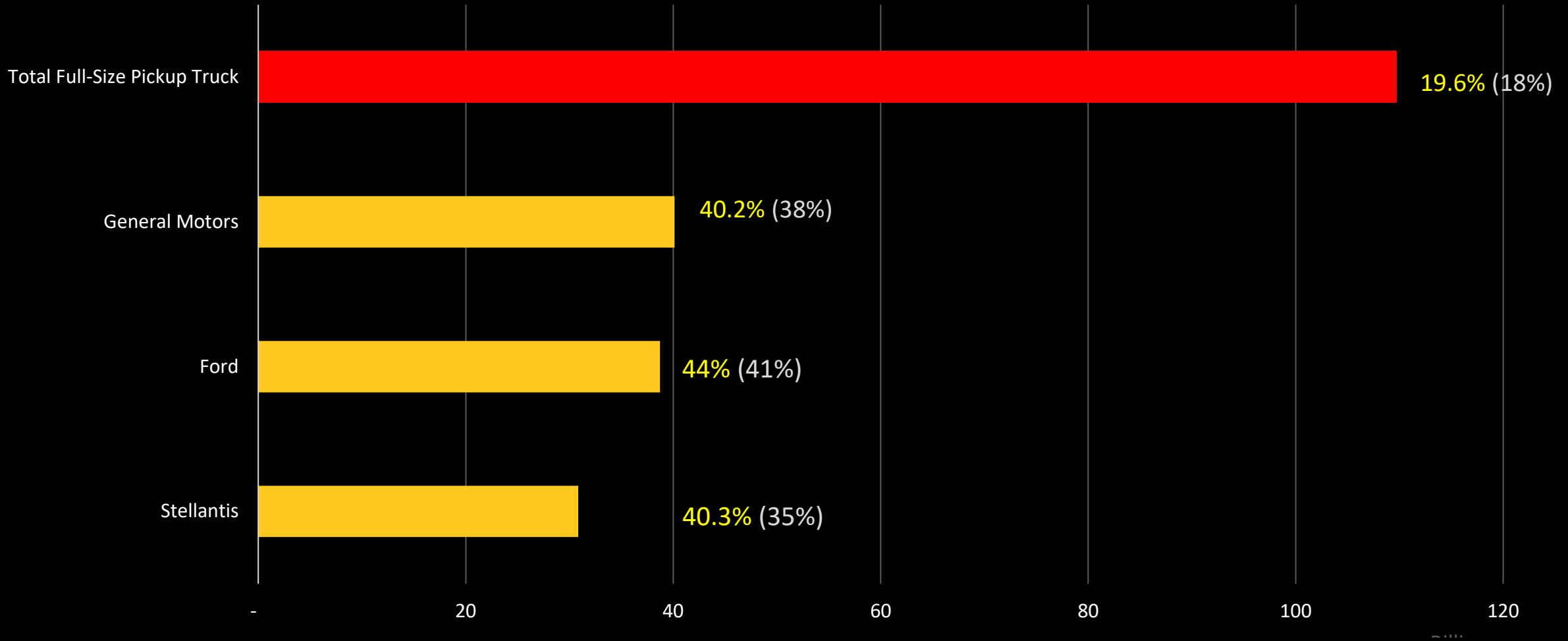


Source: Company Data

Bloomberg Intelligence

LARGE PICKUP RETAIL REVENUE BY AUTOMAKER

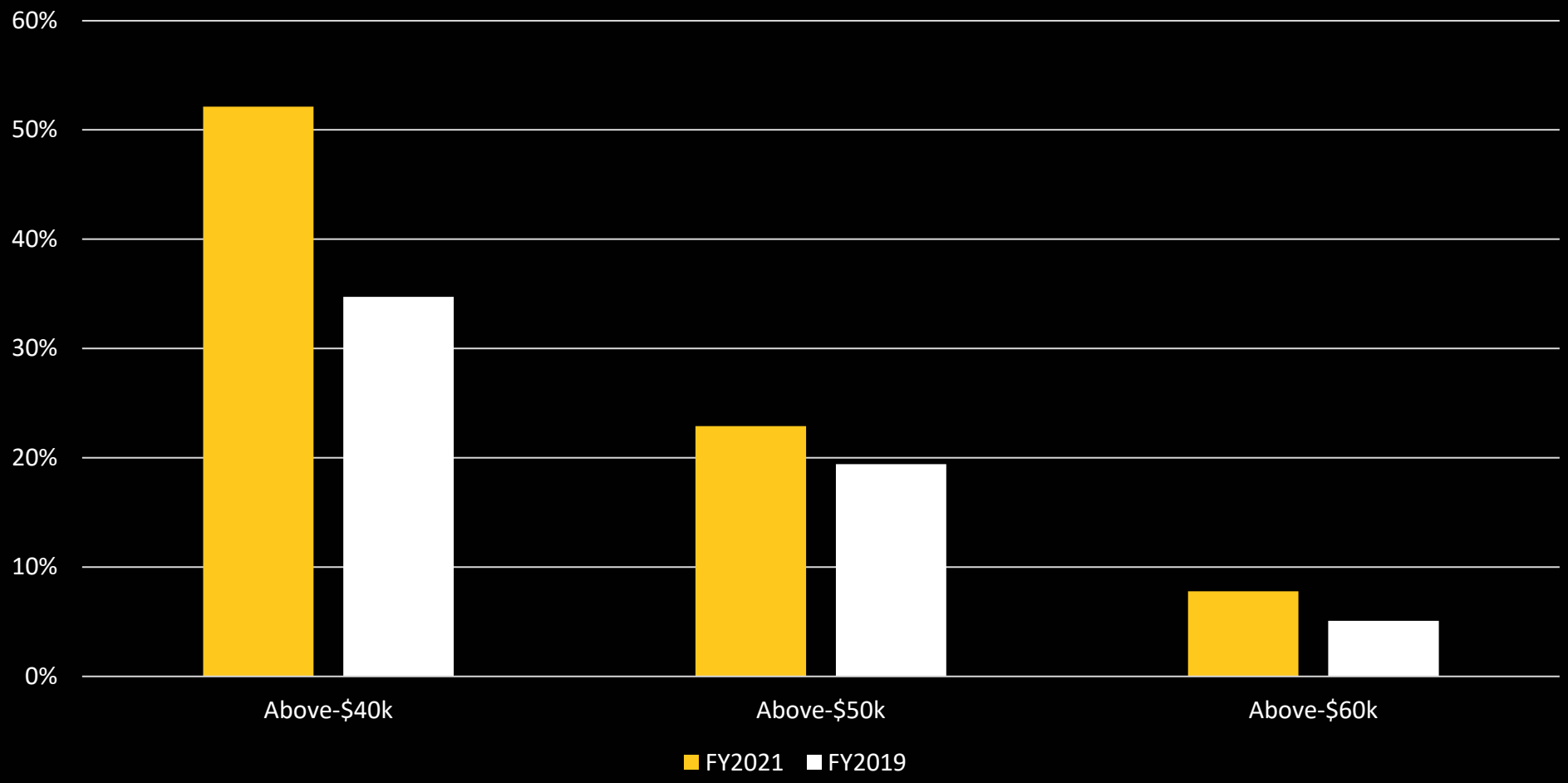
FY2021



Source: Company Data, Edmunds.com, Bloomberg Intelligence

% OF US NEW VEHICLES ABOVE $40,000 ATP

More than half the market above $40k



Source: Company Data, Edmunds.com, Bloomberg Intelligence

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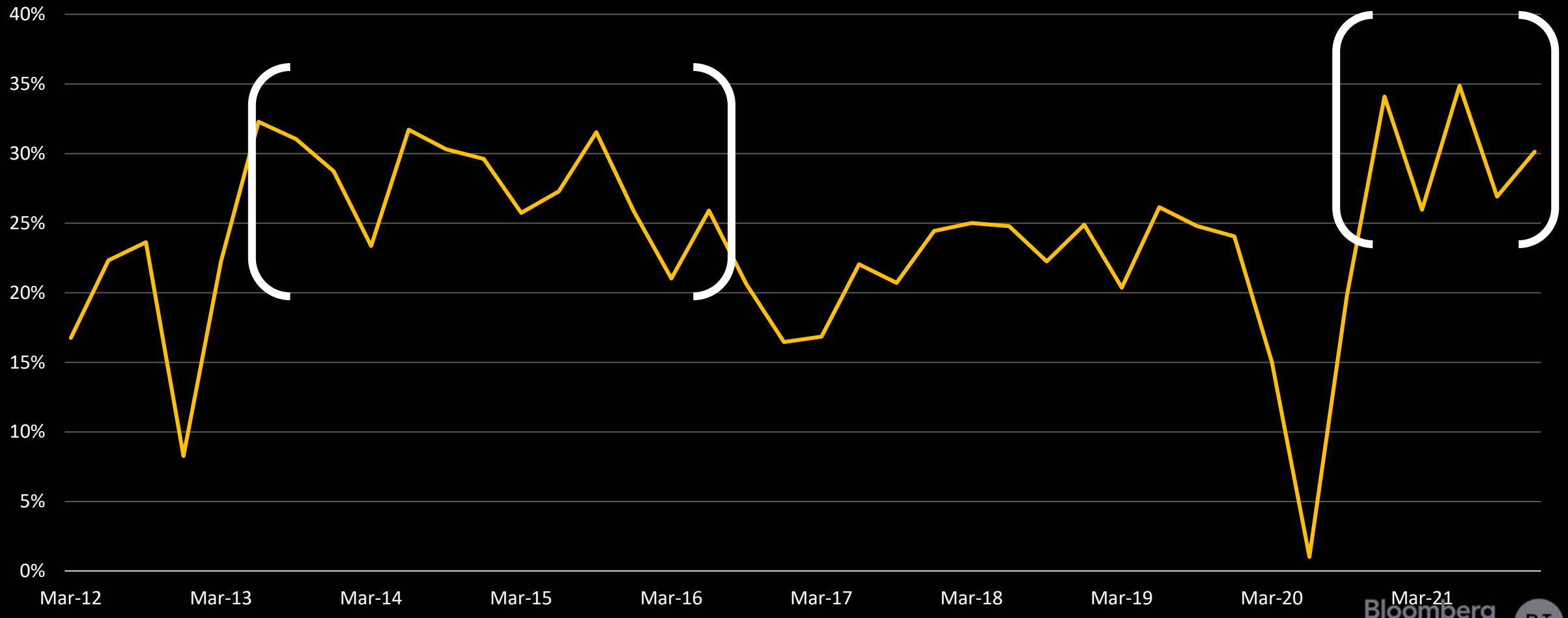
OPERATING MARGIN – TOYOTA NORTH AMERICA

Next step in cost rationalization aligns with price power



Source: Company Filings

Bloomberg Intelligence

Used Vehicle Supply

The Affordability Gap Impact on Demand

Bloomberg Intelligence

US USED VEHICLE AVERAGE PRICE

In '000 USD

Source: Company Data, Bloomberg Intelligence

Bloomberg Intelligence BI

US USED VEHICLE WHOLESALE PRICE INDEX

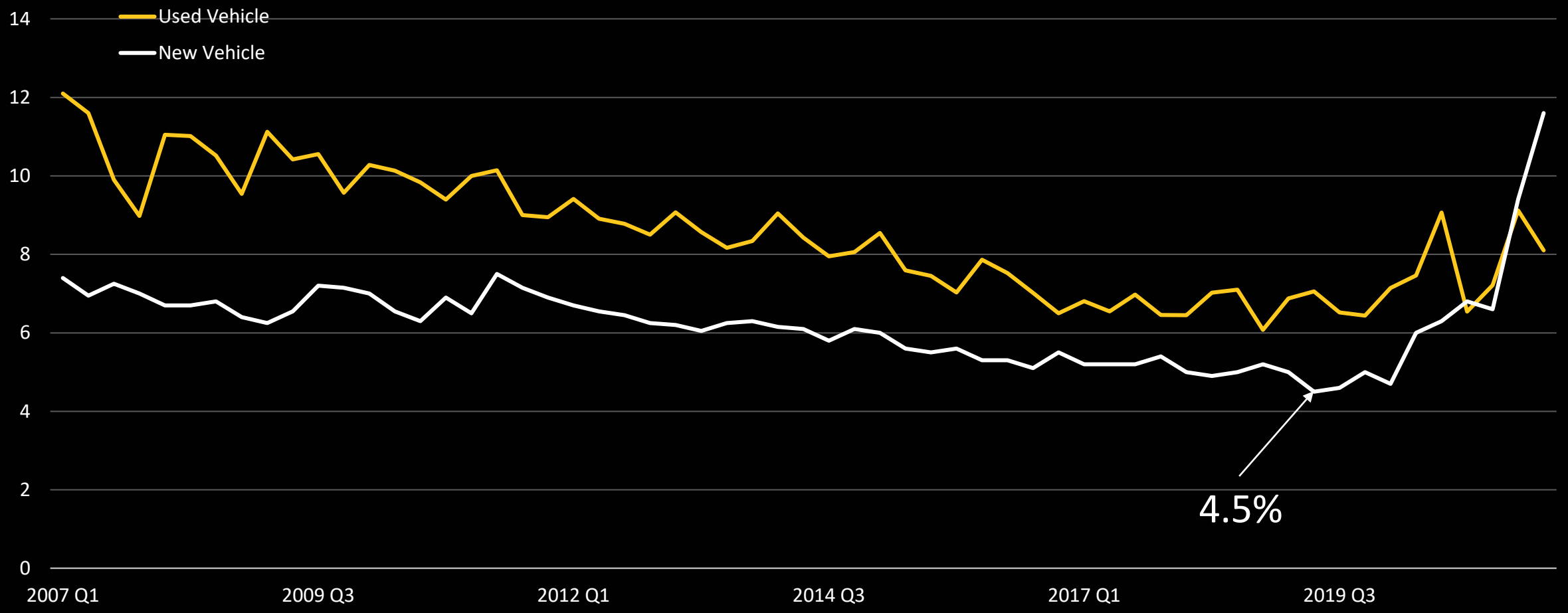
In '000 USD

Bloomberg Intelligence BI

Source: Manheim Auctions

U.S. RETAIL GROSS MARGIN BY SEGMENT

In %



Source: Company Data, Edmunds.com, Bloomberg Intelligence

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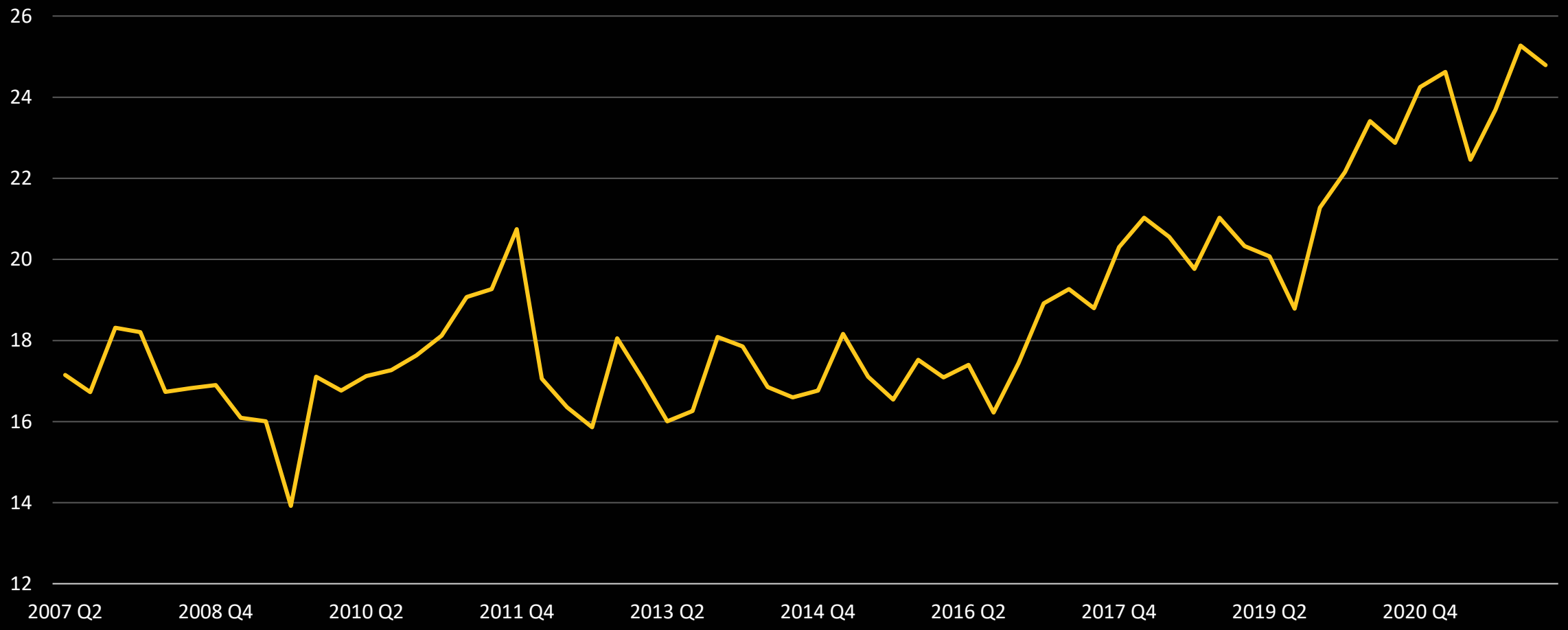
US AFFORDABILITY GAP BETWEEN NEW AND USED VEHICLES

In '000 USD



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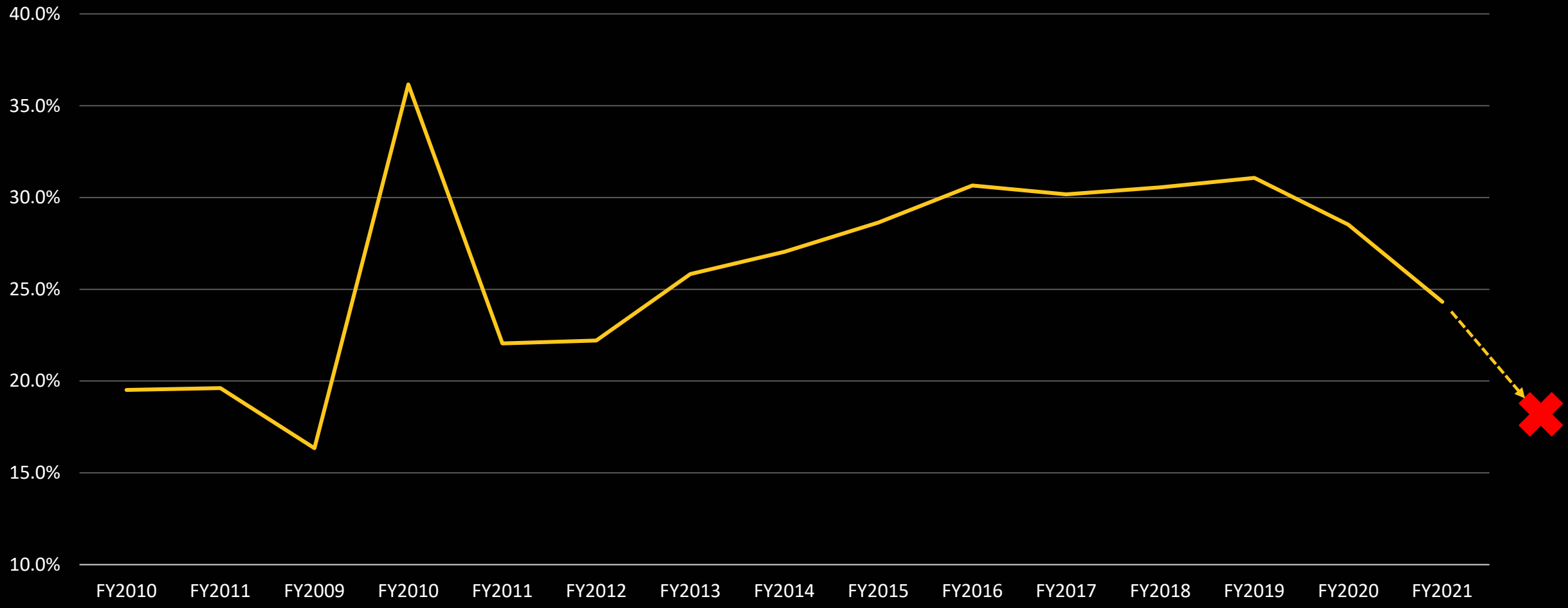
Source: Company Data, Bloomberg Intelligence

US LEASE PENETRATION

In %



Source: Company Data, Edmunds.com

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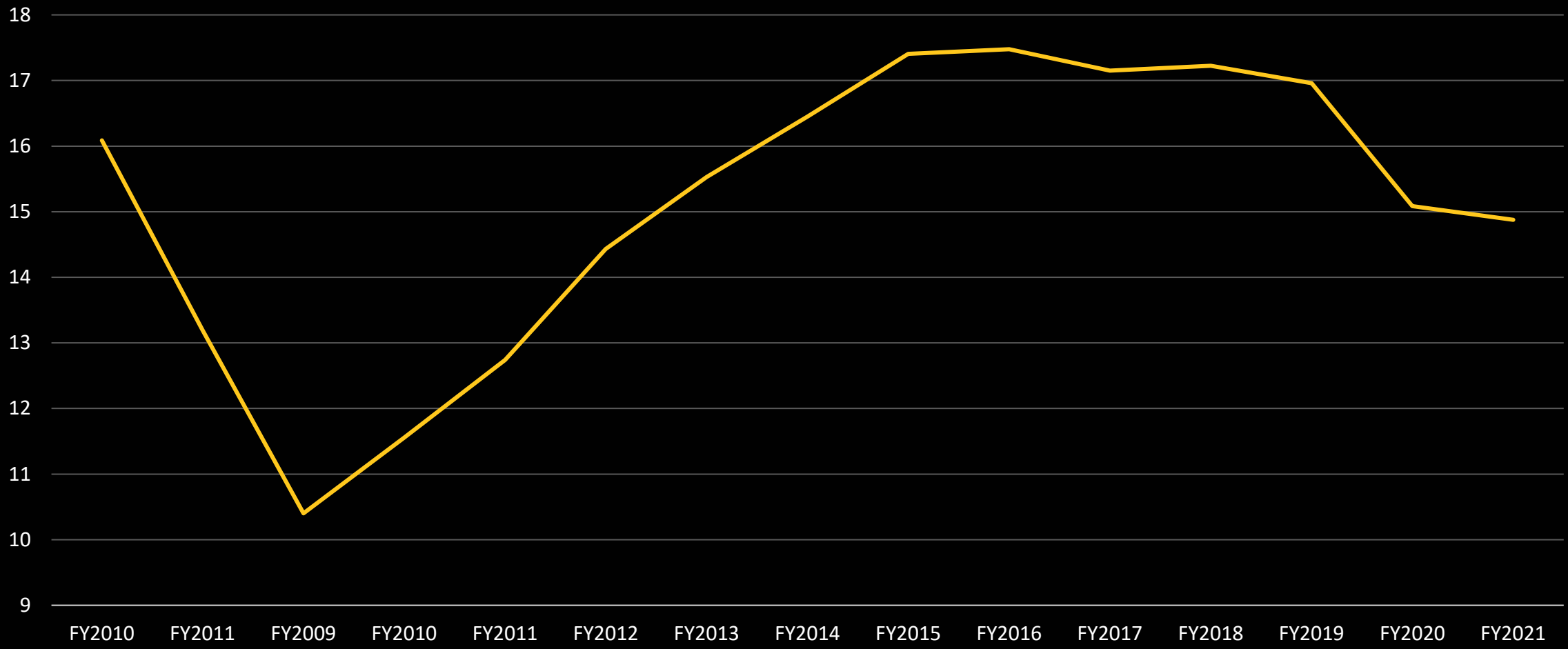
US TOTAL VOLUME

In million units



Source: Company Data, Wards Auto

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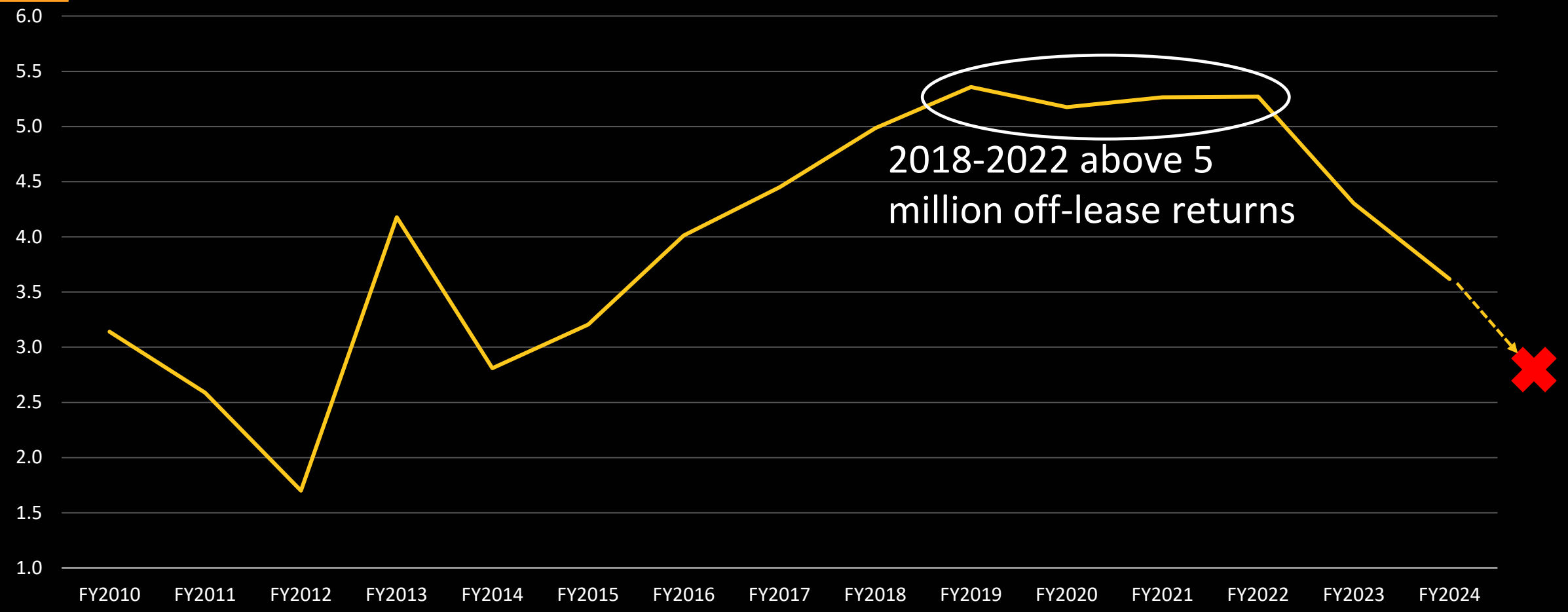
US OFF-LEASE RETURNS

In million units

Average lease term = 36 months



Bloomberg Intelligence BI

Source: Company Data, Edmunds.com, Bloomberg Intelligence

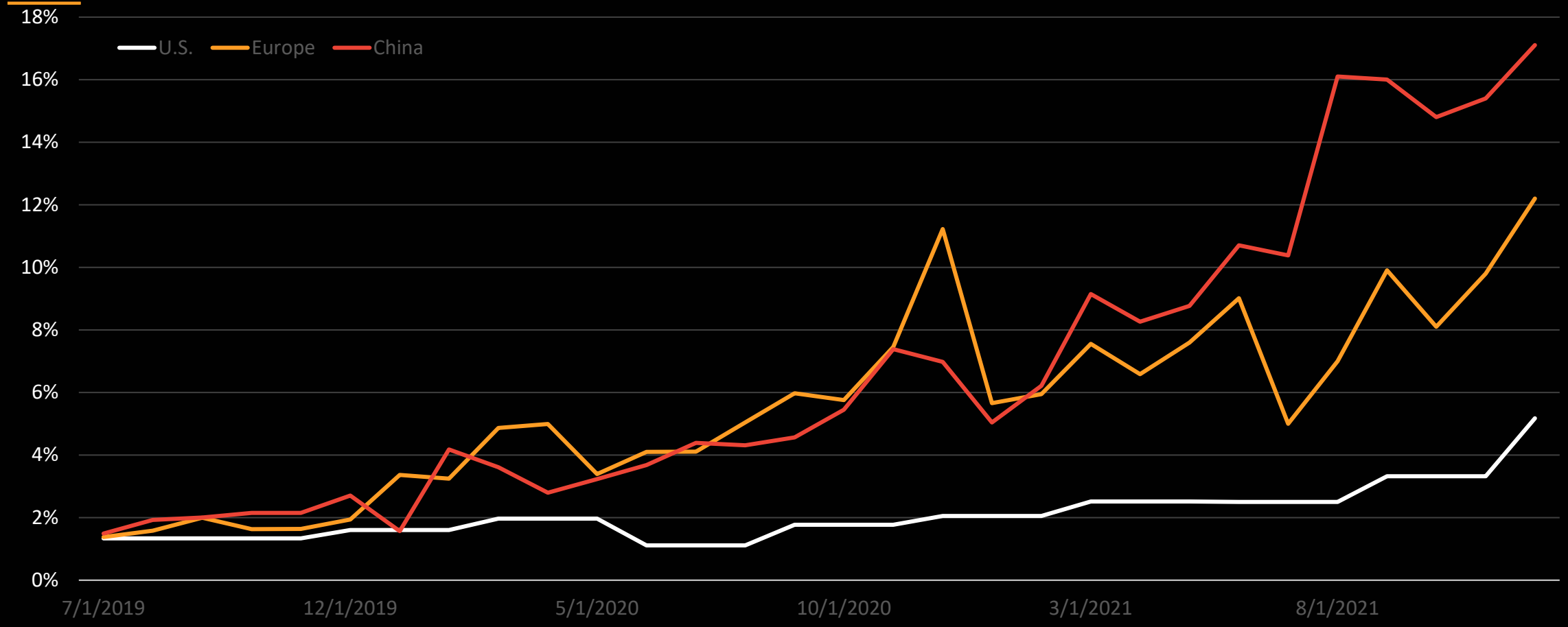
EV ADOPTION

Manufacturers, Governments and Consumers

Bloomberg Intelligence

CHINA, EUROPE 5, US BEV SALES

As % of total volume



Source: Company Data, JATO, CAIN

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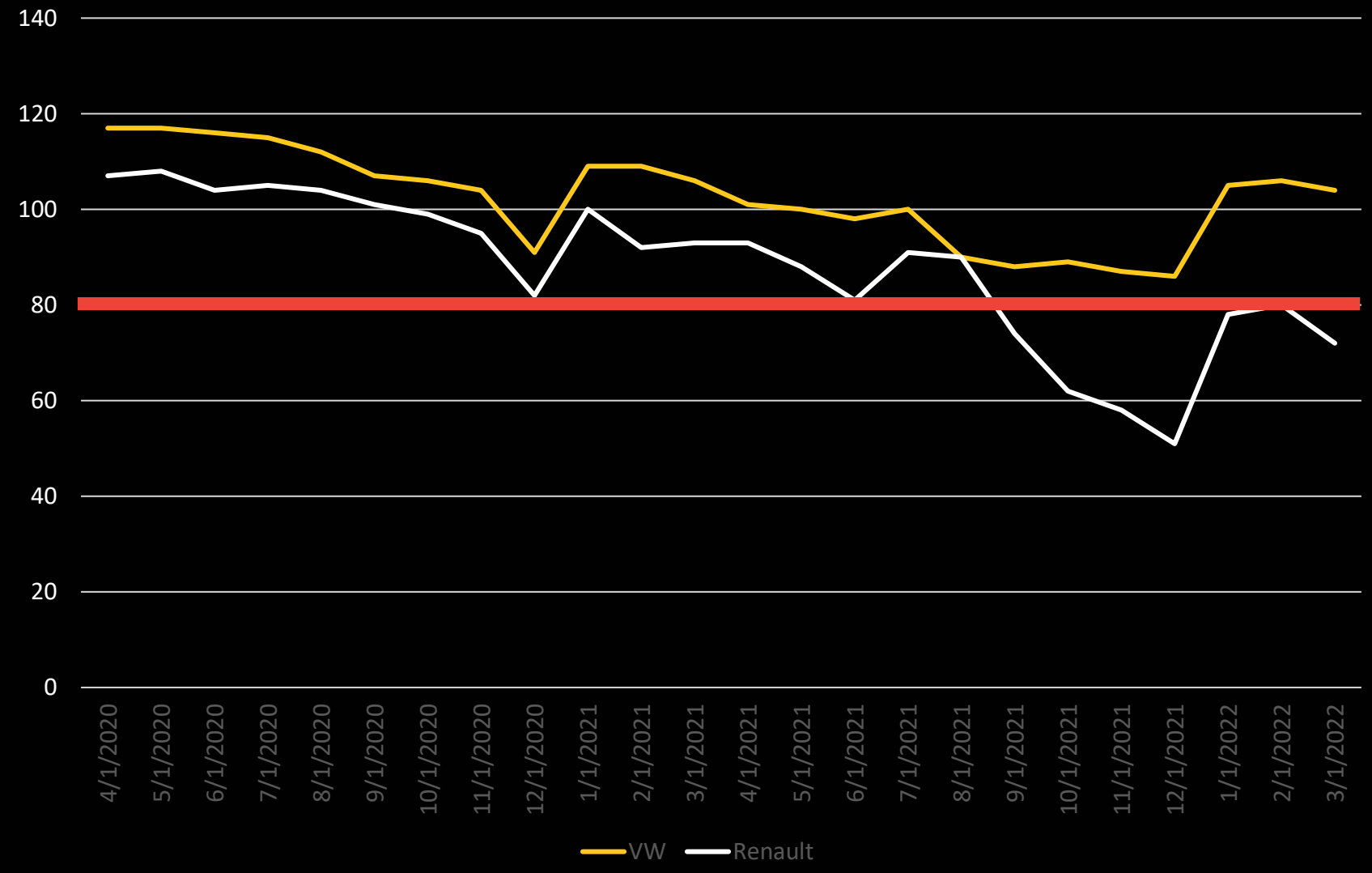
EUROPE EMISSIONS REDUCTION

Fines = $106 USD per C02g/km that exceeds the target, multiplied by unit sales.

~$300 million fine for every C02g/km miss



Source: Valeo CMD 2019

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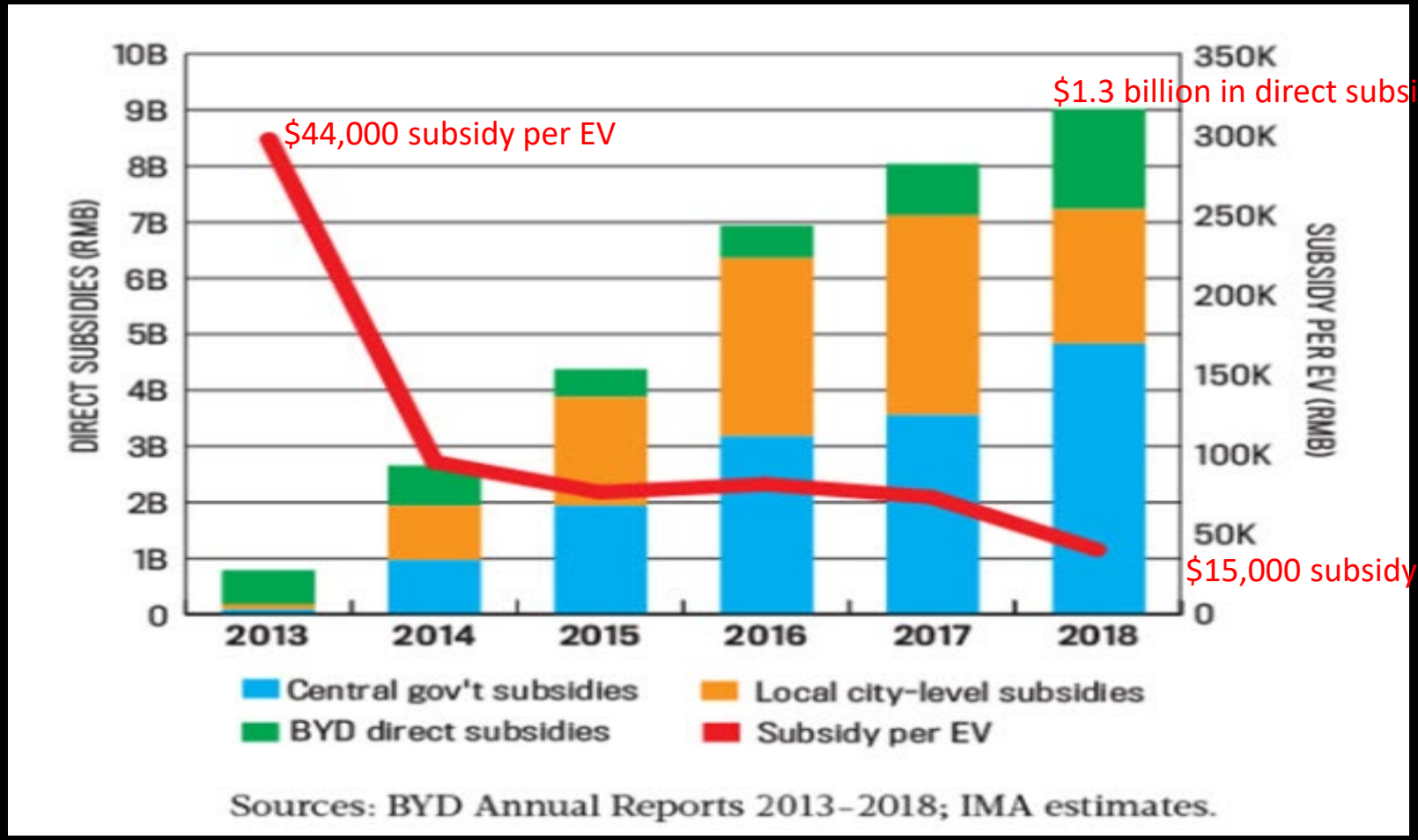
BYD TOTAL DIRECT EV SUBSIDIES RECEIVED VS. SUBSIDY PER EV



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CUMULATIVE PLUG-IN UNIT SALES IN U.S. SINCE 2014

Automakers with eligible federal tax credits

350,000

$7,500 Fe
16 k/wh

$10,000 Fe
U.S. a

$12,500 Fe
UAW, U.

$7.5 billion for electric ve
charging stations
(1 million ports)

Ford Increasing Prices of F-150 Lightning Models

By Brandon

(Bloomberg)
"significant
automobile

- Cu
  ac
- F-
  Ex

Ford Nissan Toyota

Source: Company Data, Marklines, JATO

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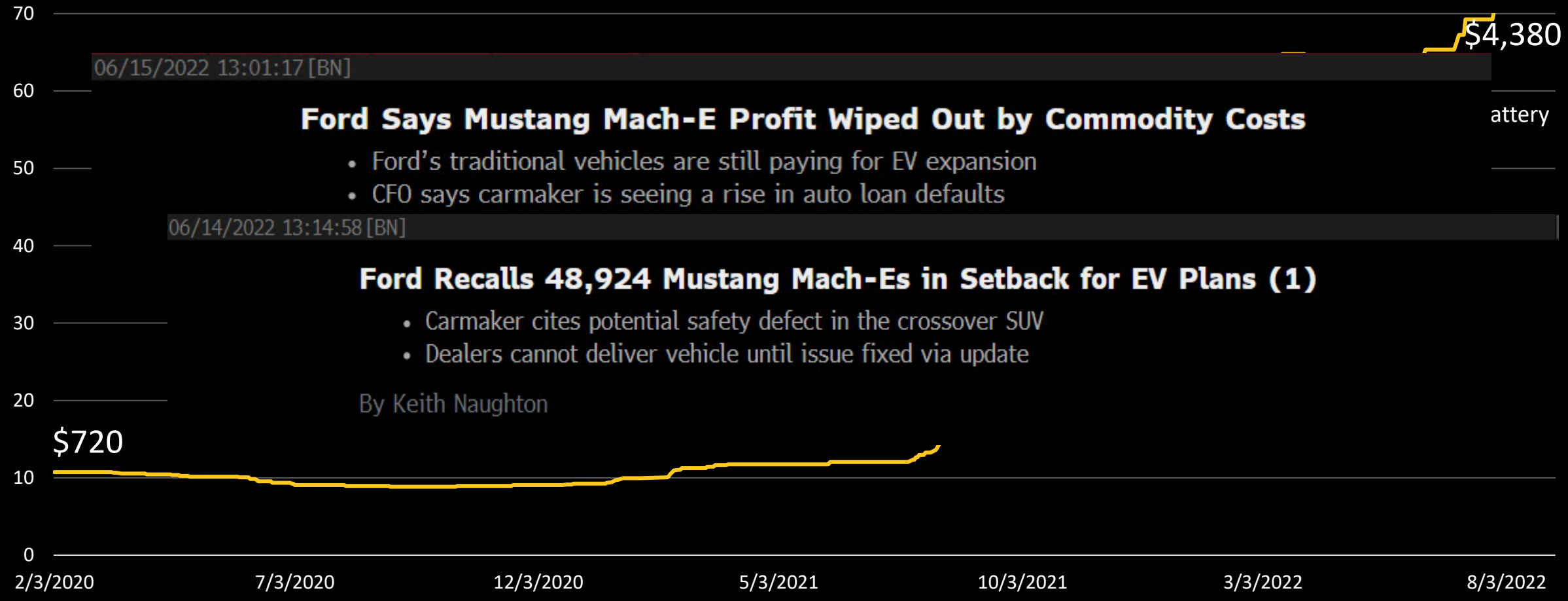
LITHIUM CARBONATE COST PER VEHICLE

In USD/kilogram



Source: Asian Metal Inc

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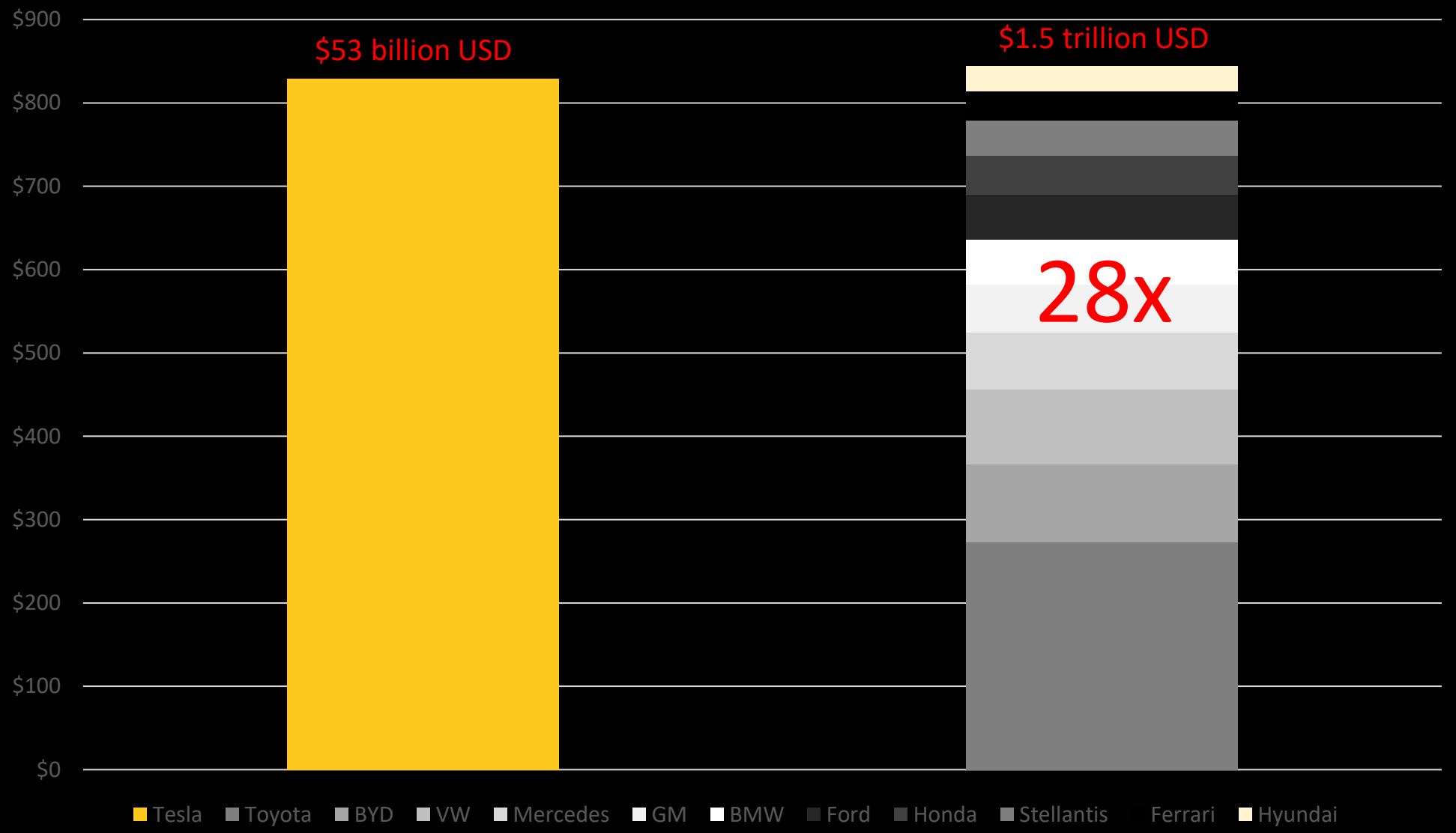
The Advantages of Scale

The Case For Large Automakers

Bloomberg Intelligence

MARKET CAP OF GLOBAL AUTOMAKERS

In billion USD



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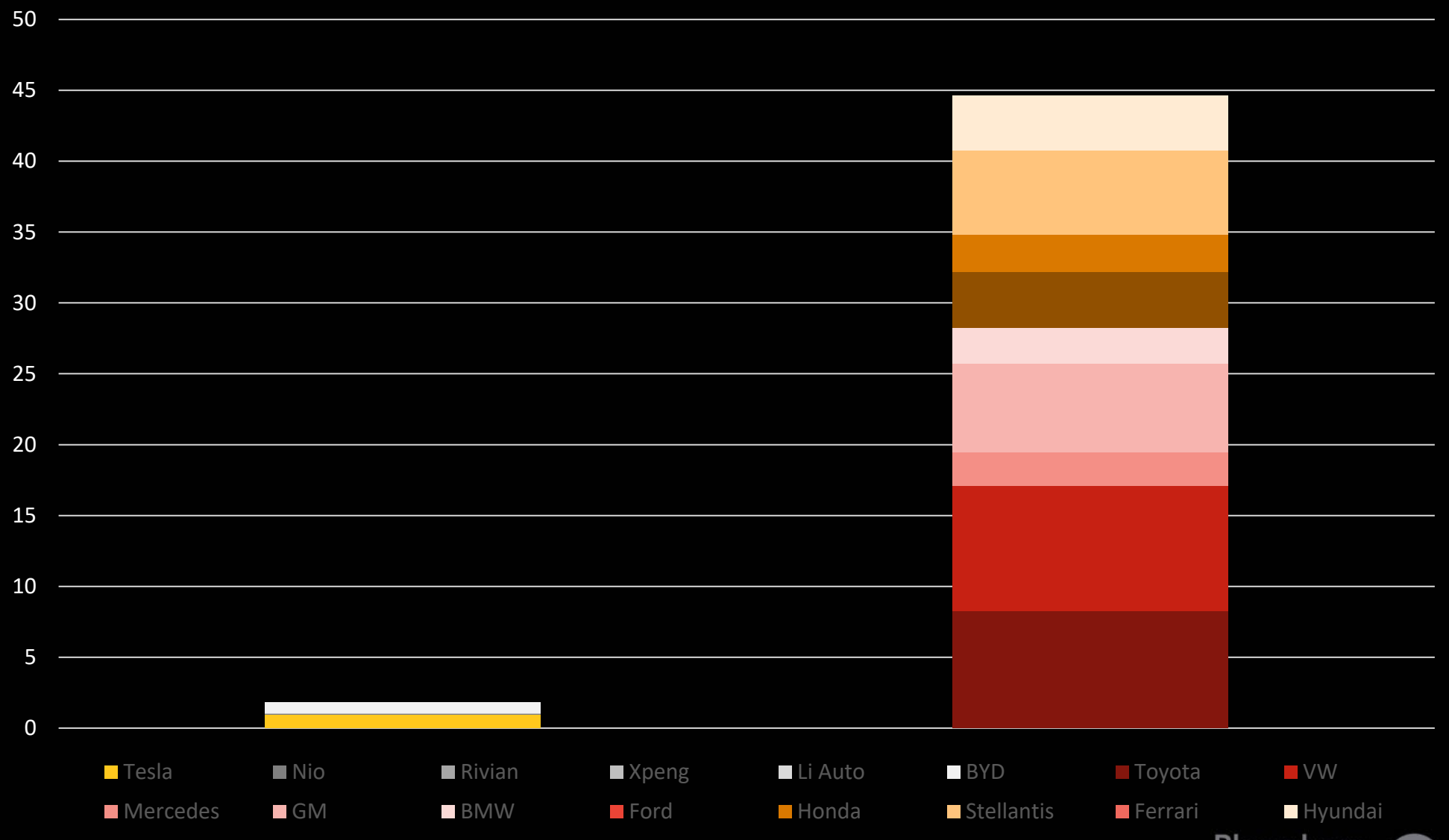
Source: Bloomberg Data

GLOBAL UNIT VOLUME COMPARISON

In million units



Source: Bloomberg Data

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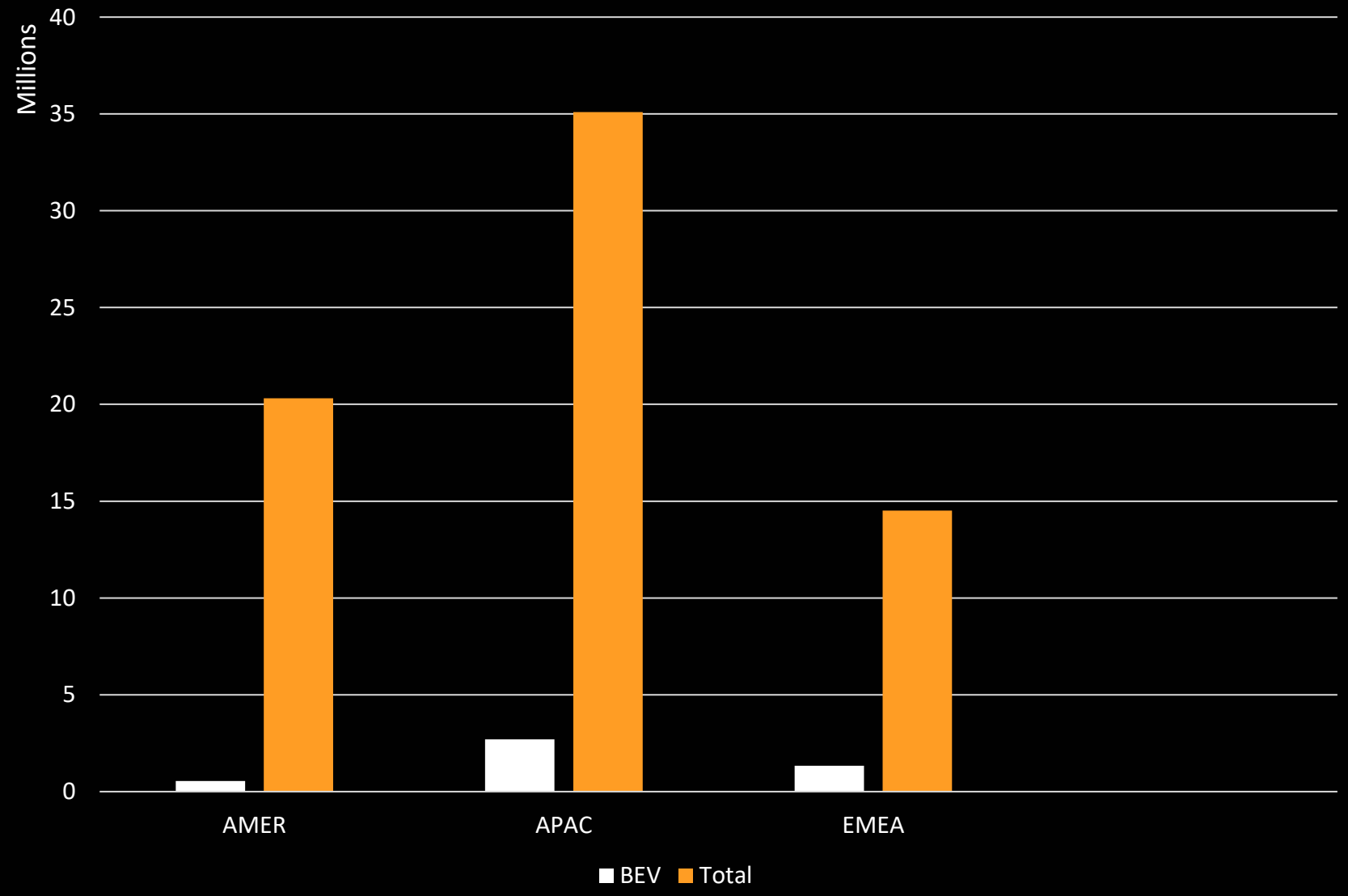
BEV VOLUME BY REGION

In million units



Source: Bloomberg Data

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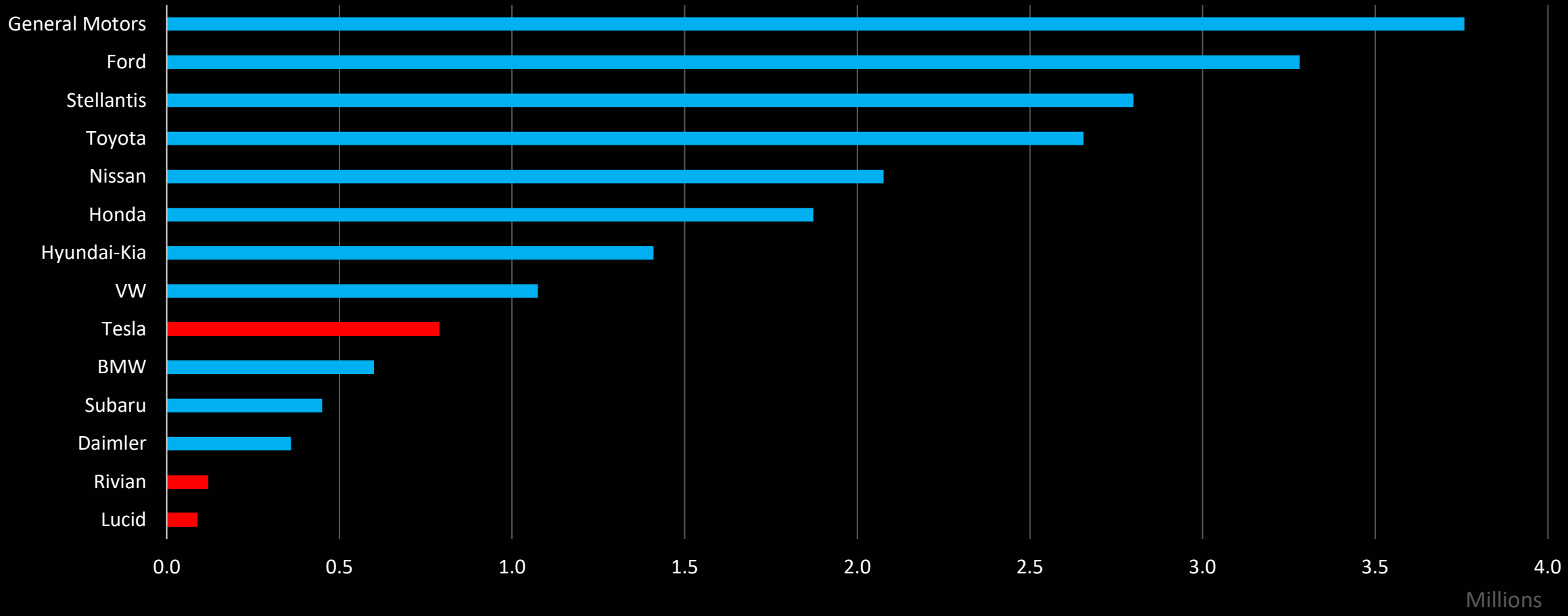
NORTH AMERICA PRODUCTION CAPACITY FORECAST

FY2025 – in millions



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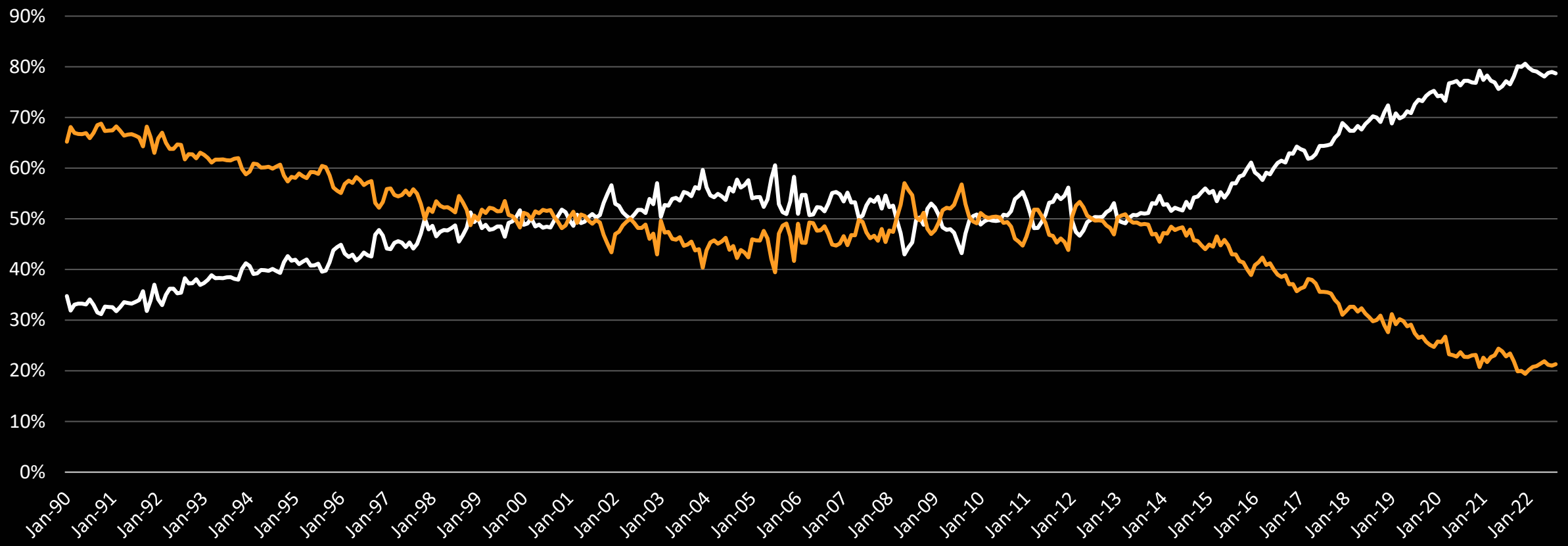
Source: just-auto.com

US LIGHT TRUCK AND CAR SALES

As % of total volume



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Source: Wards Auto

Thank you

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