AutoForecastSolutions

The Global Automotive Outlook
Market Drivers and Disruptors

Automotive LOGISTICS & SUPPLY CHAIN
GLOBAL

September 21, 2022
MGM Grand, Detroit

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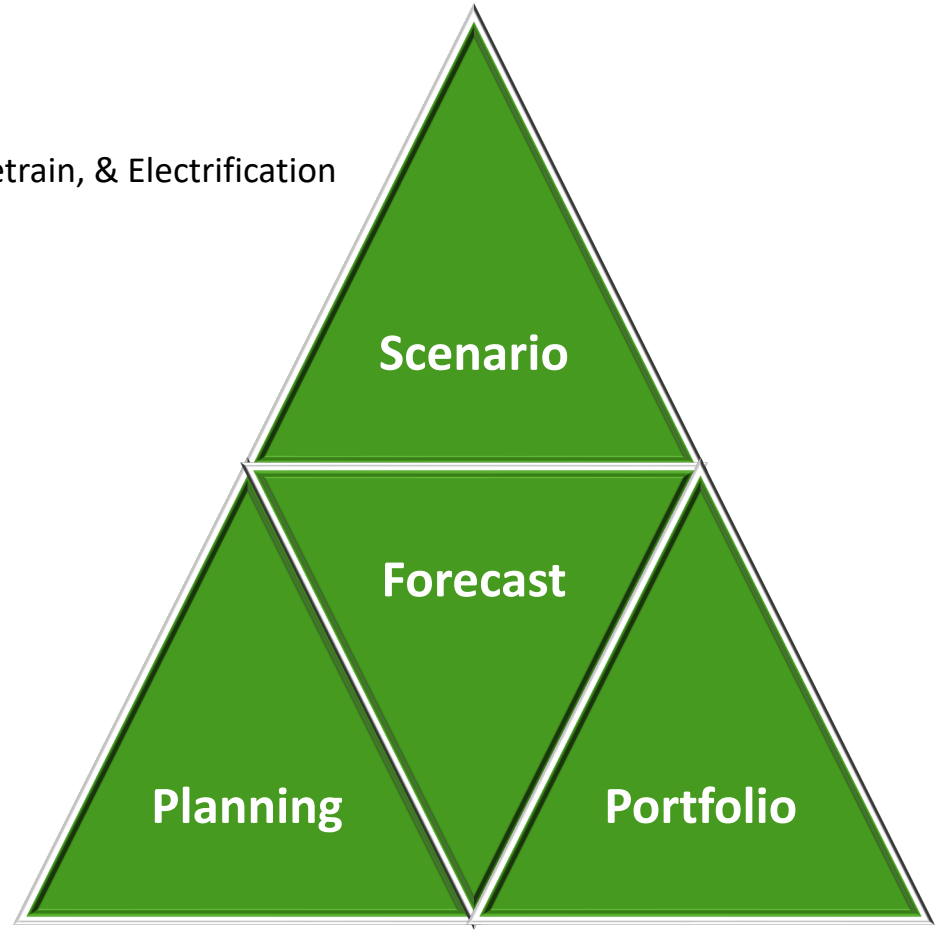
AFS Services: Automotive Forecasting & Business Intelligence Solutions

AFS Forecast

- Global Production Detail
- Vehicle, Engine, Transmission, Motor, Drivetrain, & Electrification
- BEV, PHEV, HEV, FCEV, IC
- History + 8 Year Outlook
- Updated Weekly & Monthly
- Web-Based Reporting Suite
- AFS Market Alerts

AFS Planning

- Part Number, Pipeline/RFQ Management
- Real-Time Sales Forecasting
- Risk Assessment
- Opportunity Identification
- Budget vs. Current Analysis
- Capacity planning
- Secure, Web-based Interface
- Integrate with AFS Forecast & Scenario



AFS Scenario

- Outlook Adjustment
- Proactive Approach to Prepare for Market Shifts
- Forecast Performance Comparison
- Budget vs. Current Forecast Analysis
- Secure, Web-based Interface
- Integrate with AFS Forecast & Planning

AFS Portfolio

- Opportunity Identification
- Market Share Mapping
- Competitor Analysis
- Gap Analysis
- Secure, Web-Based Interface
- Integrate with AFS Forecast & Scenario

Understand opportunities
Develop a value proposition
Identify areas of risk & growth.

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Driving Data into Decisions.
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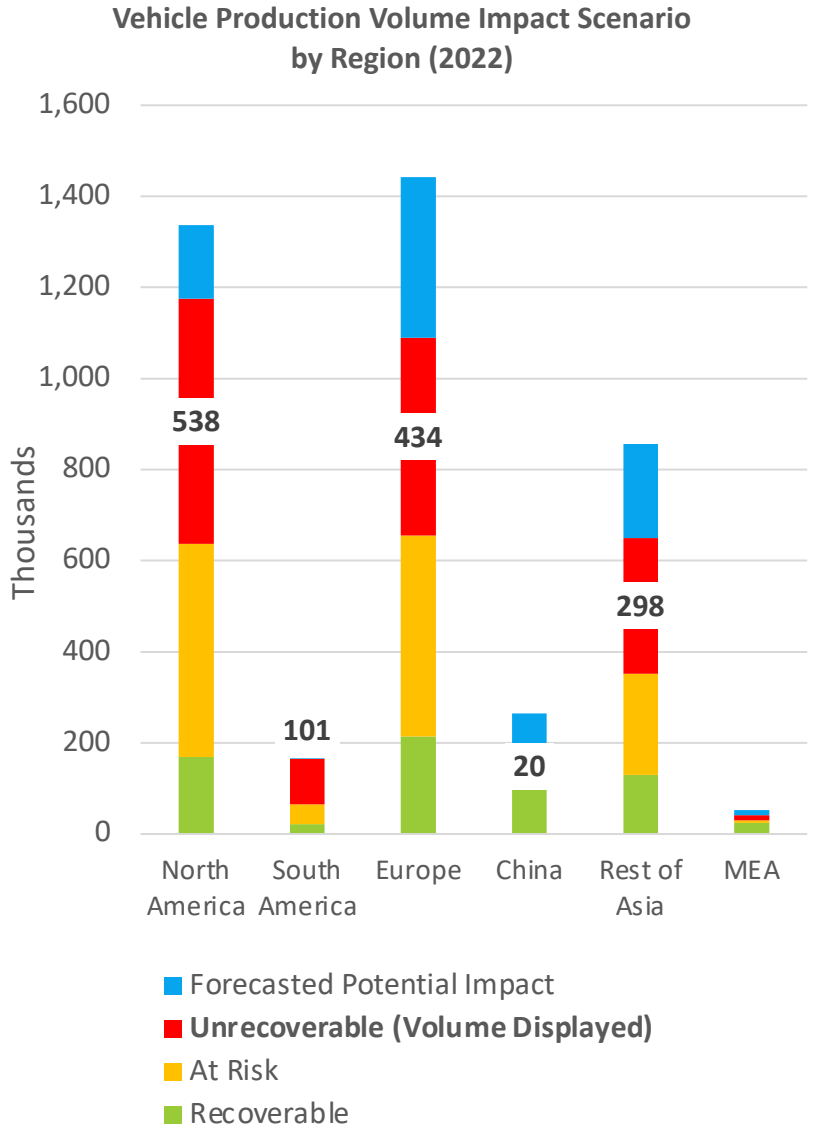
Semiconductor Shortage Impact Analysis: Global Scenario



Total Impacted Volume (Since Jan 2021)
13.83M

Total Lost Volume (Since Jan 2021)
7.70M

Total Potential Volume Impact (Since Jan 2021)
14.67M

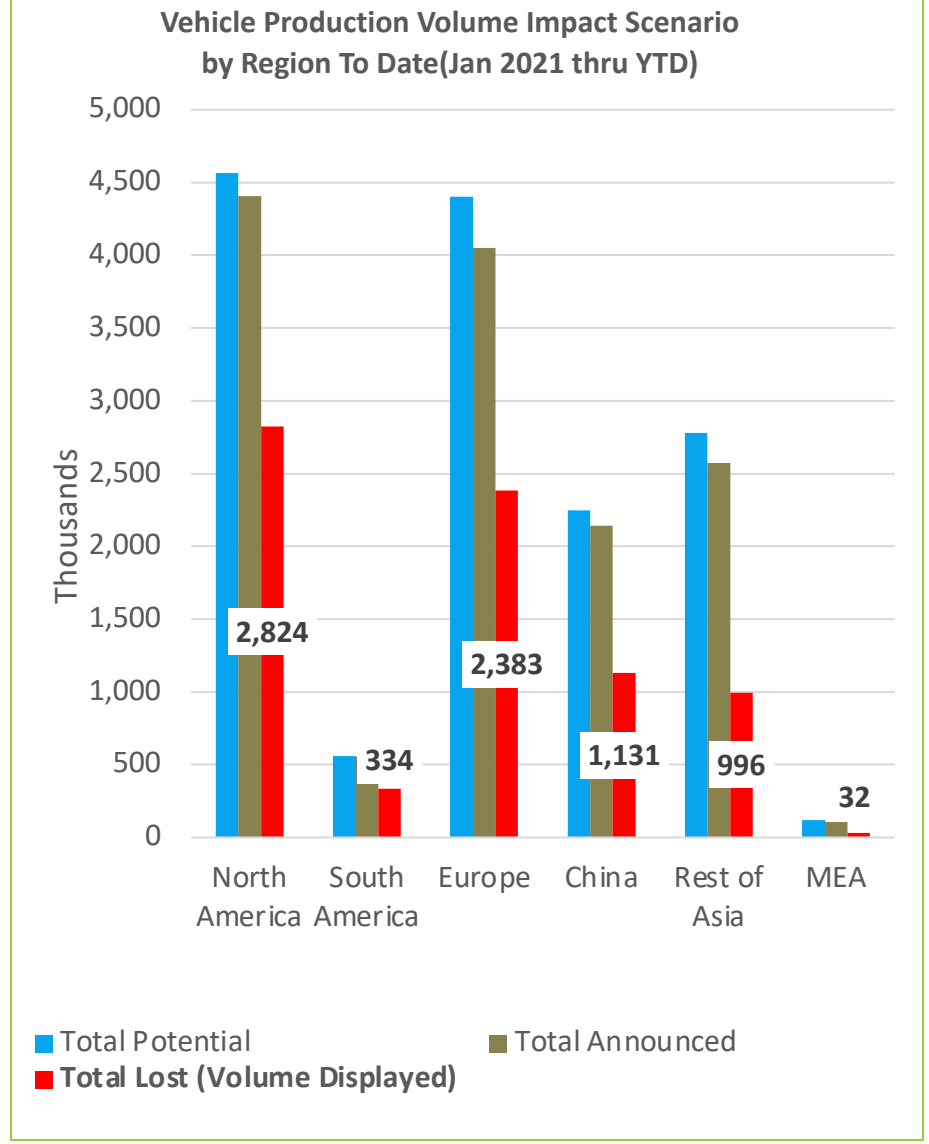
Announced Plant Impact Volumes (2022)
3.23M

Total Lost Volume (2022)
1.40M

Potential Volume Impact Total (2022)
4.12M

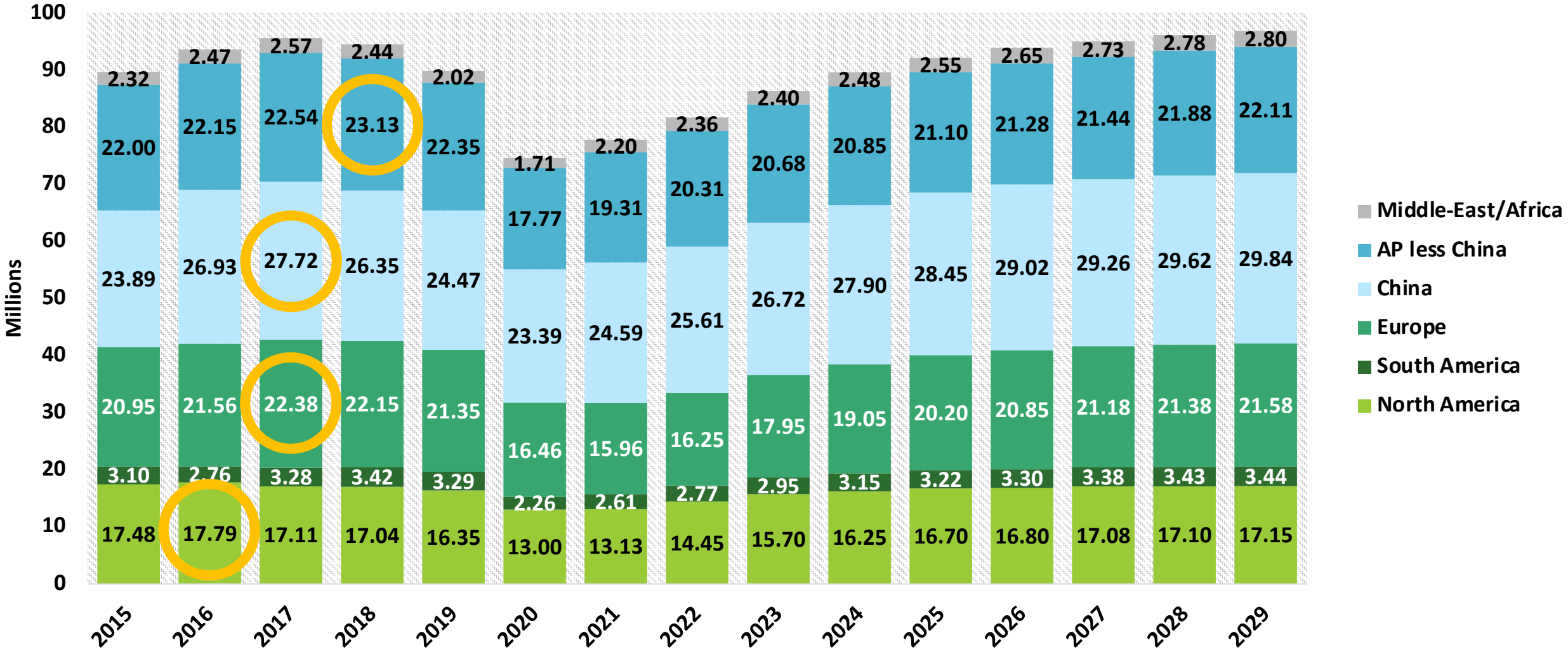
Vehicle Plants Impacted to Date
437

As of: September 16, 2022



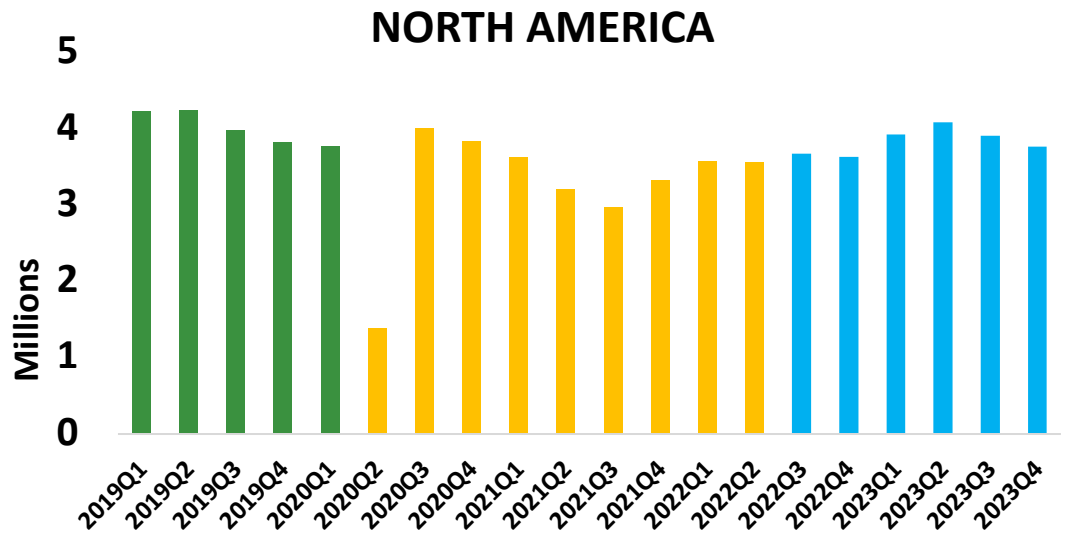
Source: AFS global forecast and services

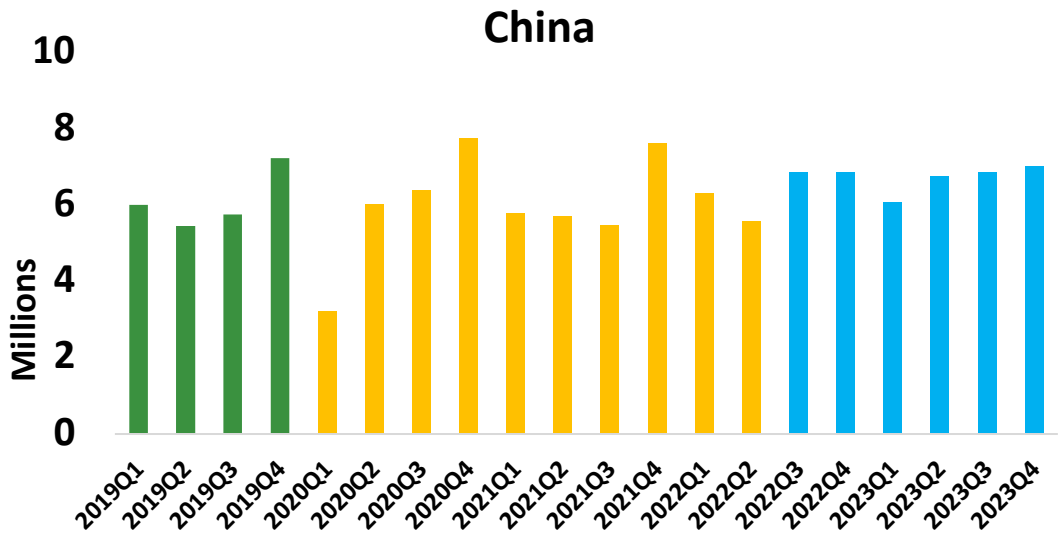
Global Light Vehicle Production Outlook (as of September 1, 2022 AFS Forecast release)

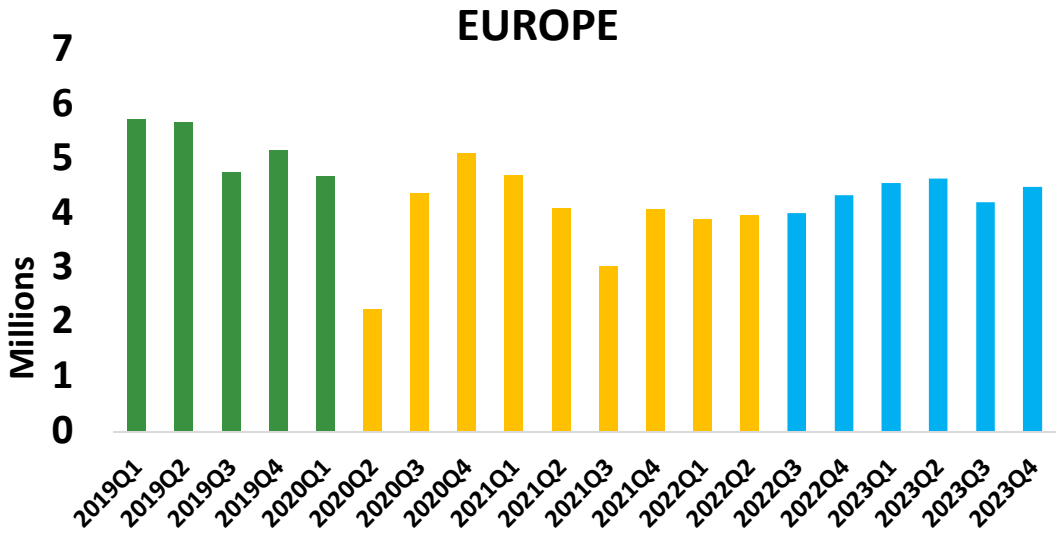


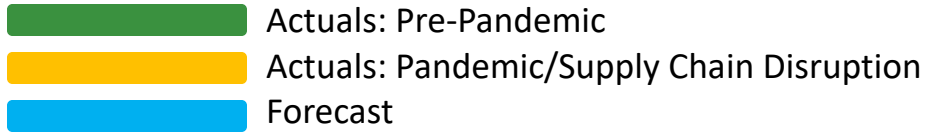
Source: AutoForecast Solutions

Major Market Production: Short-Term Quarterly







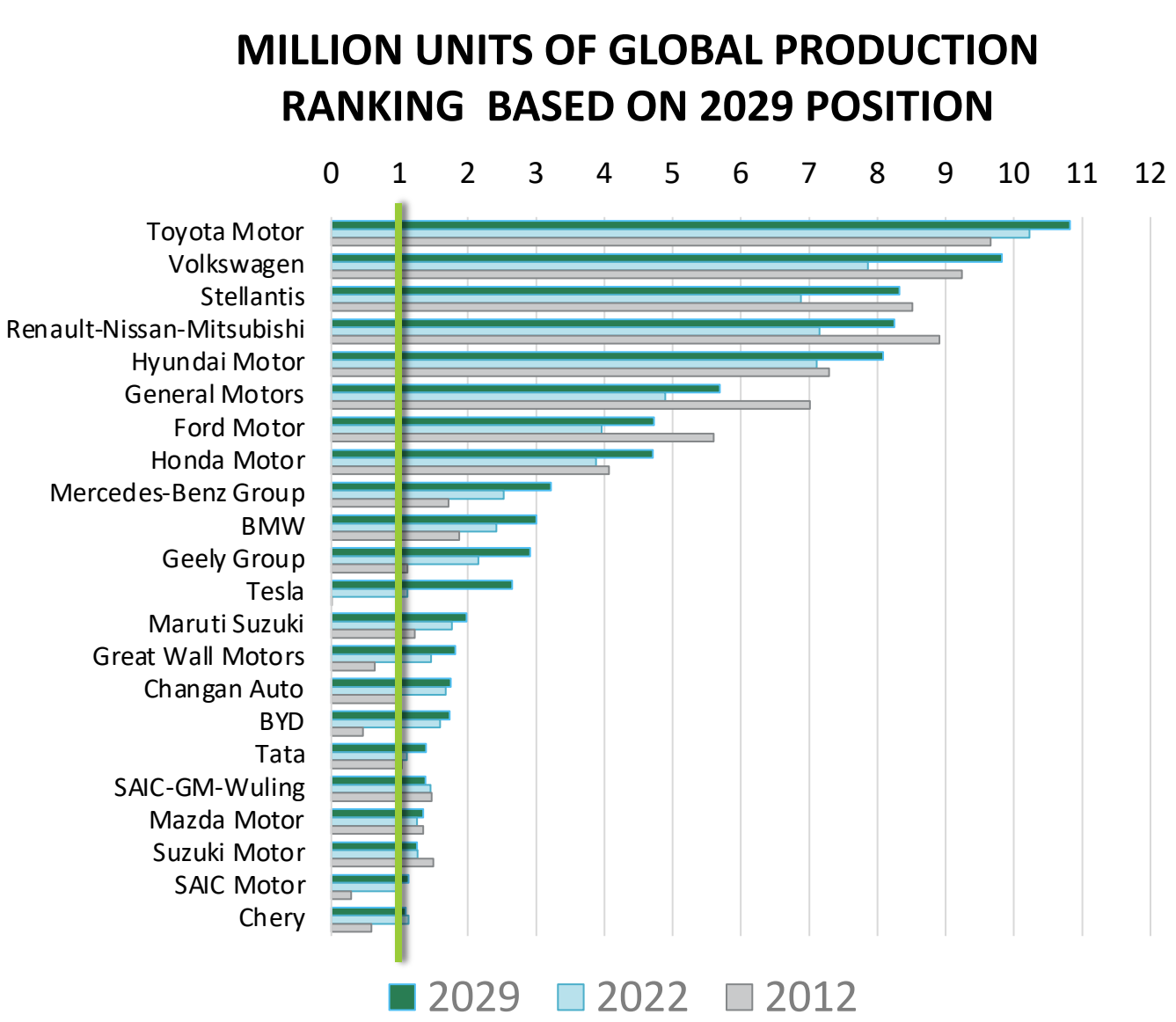


Forecast Flatness

- Semiconductor & supply chain shortage/instability
- Build-to-order production strategies
- Economic weakness and geo-political impact flattening recovery

Source: AutoForecast Solutions

“1 Million Unit Club” Brand Owner Analysis (2029)



22

Brand Owners in 2029 to produce OVER 1 Million units/year

90%

% of Global Production

Top 10 Brand Owners

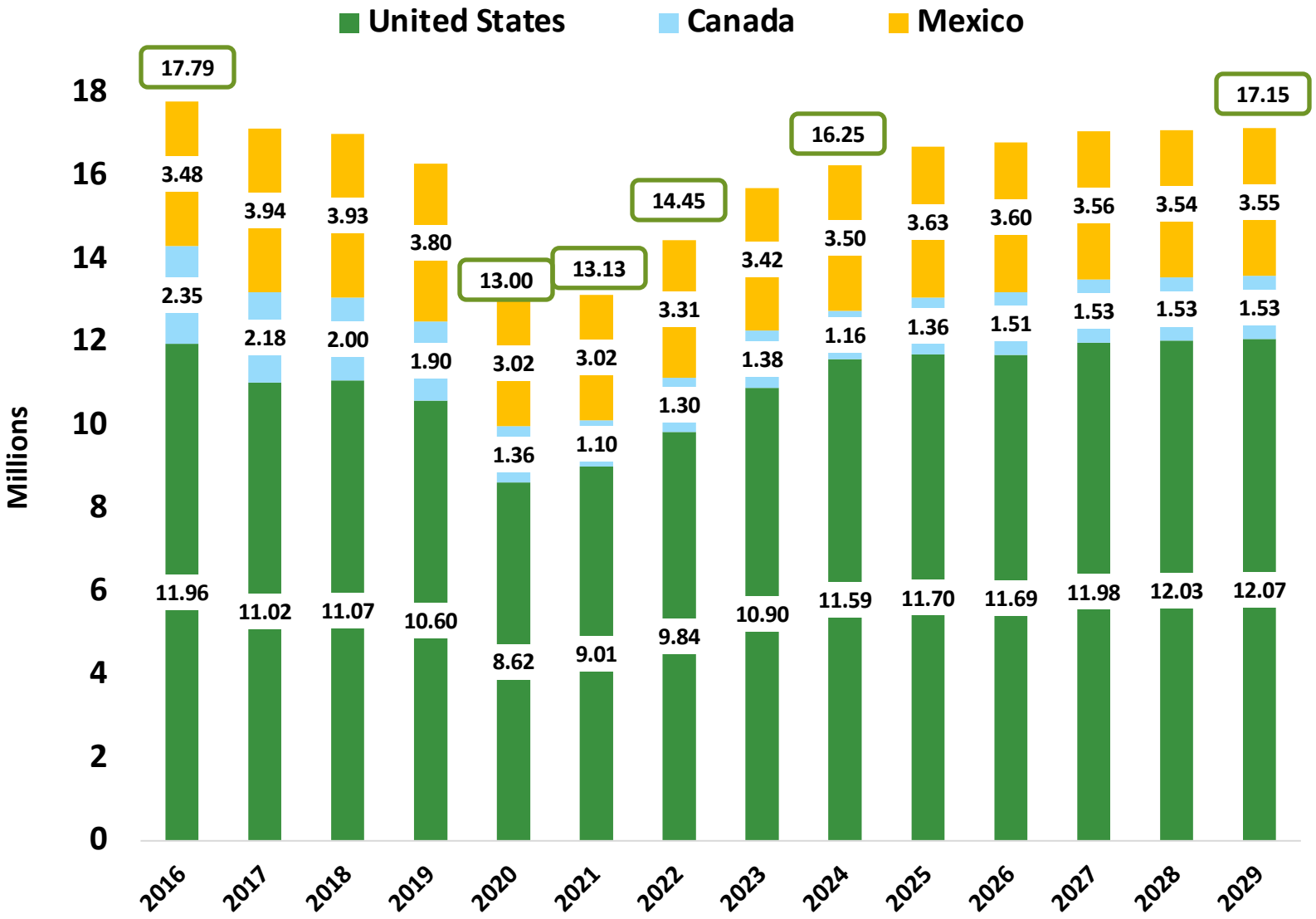
70% of total market

Inductees Since 2012
BYD
Chery
Geely Group (with Volvo)
Great Wall Automobile
SAIC Motor
Tata
Tesla

500K – 1 Million in 2029
Beijing Automotive Group
Dongfeng Motors
GAC Motor
FAW
Isuzu
Subaru

Source: AutoForecast Solutions

North America Growth Outlook and Growth



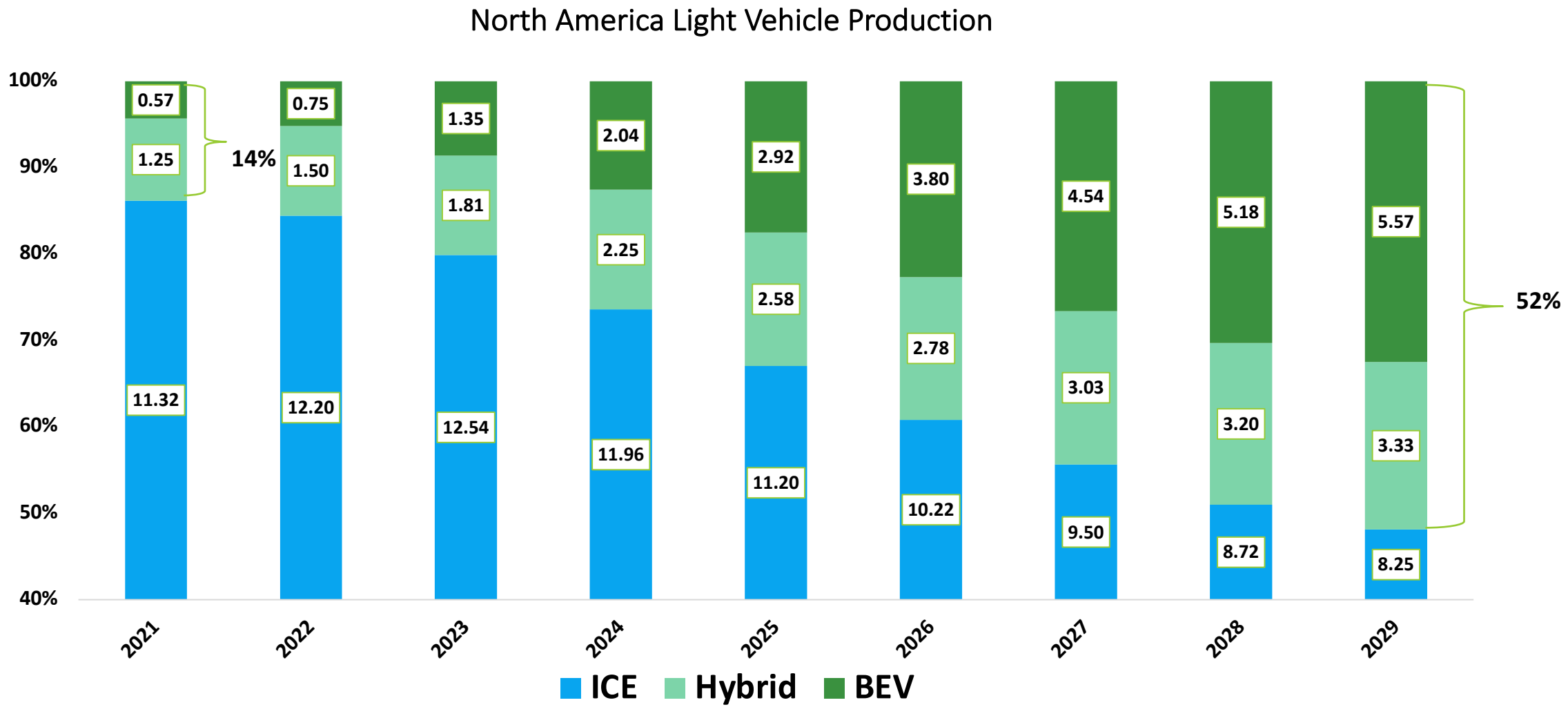
Jurisdiction	Growth (2020-2029)	CAGR (2016-2029)	CAGR (2020-2029)
North America	31.92%	-0.28%	3.13%
United States	40.02%	0.07%	3.81%
Canada	12.21%	-3.28%	1.29%
Mexico	17.65%	0.16%	1.82%

Disruptors

- COVID, Semiconductors, raw materials, logistics
- Global conflicts and geo-political impacts
- USMCA compliance in 2023
- Inflation Reduction Act
- Canada Electrification:
  - Brampton unassigned product
  - Ford Oakville BEV retooling
  - Windsor BEV investment
  - GM Brightdrop

Source: AutoForecast Solutions

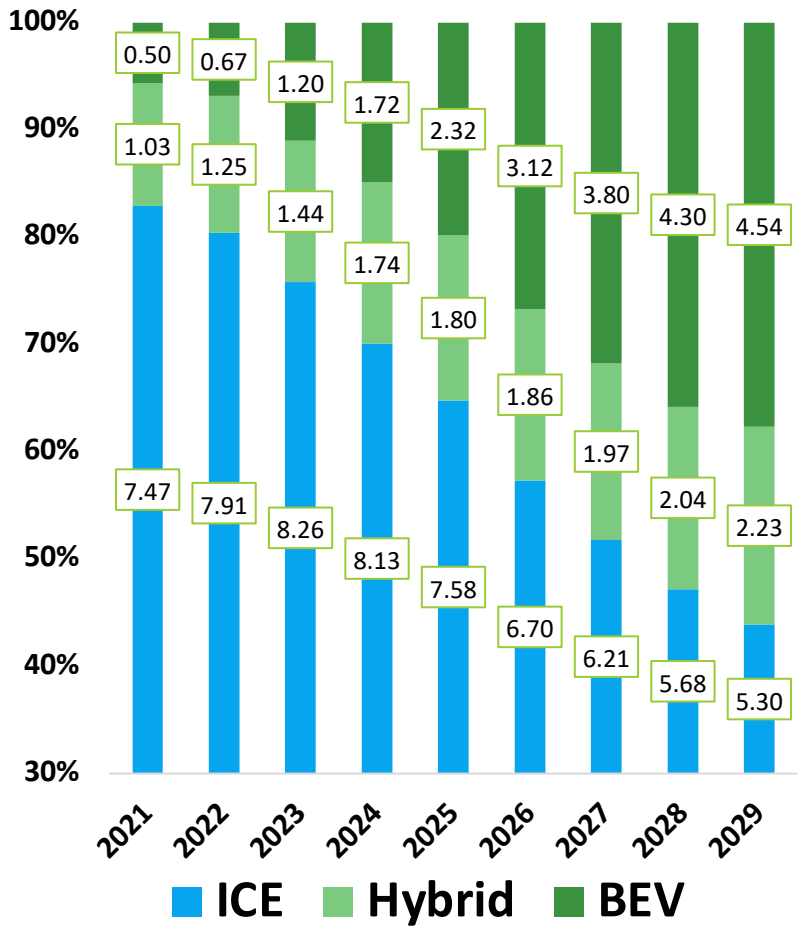
Powertrain Production Mix: North America



A different story when viewed for a propulsion perspective
2029: Electrification tipping point

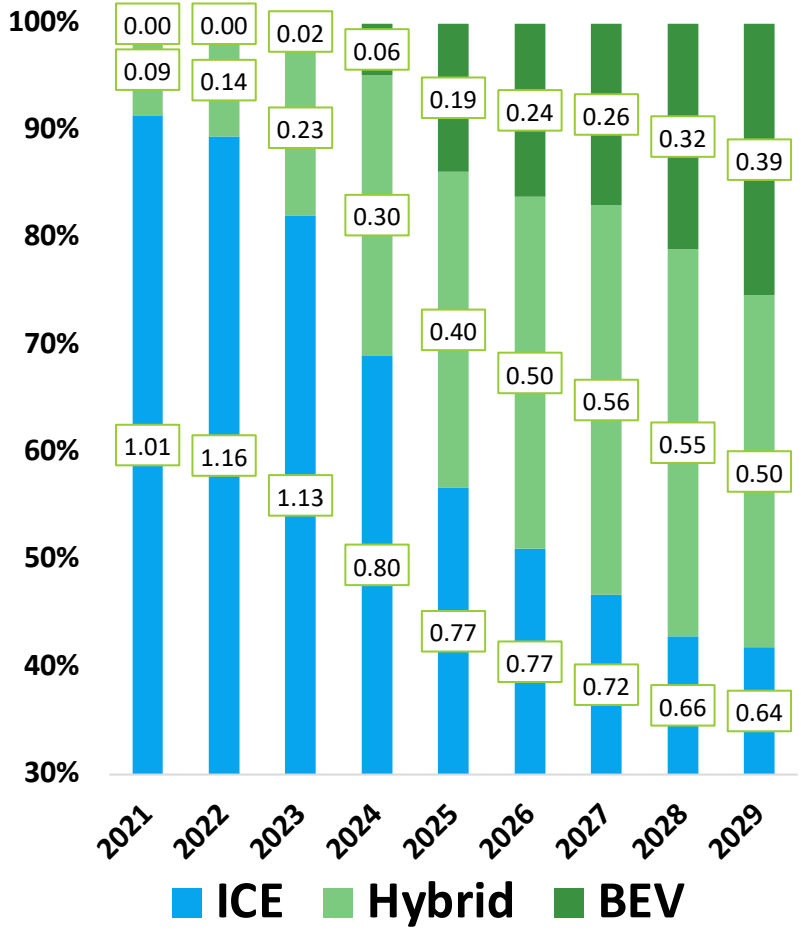
Powertrain Production Mix by Country: North America

U.S. Light Vehicle Production



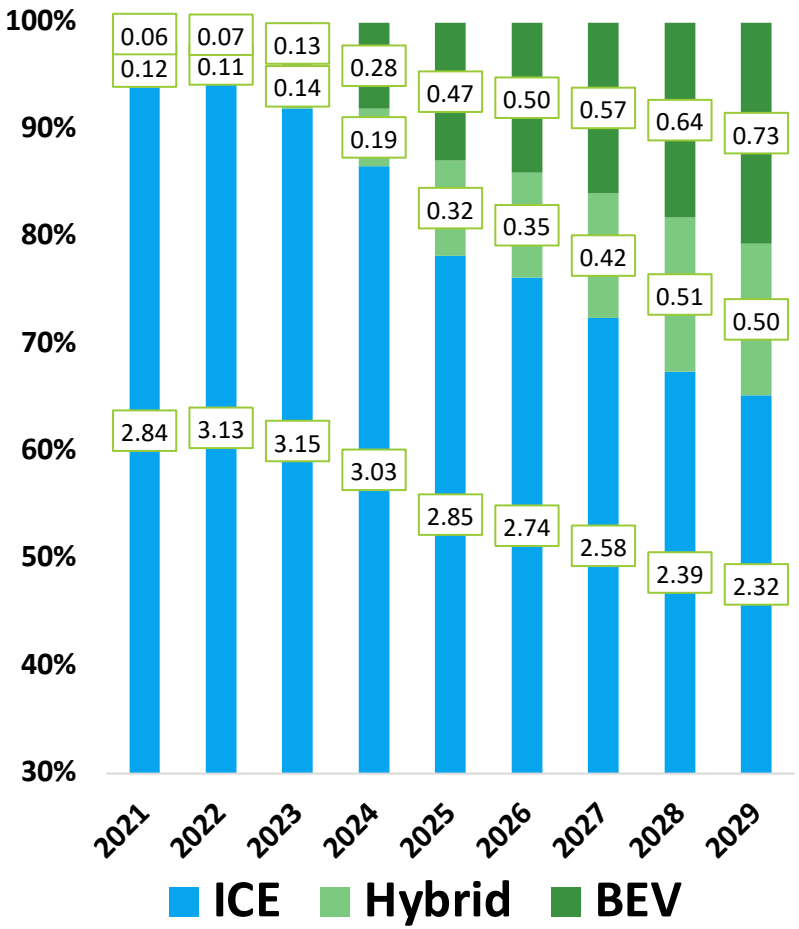
Market Leader

Canada Light Vehicle Production



Strategic Investment

Mexico Light Vehicle Production



Steady Growth

NOTE: Values in columns represent light vehicle production in millions

Source: AutoForecast Solutions

Domestic Investment Opportunity: New Players

GAC

- Heavy investment in auto shows
- Stellantis relationship fractured but not dissolved
- Rebadging GAC Chinese-assembled vehicles as Dodge in Mexico

GEELY

- Owner of Volvo & Lotus
- 10% stake in Daimler and looking to invest in Aston Martin
- The Lynk & Co and Polestar brands developed as exports
- The new Volvo plant in the U.S. will assemble Polestar-branded vehicles; opportunity to add Lynk & Co in future

CHERY

- U.S. plans to market Chery products under the importer HAAH brands of VANTAS & T-Go brands were cancelled; investigating new ways to enter the market

SAIC MOTOR

- Heavy expansion throughout southeast Asia and targeting Western Europe – with their sights on North America
- Already produces/assembles MG/Roewe products in China, England, India, and Thailand
- Focusing on MG as an electric brand in Europe

VINFAST

- $2 - $4 Billion investment in North Carolina to assemble electric buses, SUVs, and batteries – Target July 2024
- US$200 Million investment in California to sell electric vehicles through a network of 60 dealers starting 2022.

BYD AUTO

- Partially financed by Warren Buffett
- Global expansion focus on Europe; laying groundwork for North America entry
- Currently produces electric buses in California
- Supporting Toyota bZ series of EVs

ARRIVAL

ZOOX

Faraday Future

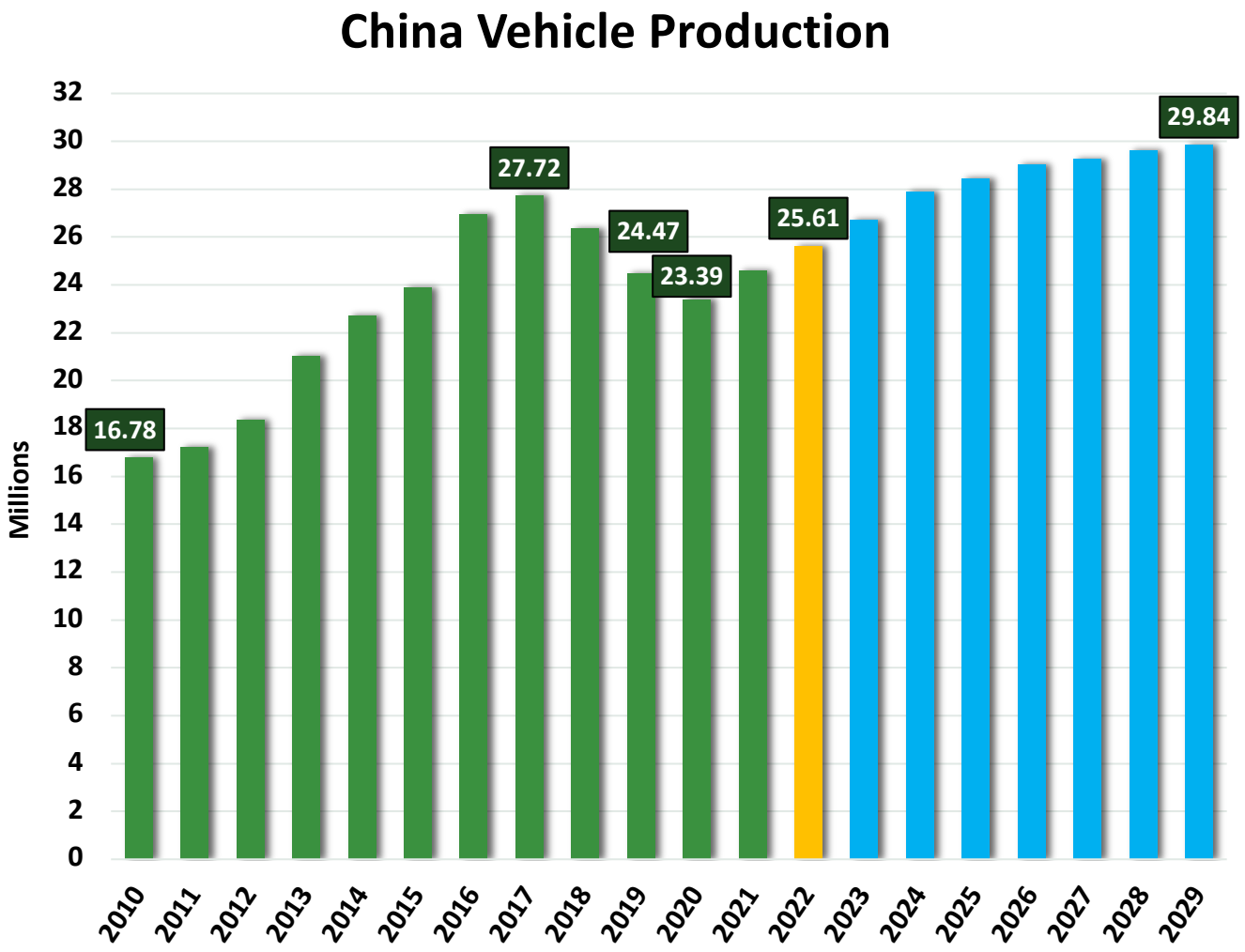
FOXCONN

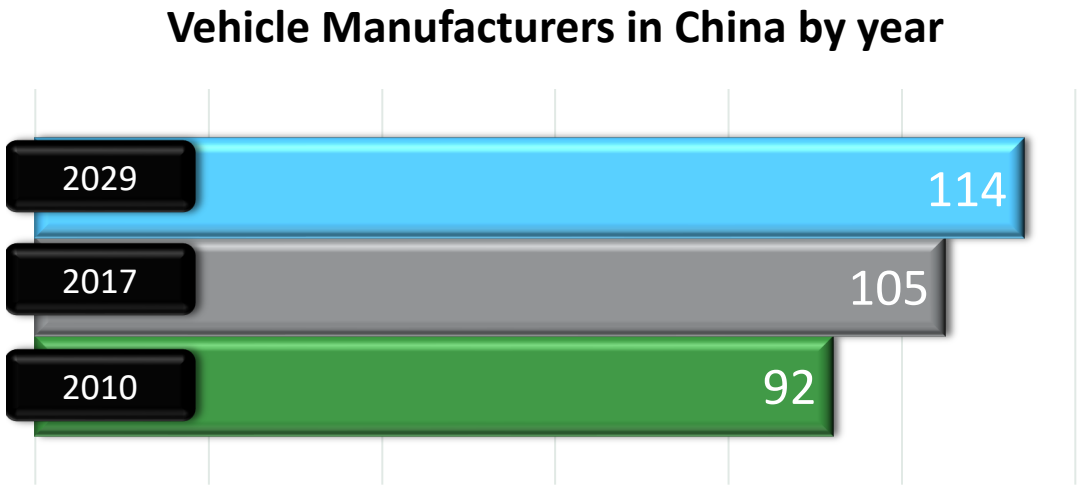
LUCID

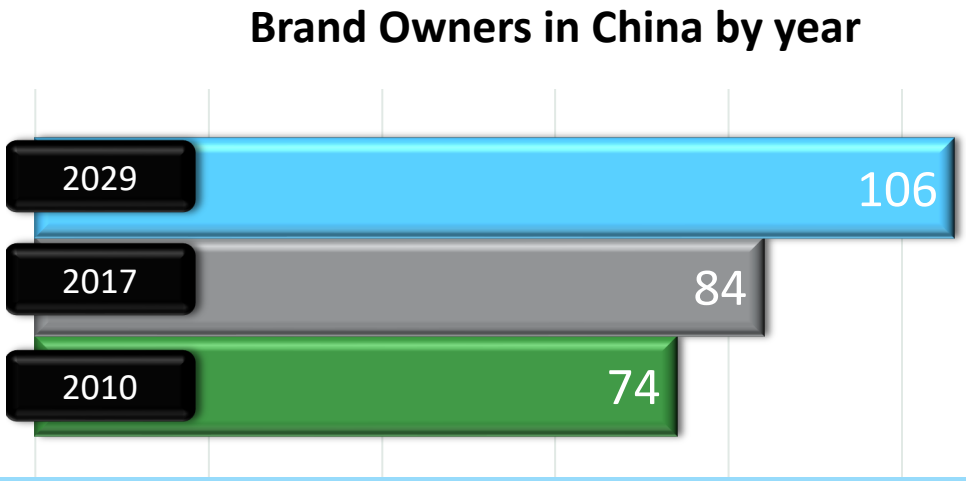
RIVIAN

Source: AutoForecast Solutions

China Vehicle Production Outlook





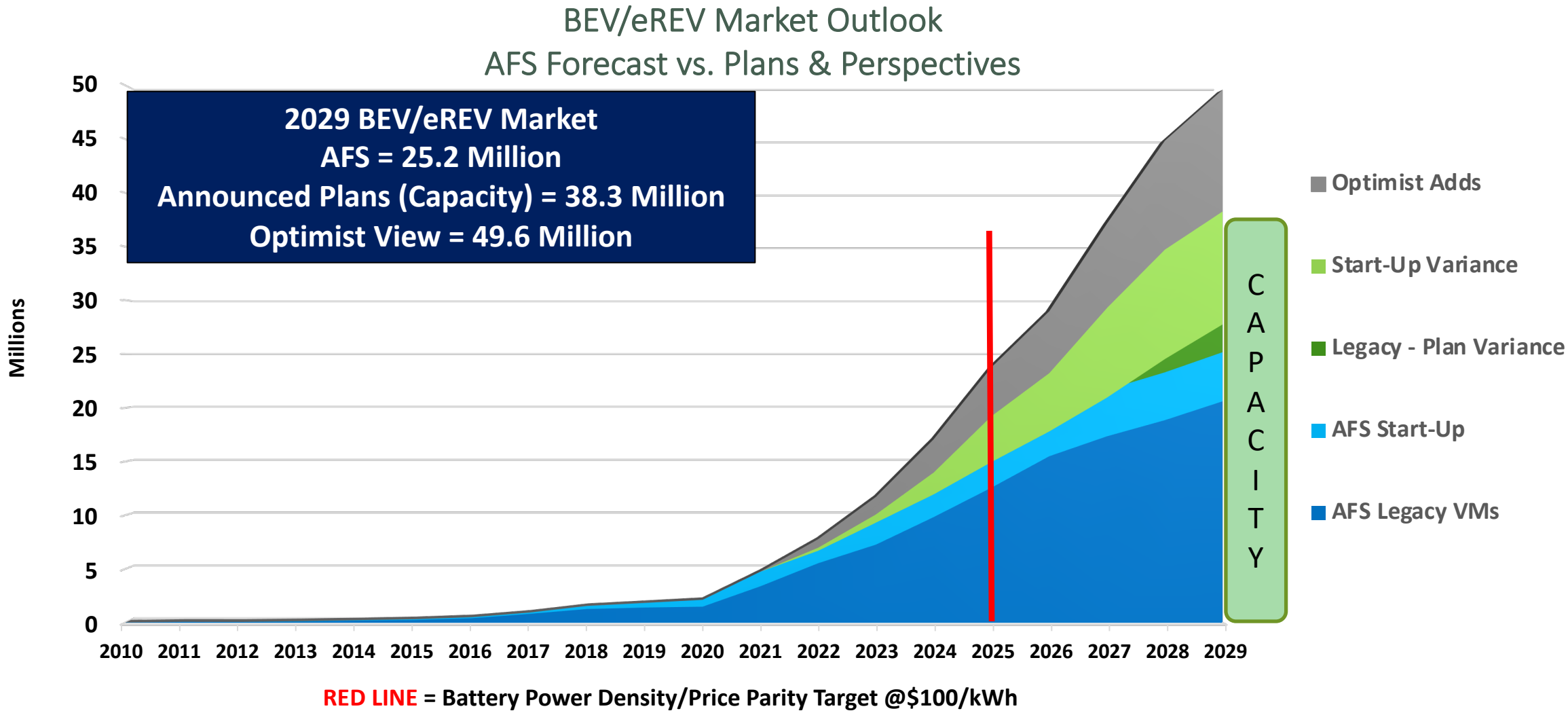


A lesson is leveraging disruption

Source: AutoForecast Solutions

ELECTRIFICATION

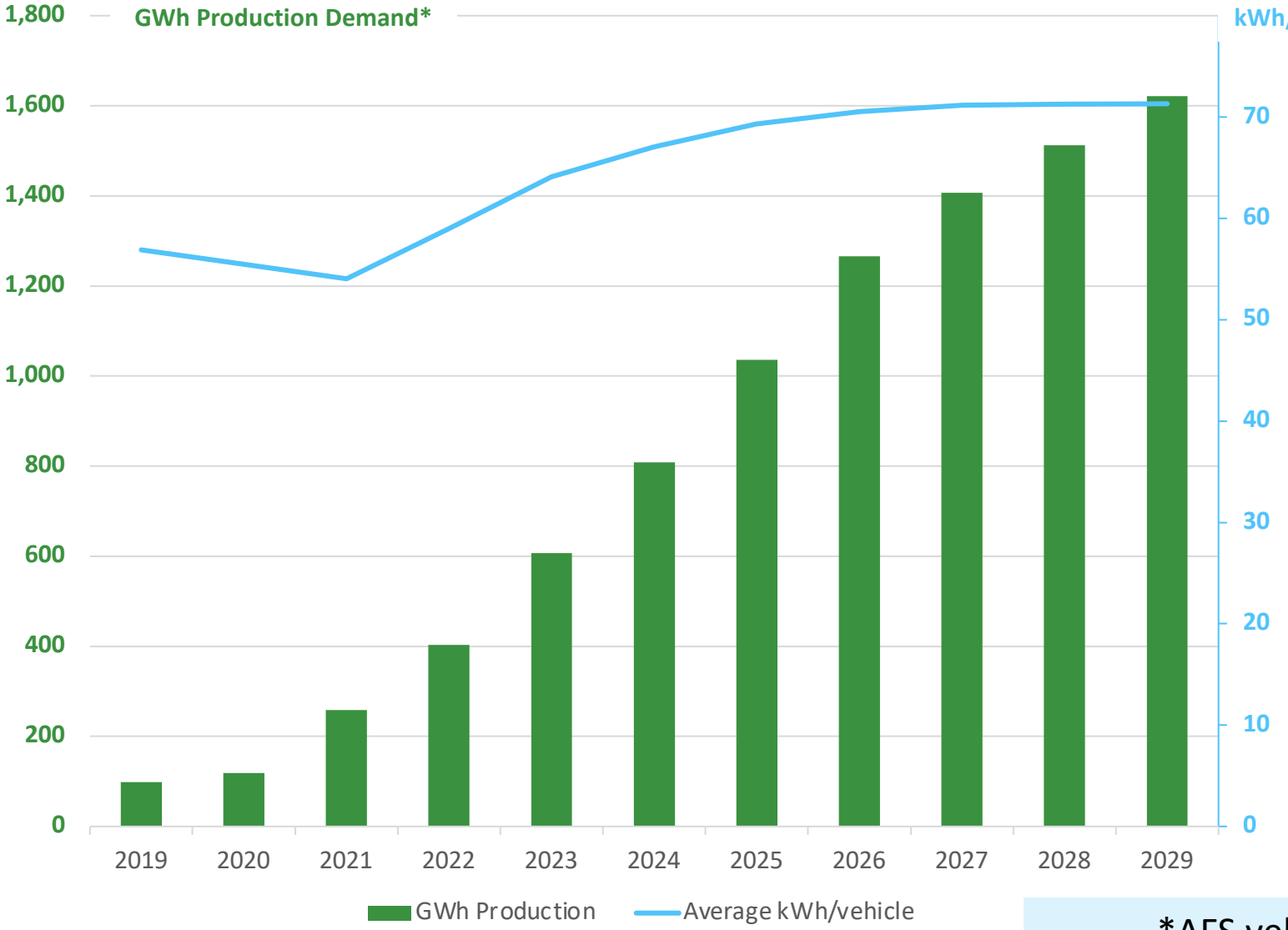
Global EV Market Sizing: The Planning Dilemma



EVEN AN OPTIMISTIC VIEW REQUIRES OVER HALF OF VEHICLES TO HAVE AN ENGINE

Source: AutoForecast Solutions

Global Battery Production Forecast

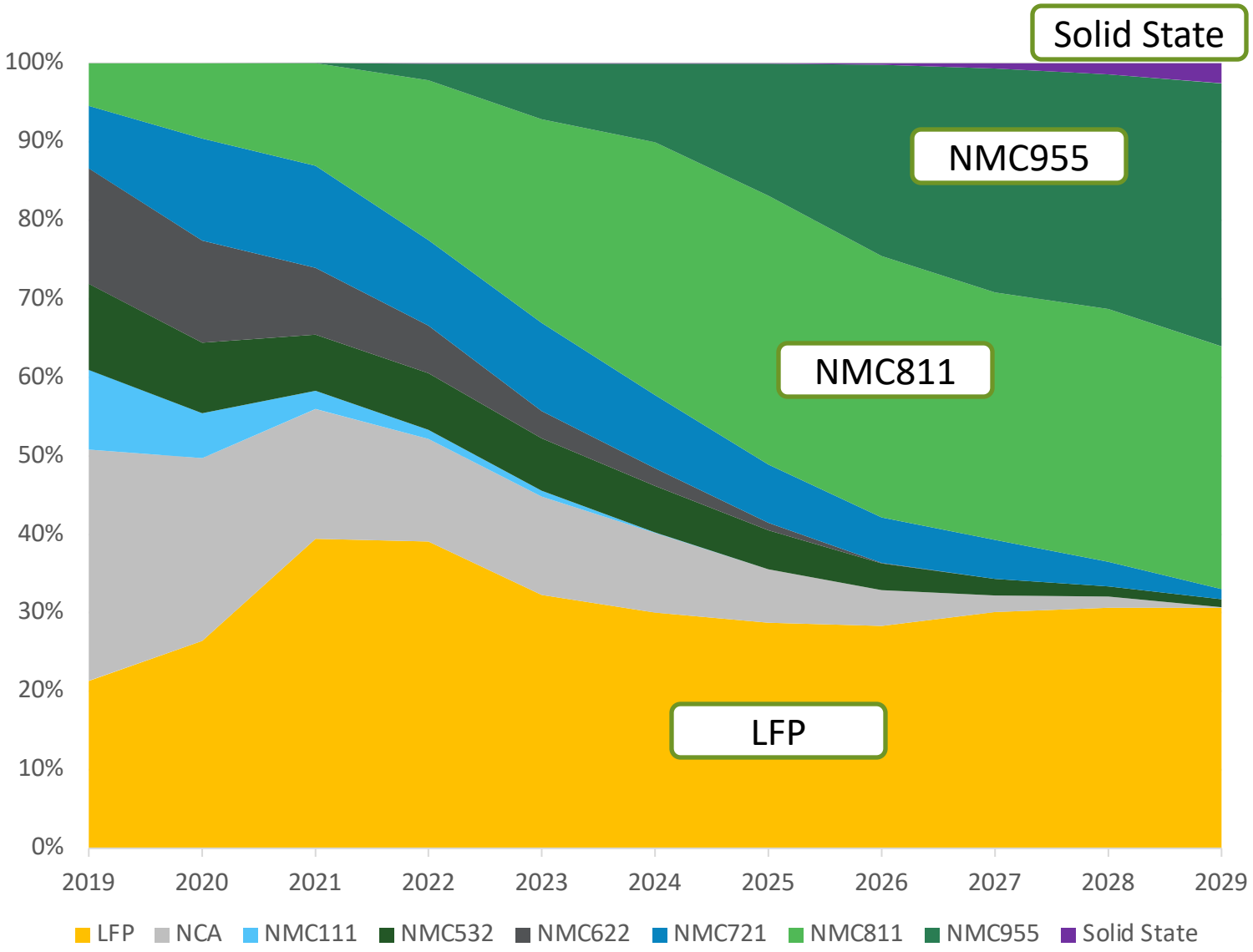


- Average kWh/vehicle is rising
  - OEM targets of >300 miles (480km) for NA and EU
  - Lower targets across Asia
- Global EV battery demand is expected to exceed 1,600GWh by 2029*
  - 4X what is needed today
  - 2/3 of growth will come from markets outside of China
  - OEM announced goals significantly higher
- 30-50 more Gigafactories will need to be completed in the next 5 years to hit these production numbers

*AFS vehicle production forecast used for analysis

Source: AutoForecast Solutions

Global Battery Chemistry Trend



- **Automakers are settling on 3 batteries chemistries before the end of the decade.**
  - NMC955 and NMC811 for premium applications
  - LFP for value applications
- Higher nickel and lower cobalt batteries have better cost and energy density but need to have more active thermal management systems to prevent thermal runaways (fires)
- Solid State batteries are rapidly advancing but will not be seen in high volume applications before the end of the decade.

Source: AutoForecast Solutions

Raw Material Shortages in the Future?

TODAY

- Global production of lithium in 2021 was ~100,000 mt (metric tons)
  - All industries
- Almost all future growth in lithium will support automotive batteries

Future (2030)

- Global production of lithium in 2030 will need to be ~260,000 mt to meet AFS's EV forecast demand
  - 2.6X the miners, mining equipment, and approved mining sites will need to be introduced in a very short timeframe
- Estimates from the OEMs will require much higher lithium production than this!

Source: AutoForecast Solutions

Inflation Reduction Act: Automotive Highlights

Vehicle in service date →	2023CY	2024CY	2025CY	2026CY	2027CY	2028CY	2029-2032CY
North America "Clean Vehicle" Assembly*	**REQUIRED AS OF SEPTEMBER 16, 2022**						
Critical Mineral Requirement credit = $3,750**	**40%**	**50%**	**60%**	**70%**	**80%**	**80%**	**80%**
Battery Component Requirement* credit = $3,750**	**50%**	**60%**	**60%**	**70%**	**80%**	**90%**	**100%**
Adjusted Gross Income of taxpayer limitations to receive credit (New Car Purchase)	**<$300,000 Joint Return <$225,000 Head of Household <$150,000 Individual Filer**						
MSRP Price Limitations for credit (New Car Purchase)	**<$80,000 Van, Pickup, or SUV <$55,000 Passenger Car**						

KEY NOTES FROM THE INFLATION REDUCTION ACT

* **CLEAN VEHICLES** include pure all BEVs, all Fuel Cell EVs, and PHEVs with 4-7 kWh of battery capacity Assembled in North America. Additionally in the Act language is an important caveat of exclusion: Any vehicle placed in service after December 31, 2024, with respect to which ANY of the applicable minerals contained in the battery of such vehicle were extracted, processed, or recycled by a foreign entity concern, or any vehicle placed in service after December 31, 2023, with respect to which ANY of the components contained in the battery of such vehicle were manufactured or assembled by a foreign entity of concern

** The percentage of the applicable **CRITICAL MINERALS** contained in such battery that were extracted or processed in the United States, or in any country with which the United States has a free trade agreement in effect, or recycled in North America, is equal to greater than the applicable percentage

*** With respect to the **BATTERY** from which the electric motor of such vehicle draws electricity, the percentage of the value of the components contained in such battery that were manufactured or assembled in North America is equal to or greater than the applicable percentage

PREVIOUSLY-OWNED CLEAN VEHICLES

- $4,000 credit OR 30% of vehicle sale price
- Model year at least 2 years earlier than the calendar year in which the taxpayer acquires the vehicle; gross vehicle weight <14,000 lbs., and sale price <$25,000
- Taxpayer thresholds
    - $150,000 Joint Return
    - $112,000 Head of Household
    - $75,000 other categories

U.S. BEV Sales/Inflation Reduction Act: Brand Start Year Compliance

2023 Calendar Year	
VM	Brand
Amazon	Zoox
Arrival	Arrival
Bollinger	Bollinger
Canoo	Canoo
Daimler	Mercedes-Benz
Ford	Ford
Geely	Polestar
Geely	Volvo
GM	BrightDrop
GM	Cadillac
GM	Chevrolet
GM	Cruise
GM	GMC
Foxconn	Lordstown
Oshkosh	Oshkosh
Renault/Nissan	Nissan
Rivian	Rivian
Stellantis	Ram
Tesla	Tesla
Toyota	Toyota
VIA	VIA
Volkswagen	Volkswagen

2024 Calendar Year	
VM	Brand
Foxconn	Fisker
Ford	Lincoln
GM	Acura
GM	Honda
Hyundai	Kia
Lucid	Lucid
Stellantis	Chrysler
Stellantis	Dodge
Stellantis	Jeep
Vinfast	Vinfast

2025 Calendar Year	
VM	Brand
Hyundai	Hyundai

2026 Calendar Year	
VM	Brand
BMW	BMW
Hyundai	Genesis
Renault/Nissan	Infiniti
Volkswagen	Scout

2027 Calendar Year	
VM	Brand
Honda	Buick
Volkswagen	Audi

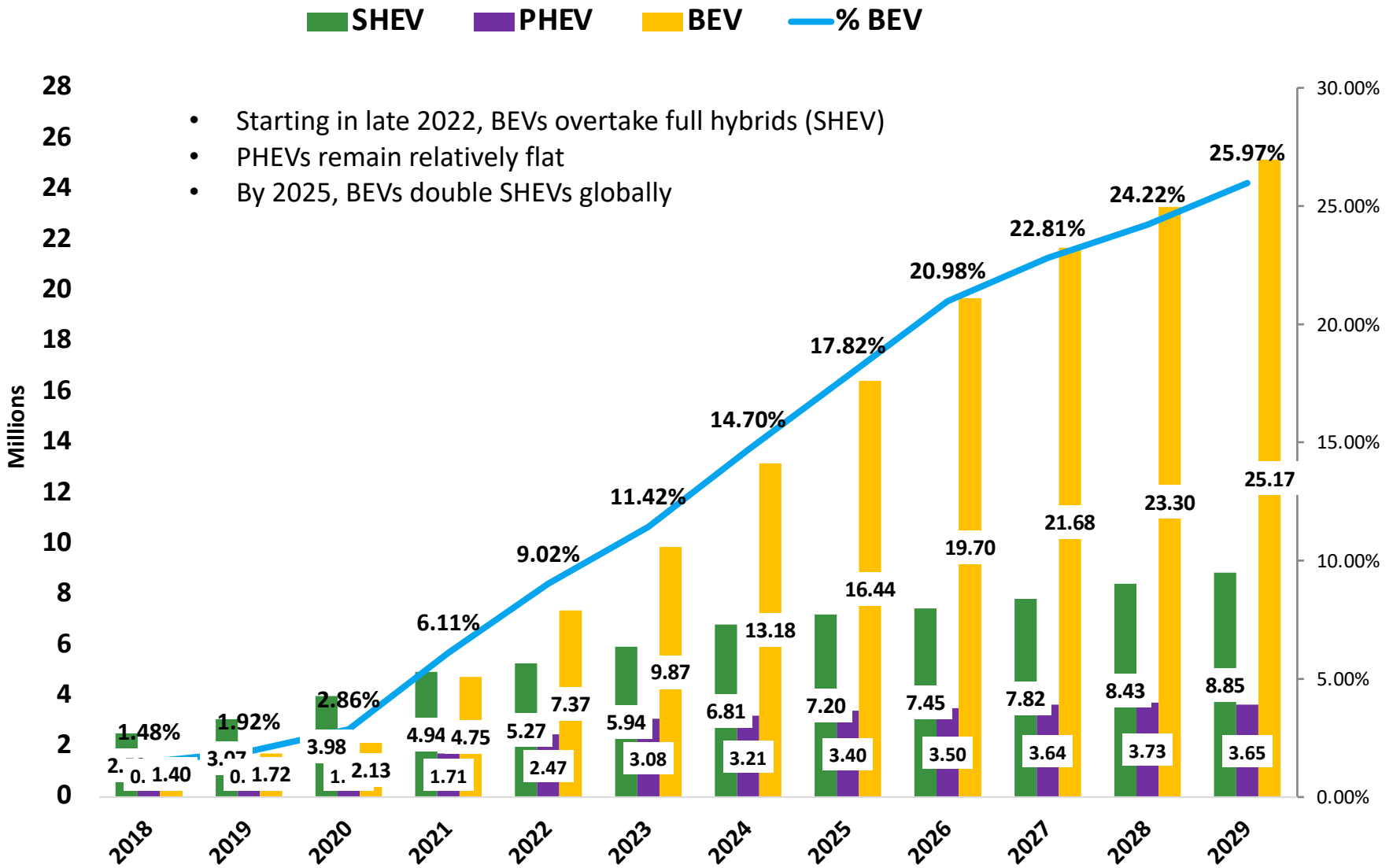
IRA-Compliance based on domestic production and if any vehicle trim levels fall within the IRA price threshold.

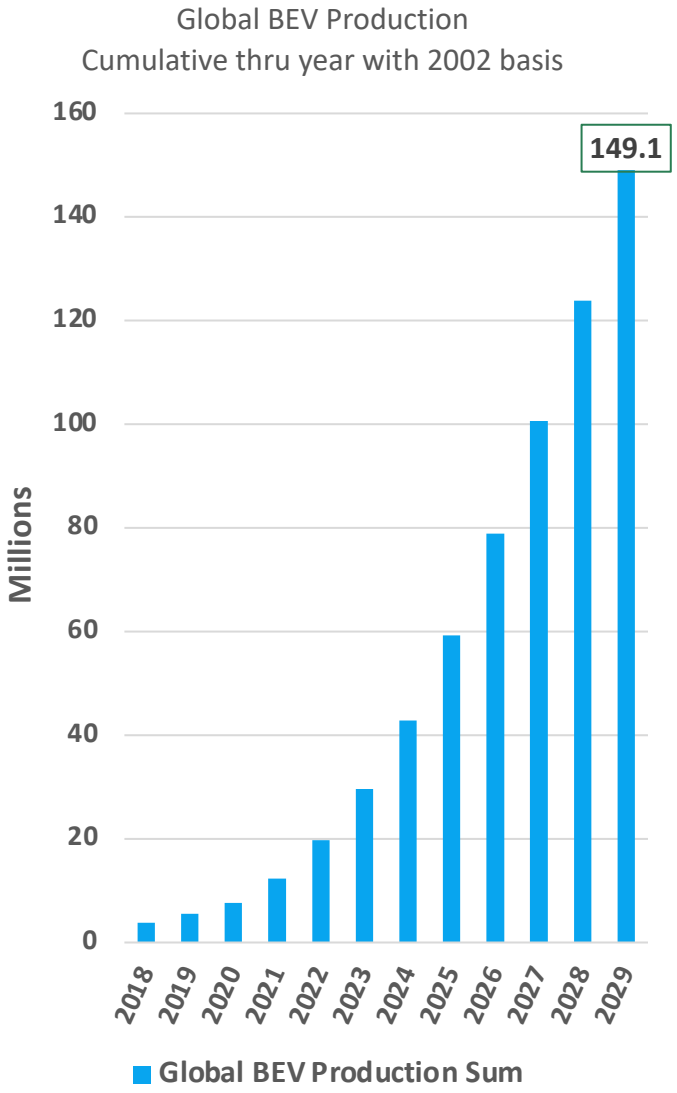
Consideration for mineral and/or battery supply/manufacturing still pending and a this time the largest hurdle to compliance

Logistically, the IRA should:

- Accelerate domestic production investment
- Reduce vehicle/component imports
- Open new jurisdictions to service the EV infrastructure

Global xEV Production Outlook

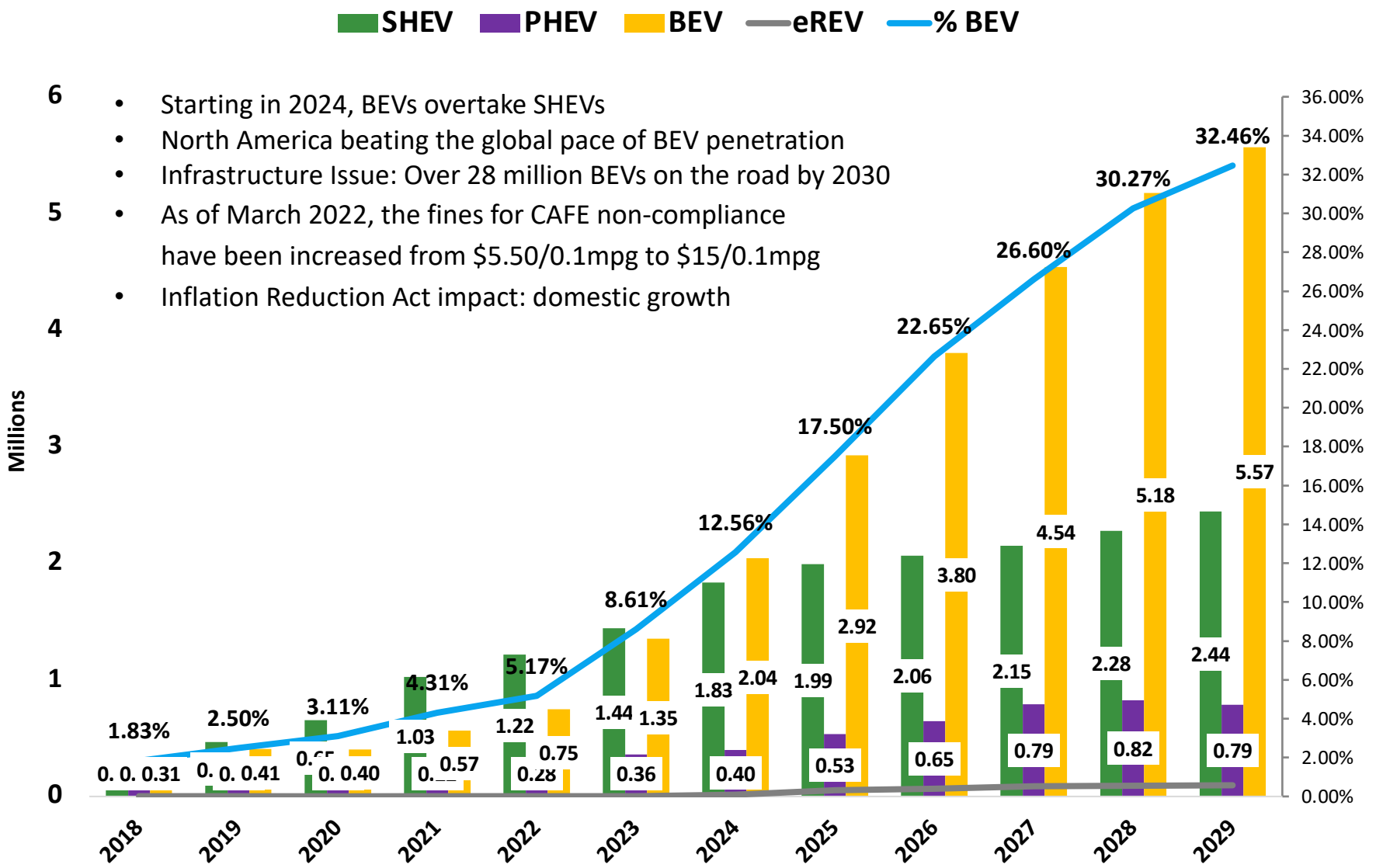


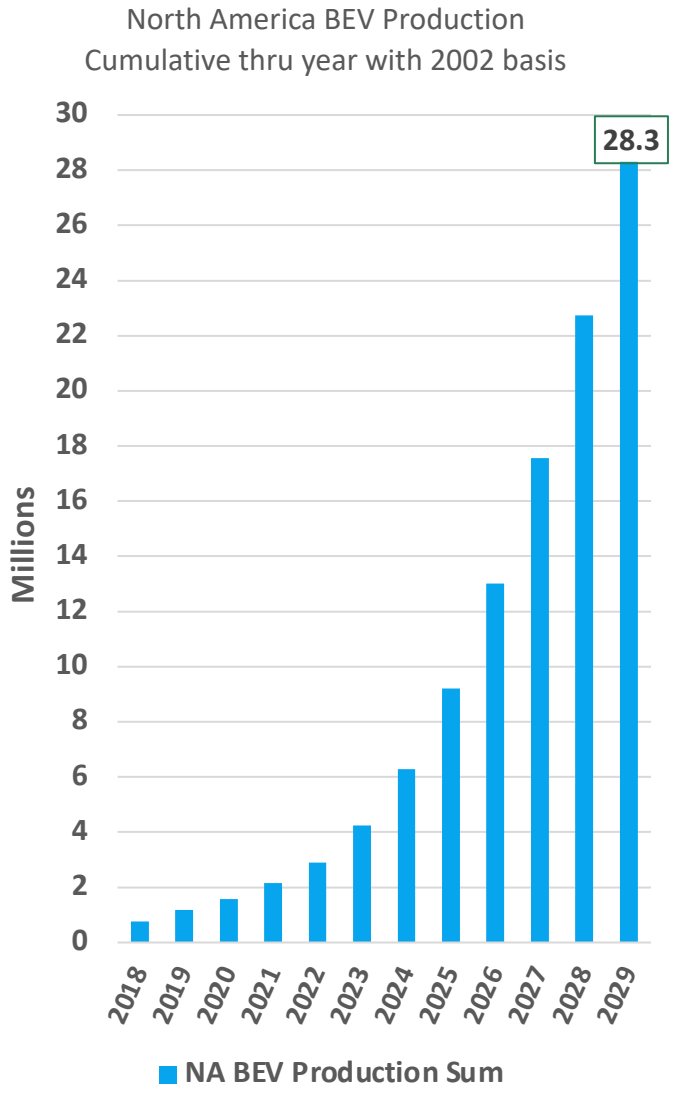


Source: AutoForecast Solutions

North America xEV Production Outlook

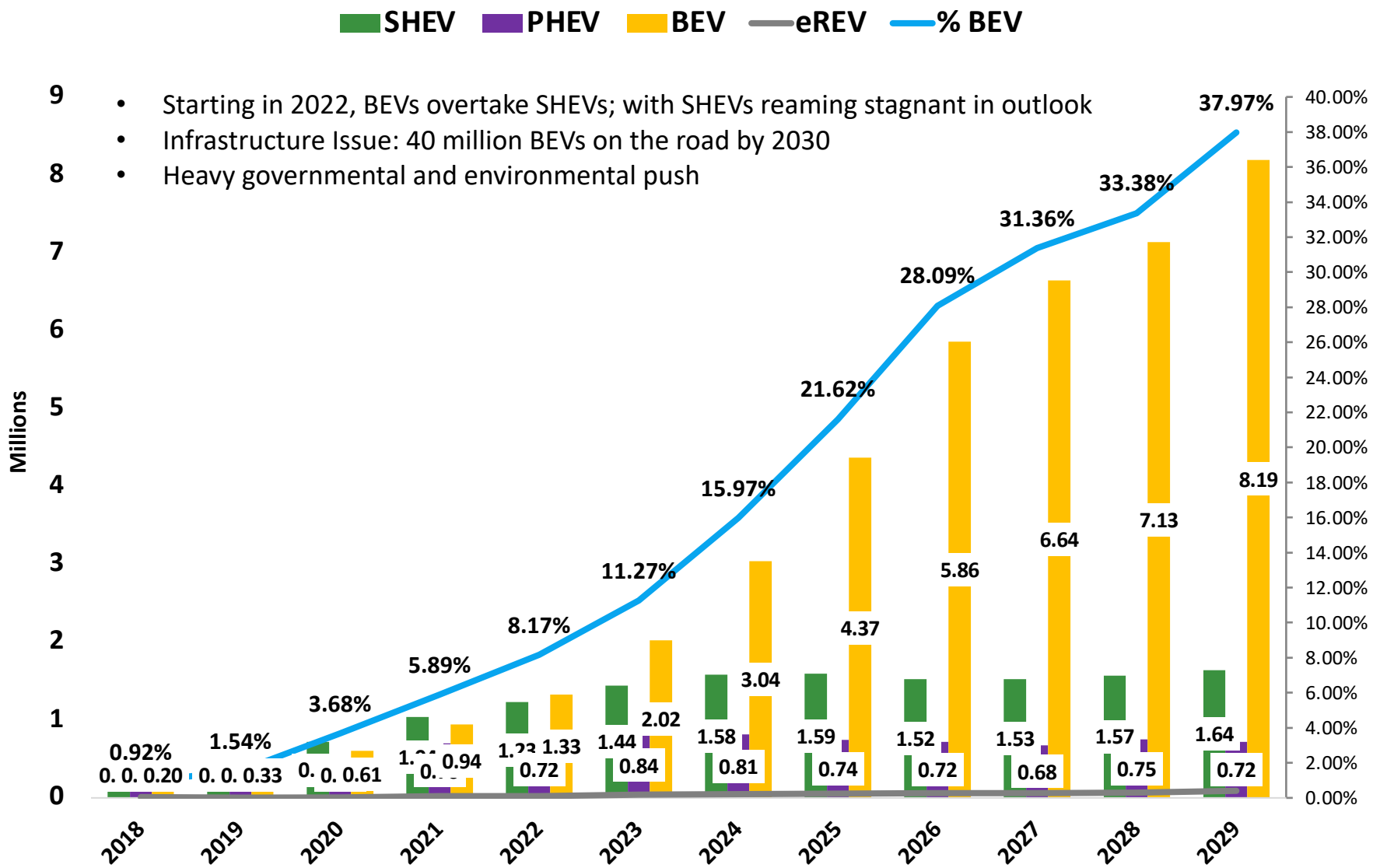
- Starting in 2024, BEVs overtake SHEVs
- North America beating the global pace of BEV penetration
- Infrastructure Issue: Over 28 million BEVs on the road by 2030
- As of March 2022, the fines for CAFE non-compliance have been increased from $5.50/0.1mpg to $15/0.1mpg
- Inflation Reduction Act impact: domestic growth

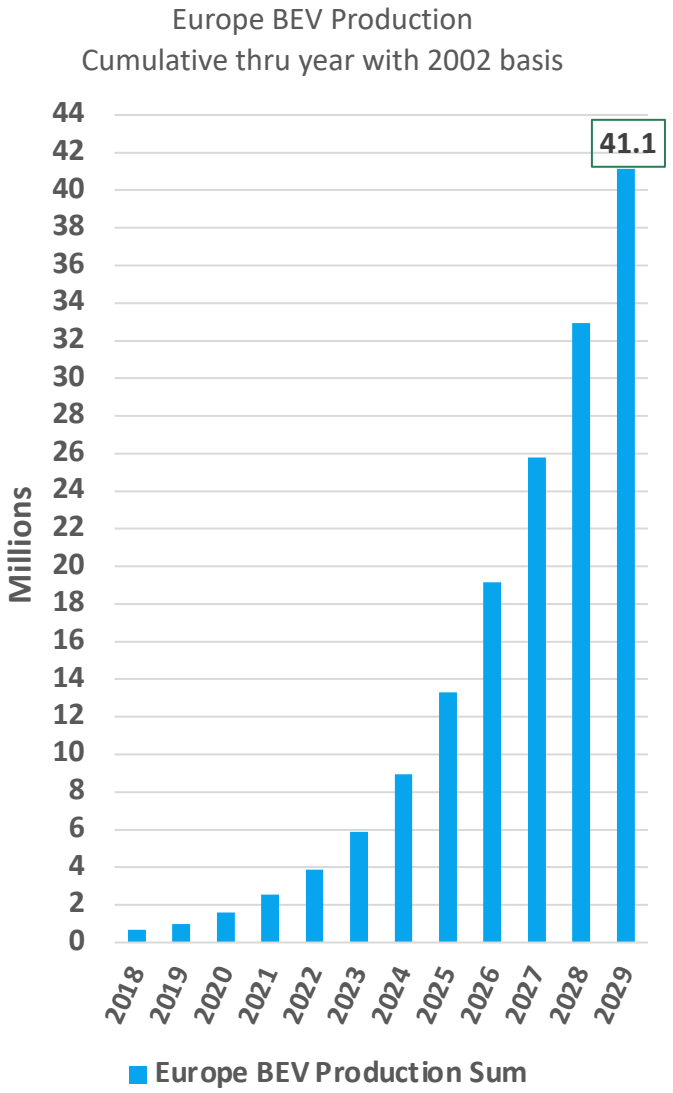




Source: AutoForecast Solutions

Europe xEV Production Outlook

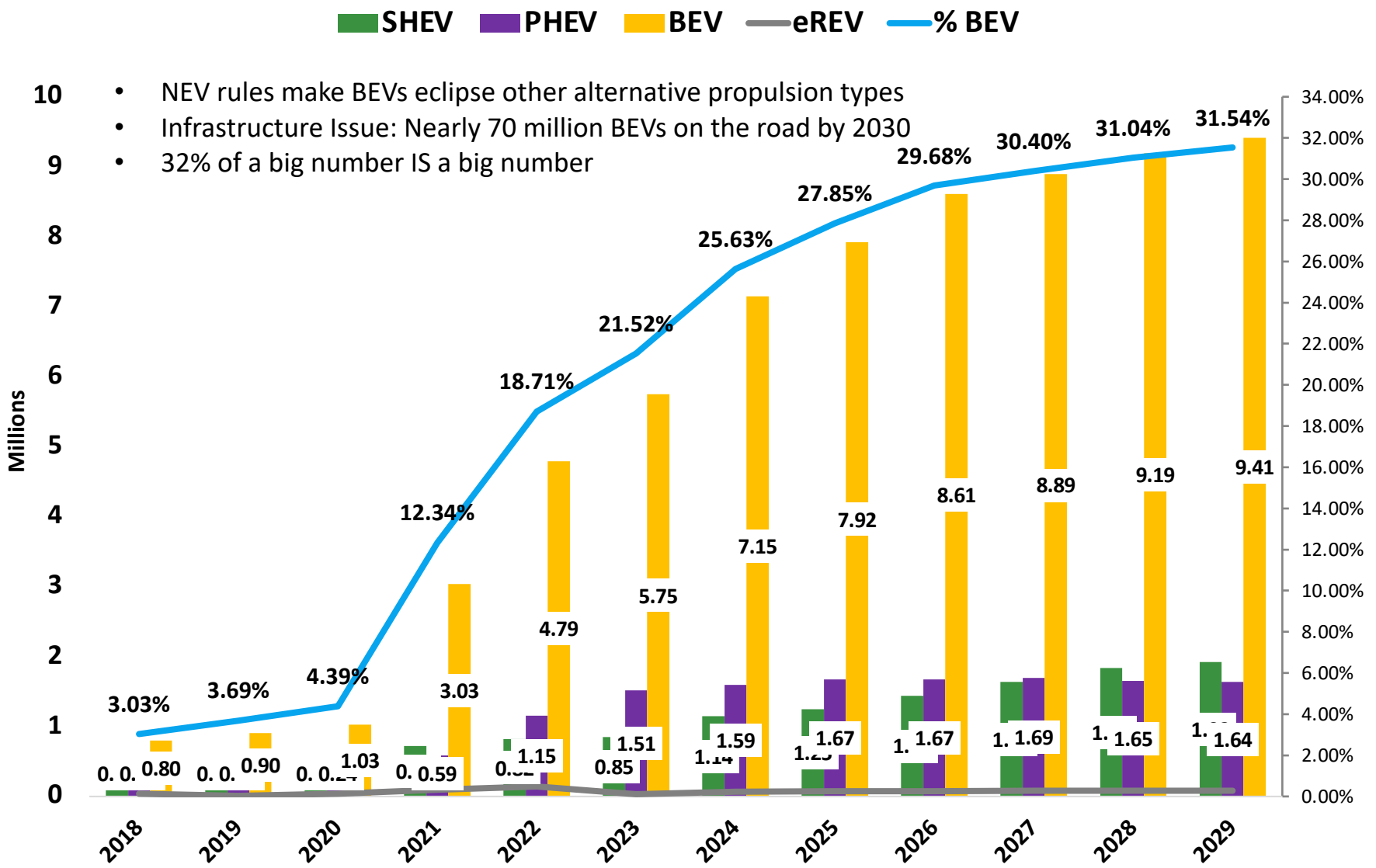


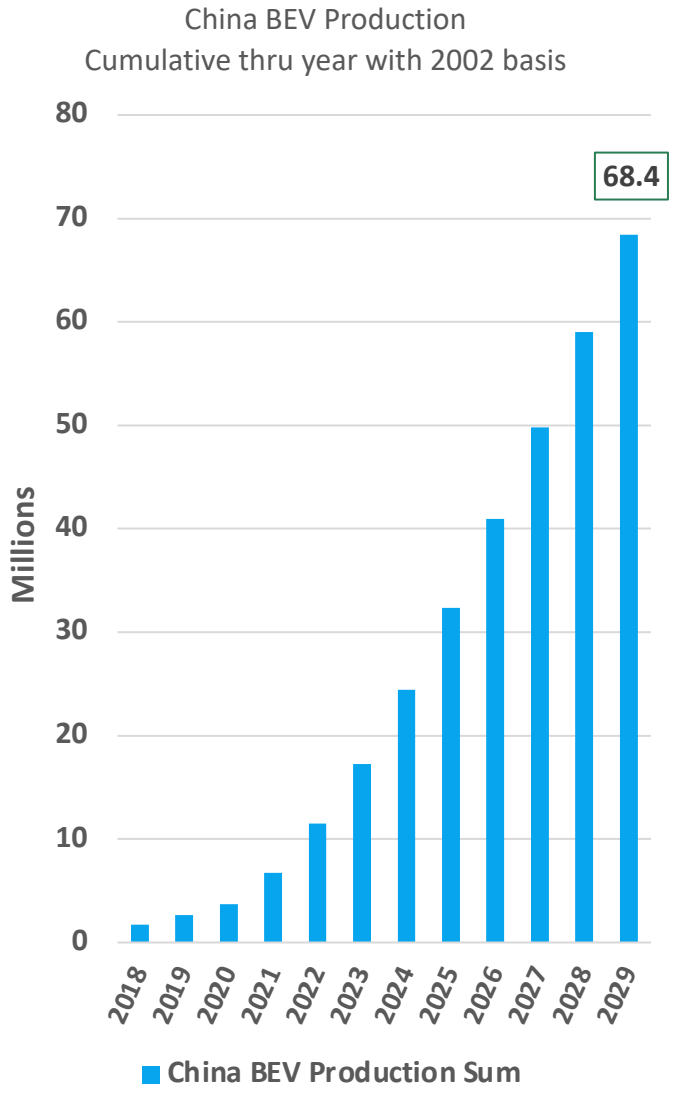


Source: AutoForecast Solutions

China xEV Production Outlook

- NEV rules make BEVs eclipse other alternative propulsion types
- Infrastructure Issue: Nearly 70 million BEVs on the road by 2030
- 32% of a big number IS a big number

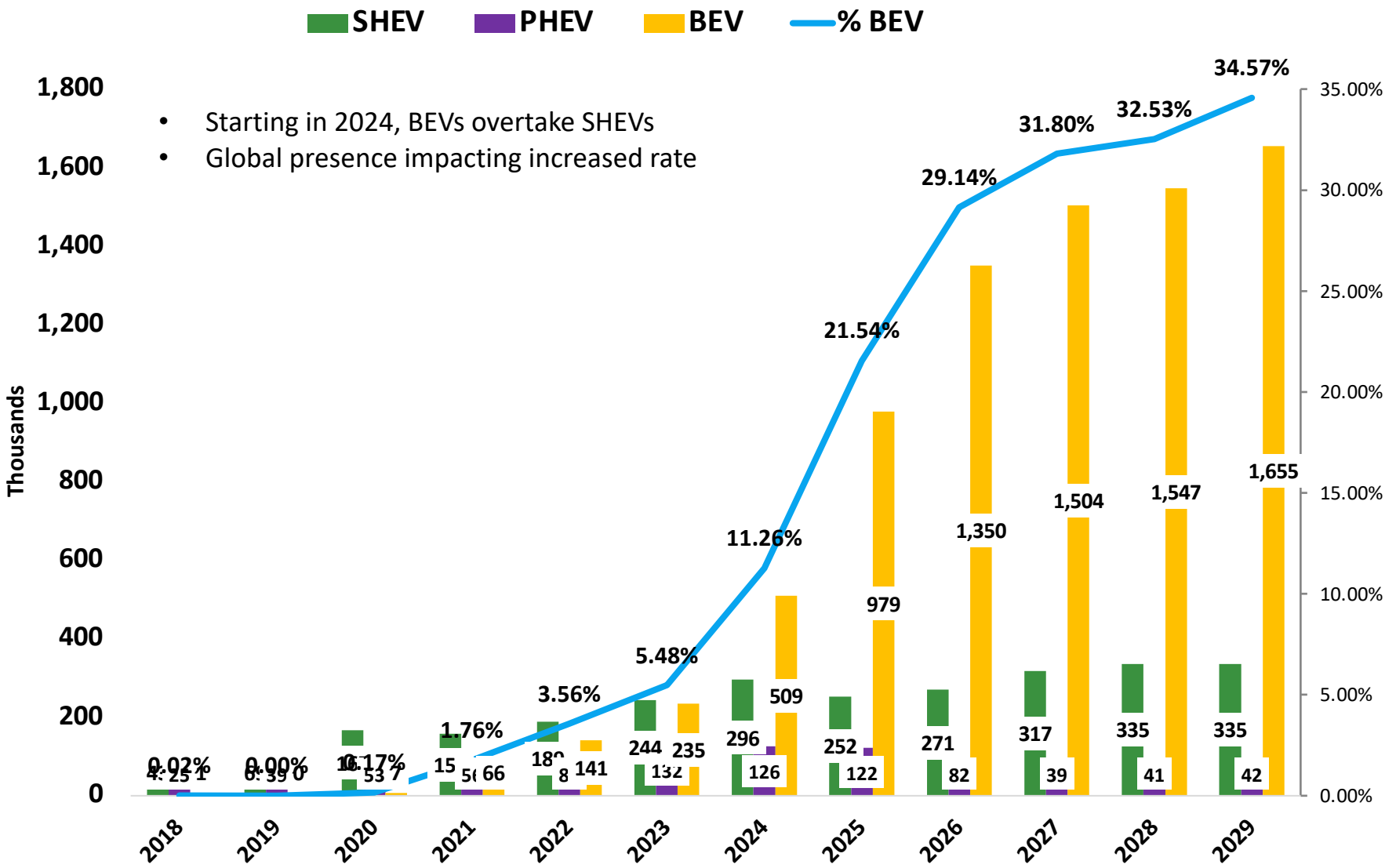


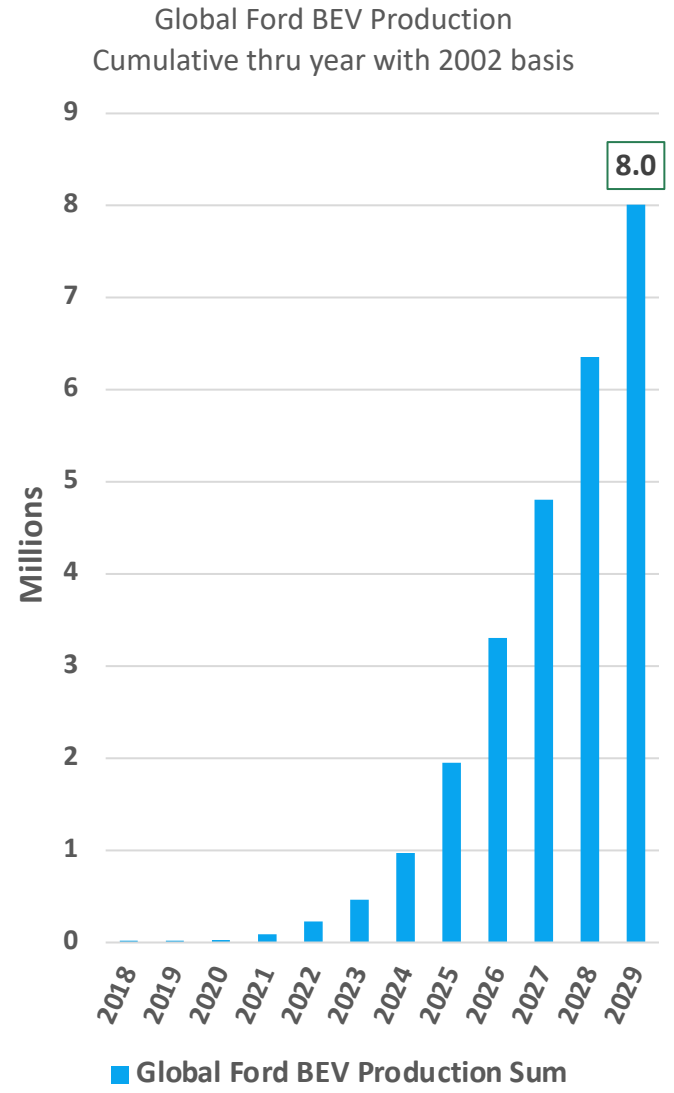


Source: AutoForecast Solutions

Ford Brand Owner xEV Production Outlook

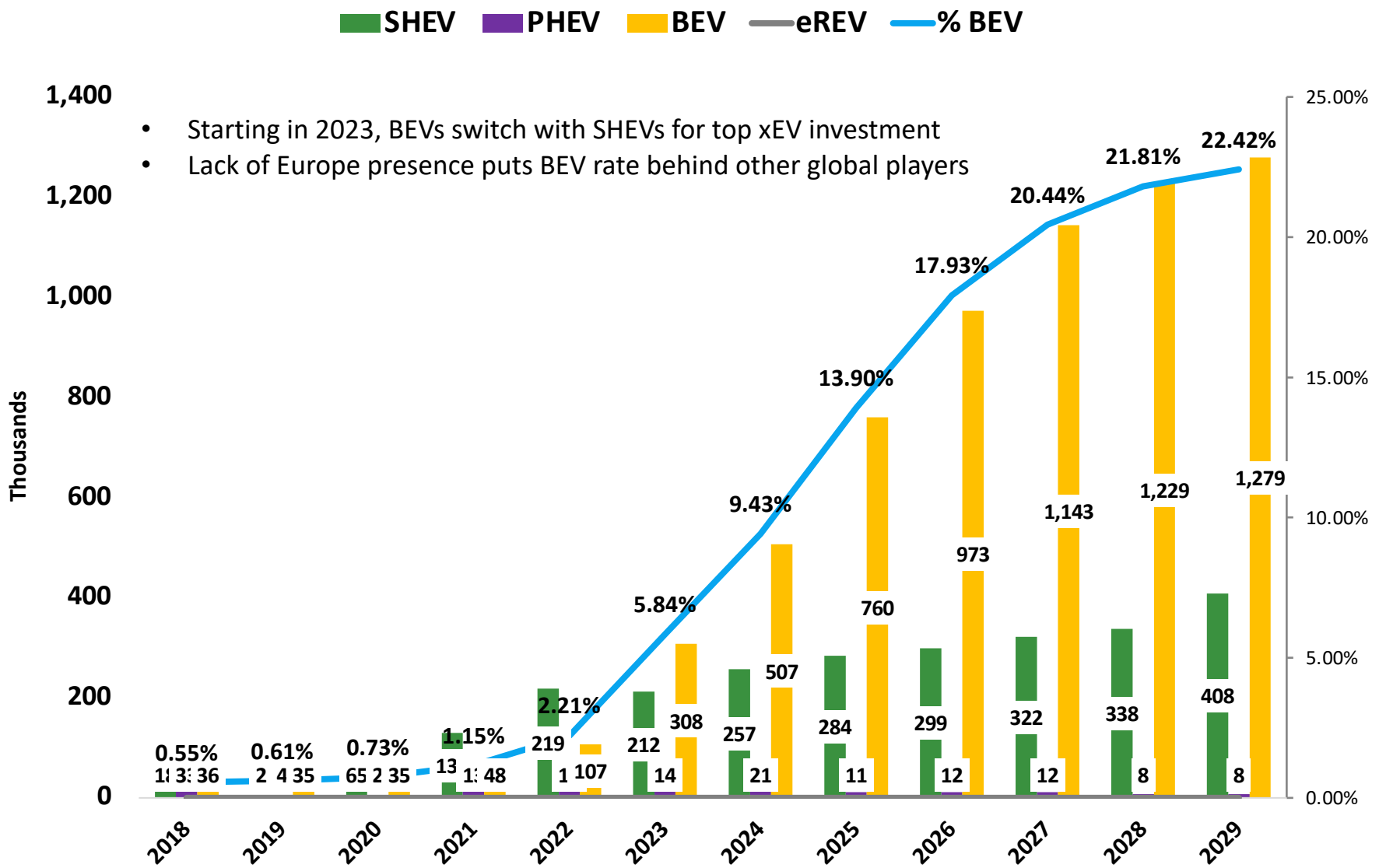
- Starting in 2024, BEVs overtake SHEVs
- Global presence impacting increased rate

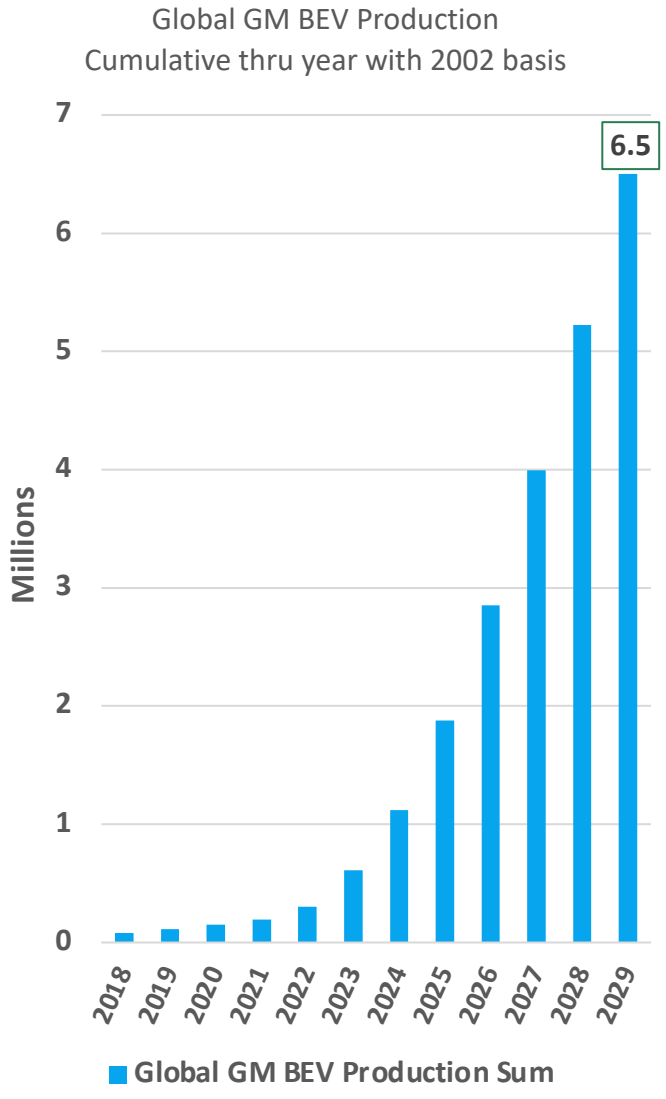




Source: AutoForecast Solutions

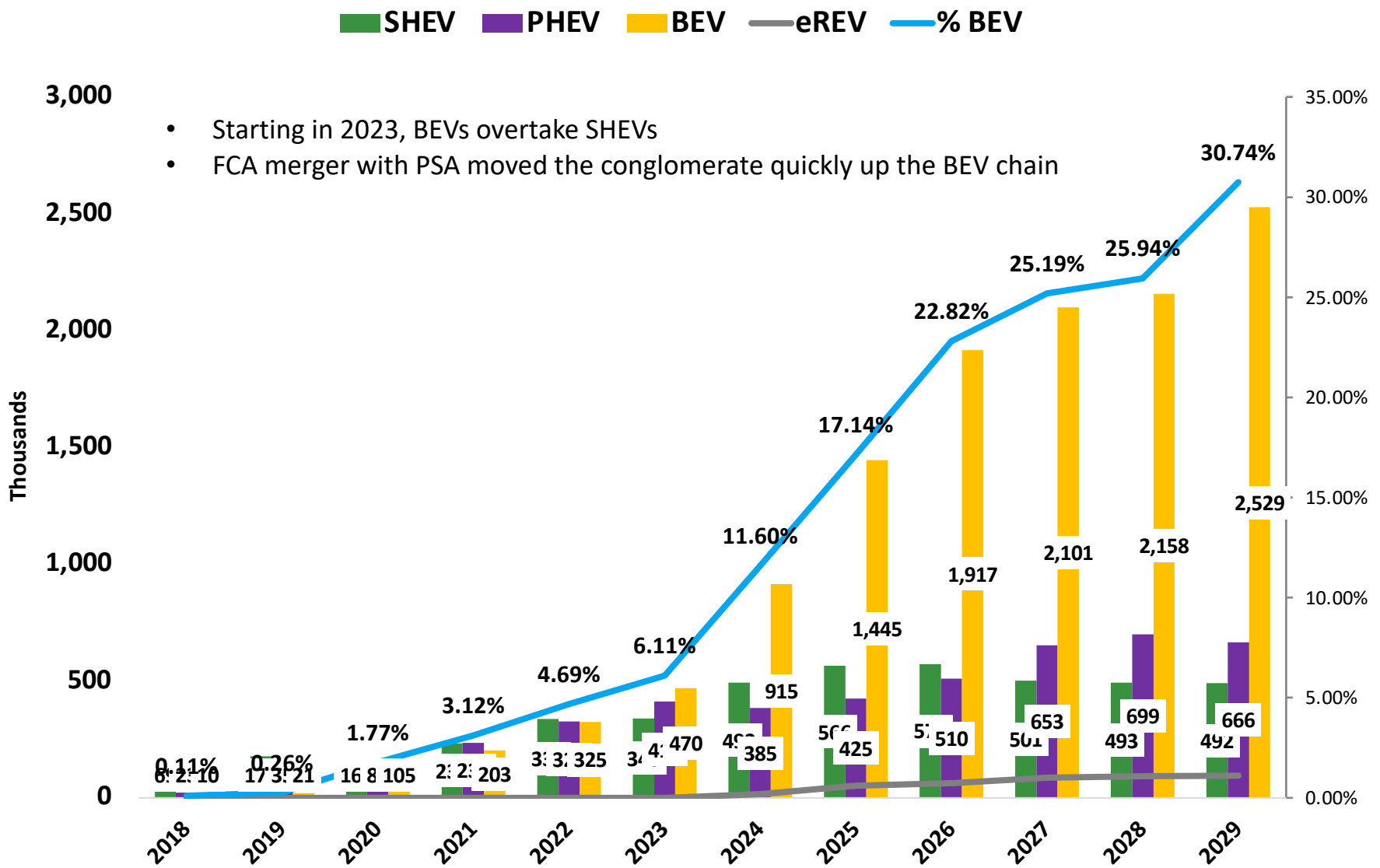
GM Brand Owner xEV Production Outlook

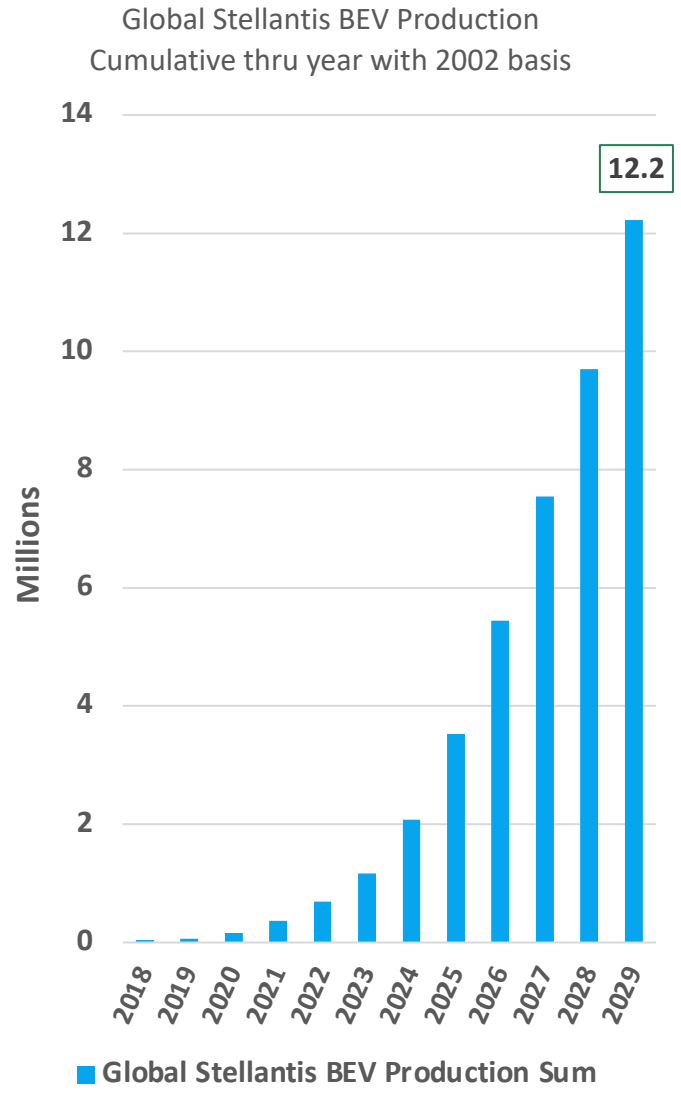




Source: AutoForecast Solutions

Stellantis Brand Owner xEV Production Outlook

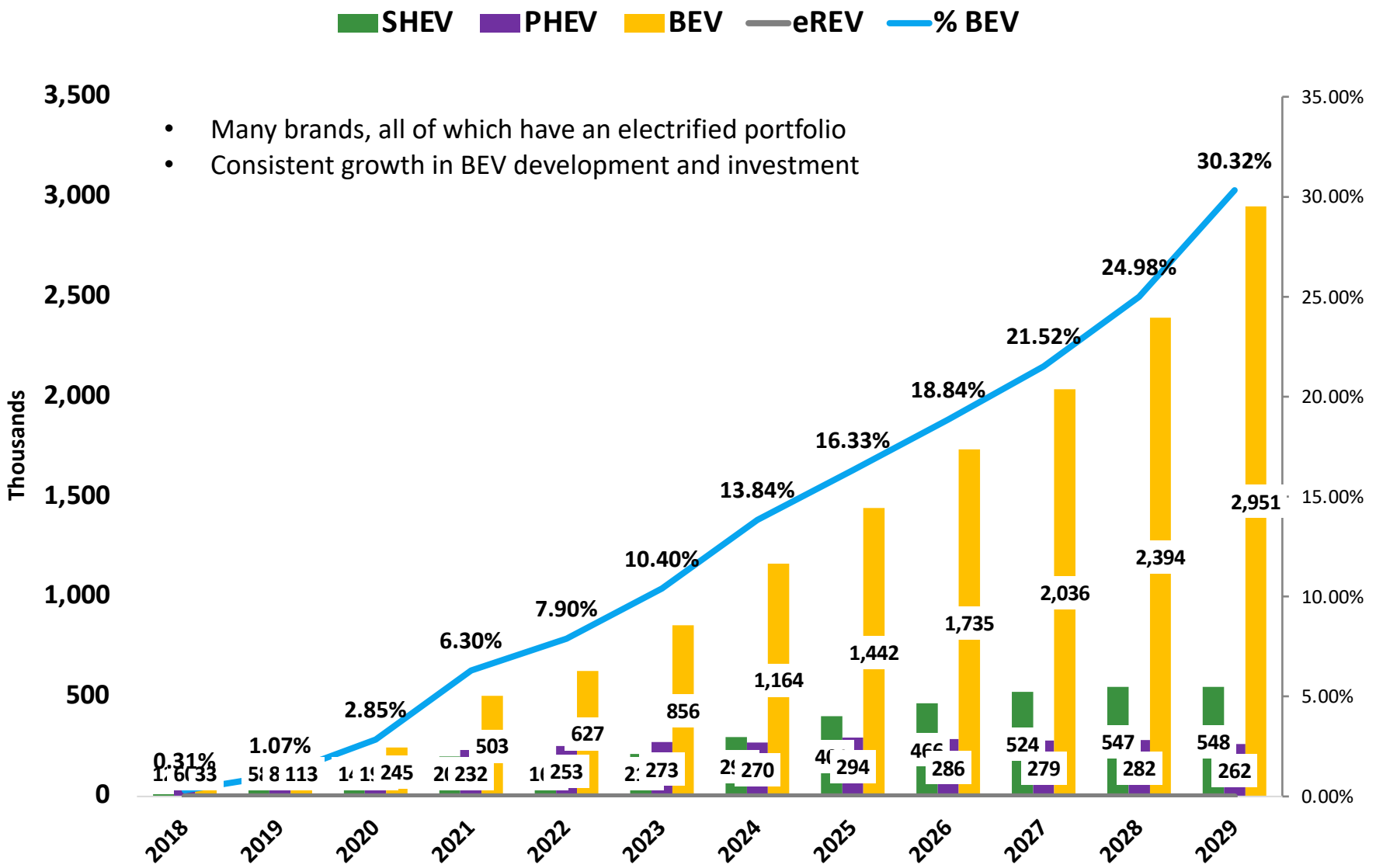


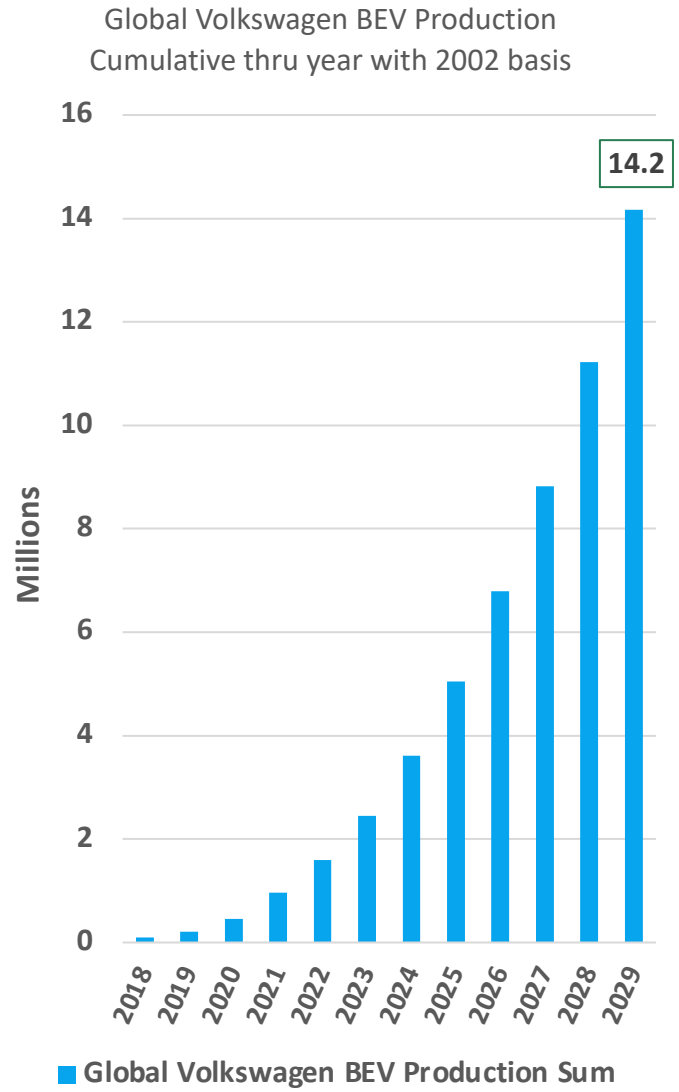


Source: AutoForecast Solutions

Volkswagen Brand Owner xEV Production Outlook

- Many brands, all of which have an electrified portfolio
- Consistent growth in BEV development and investment

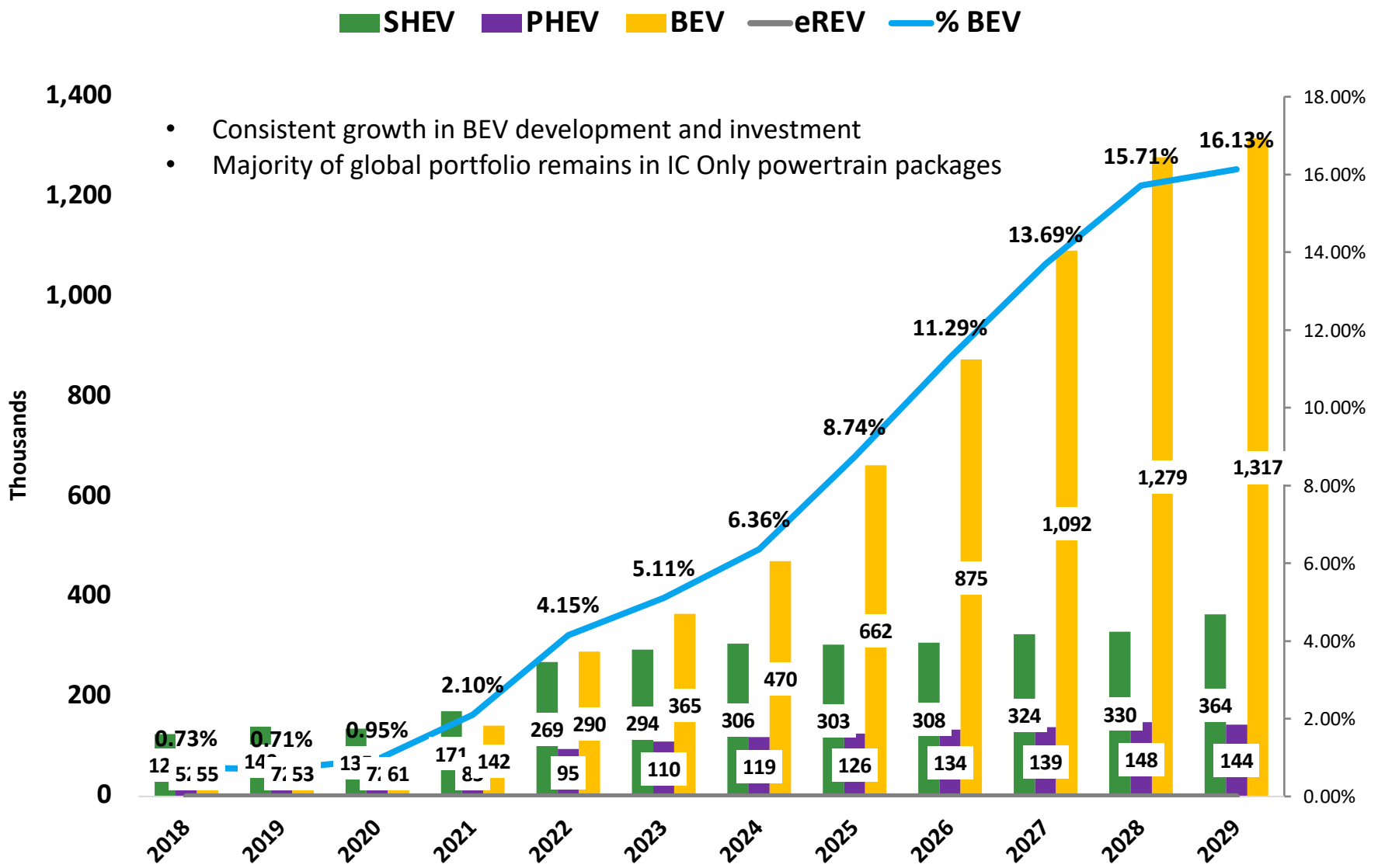


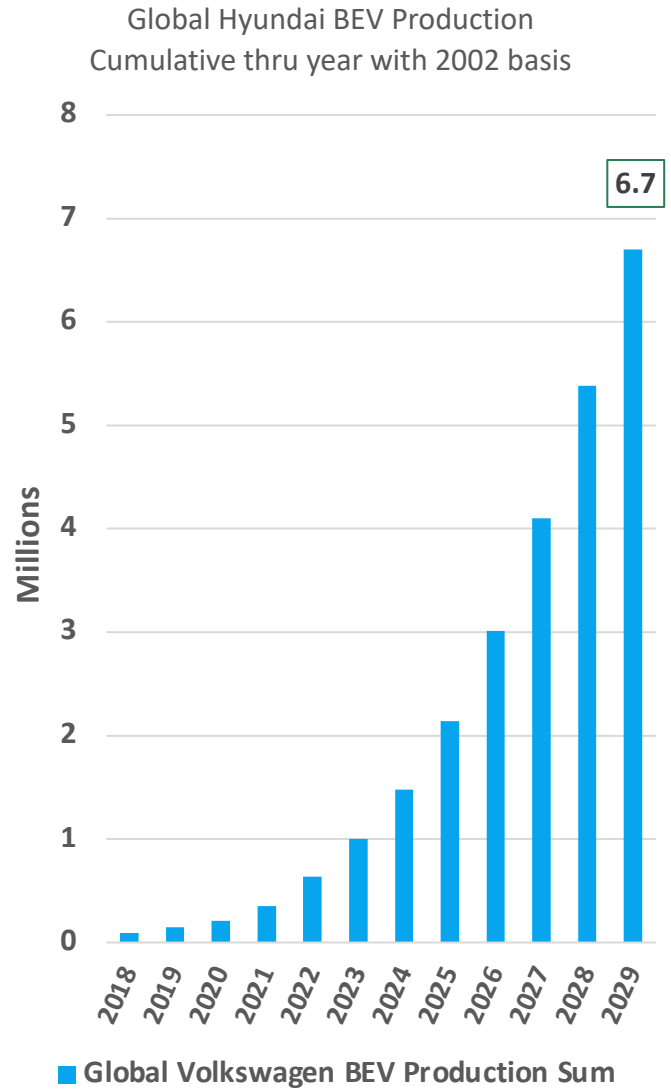


Source: AutoForecast Solutions

Hyundai Brand Owner xEV Production Outlook

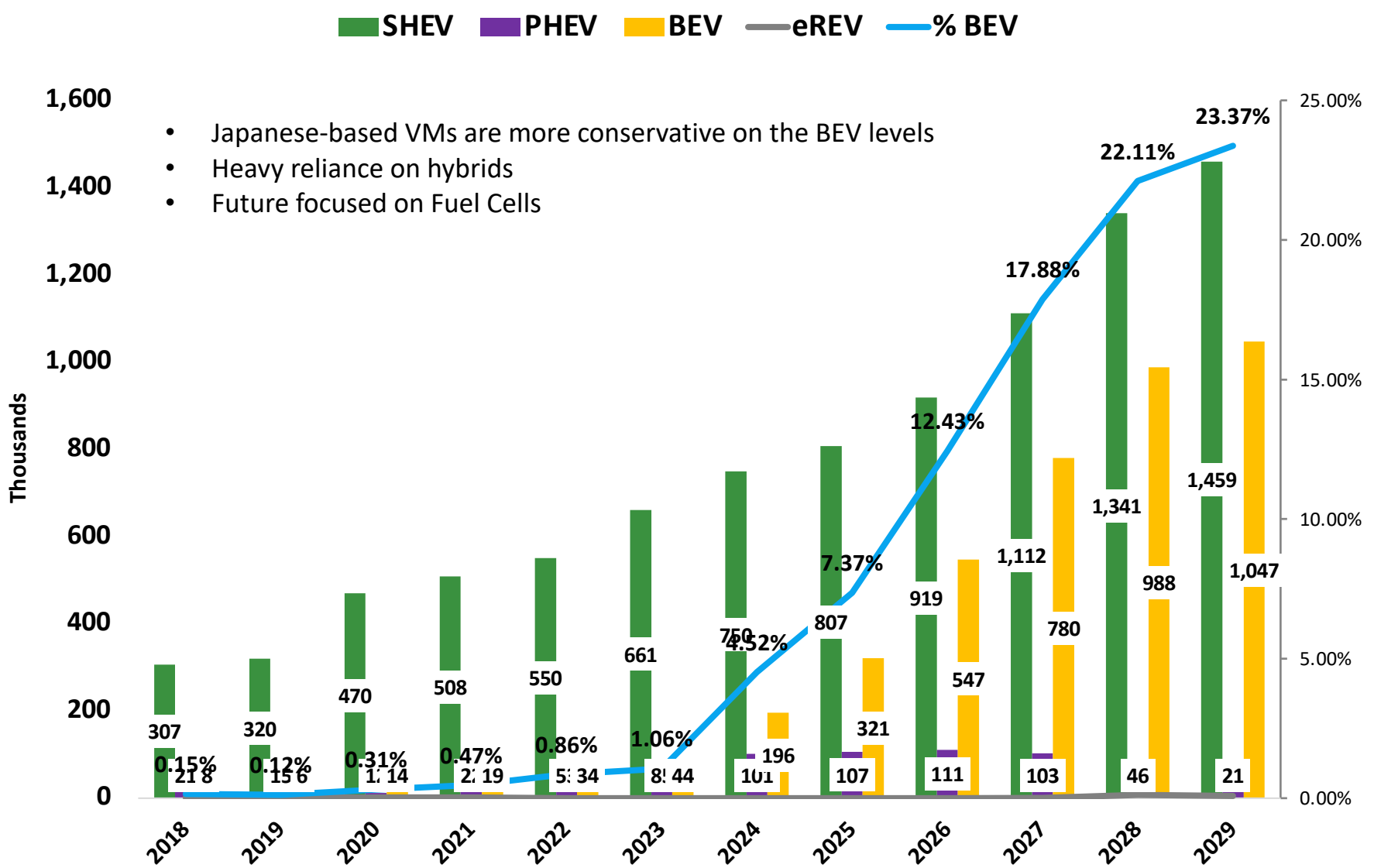
- Consistent growth in BEV development and investment
- Majority of global portfolio remains in IC Only powertrain packages

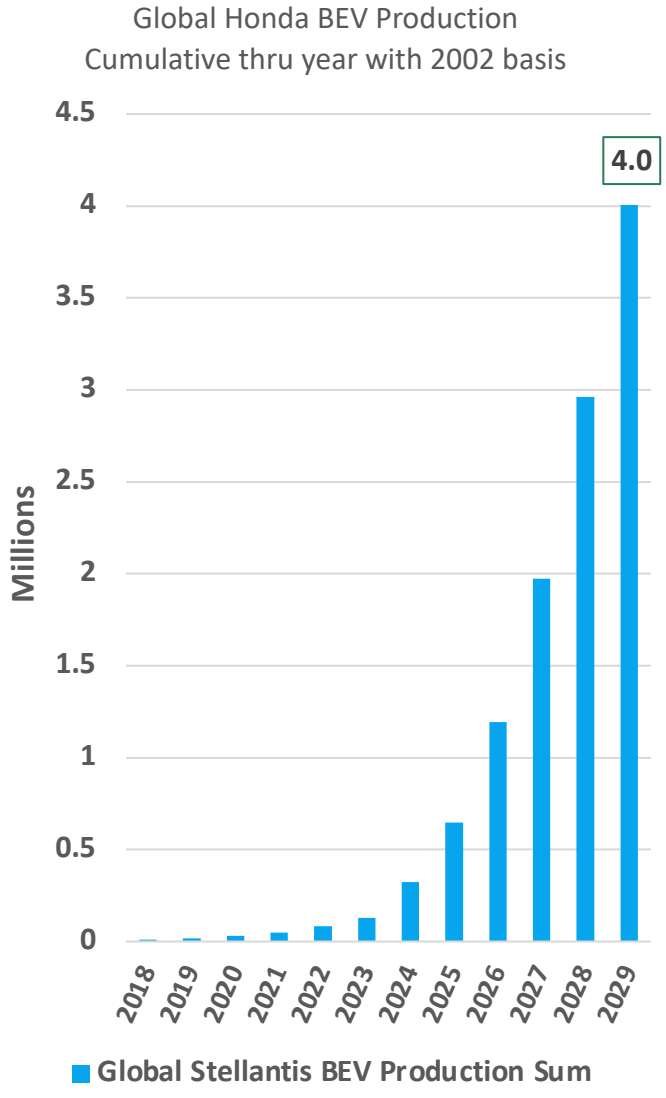




Source: AutoForecast Solutions

Honda Brand Owner xEV Production Outlook

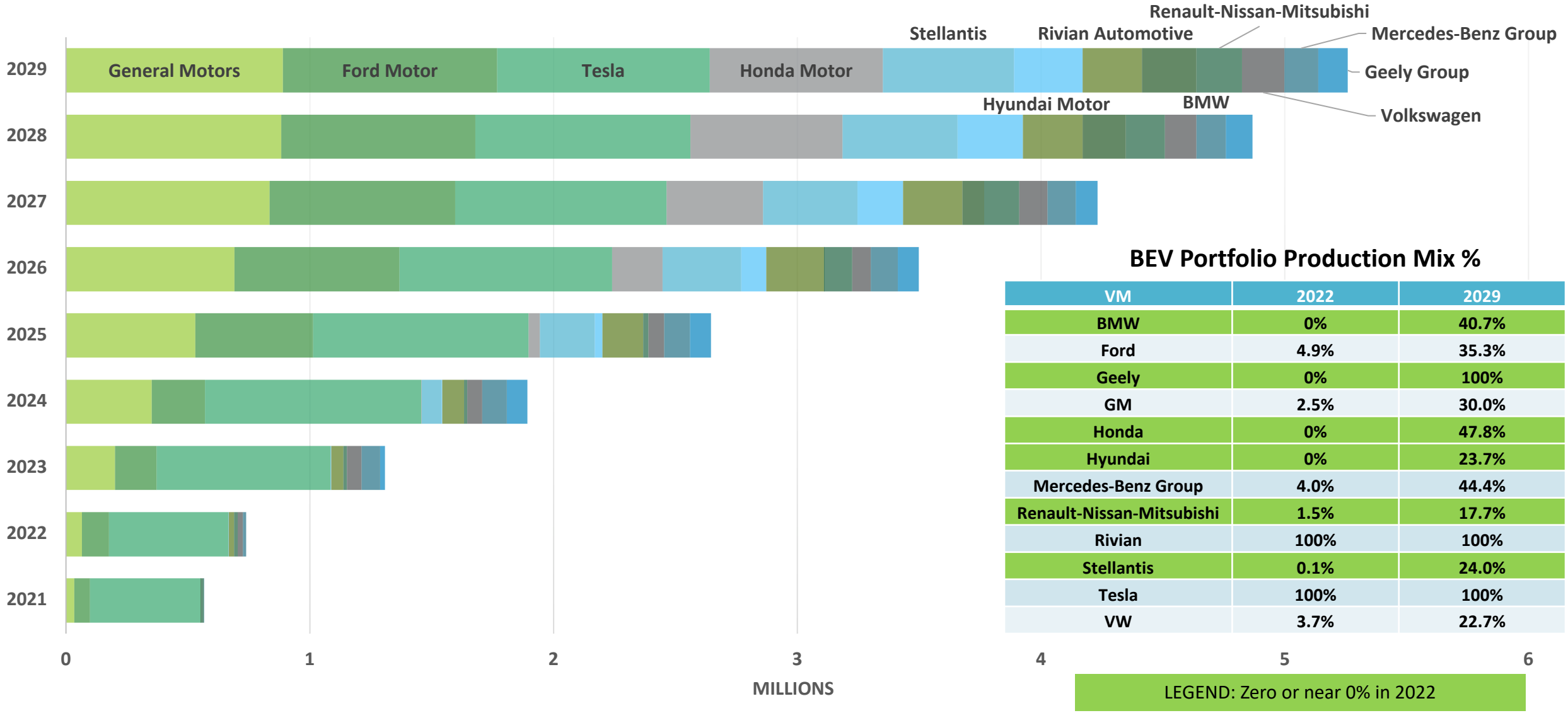




Source: AutoForecast Solutions

North America BEV Production By Vehicle Manufacturer

BASIS: >100K UNITS PER YEAR BY 2029

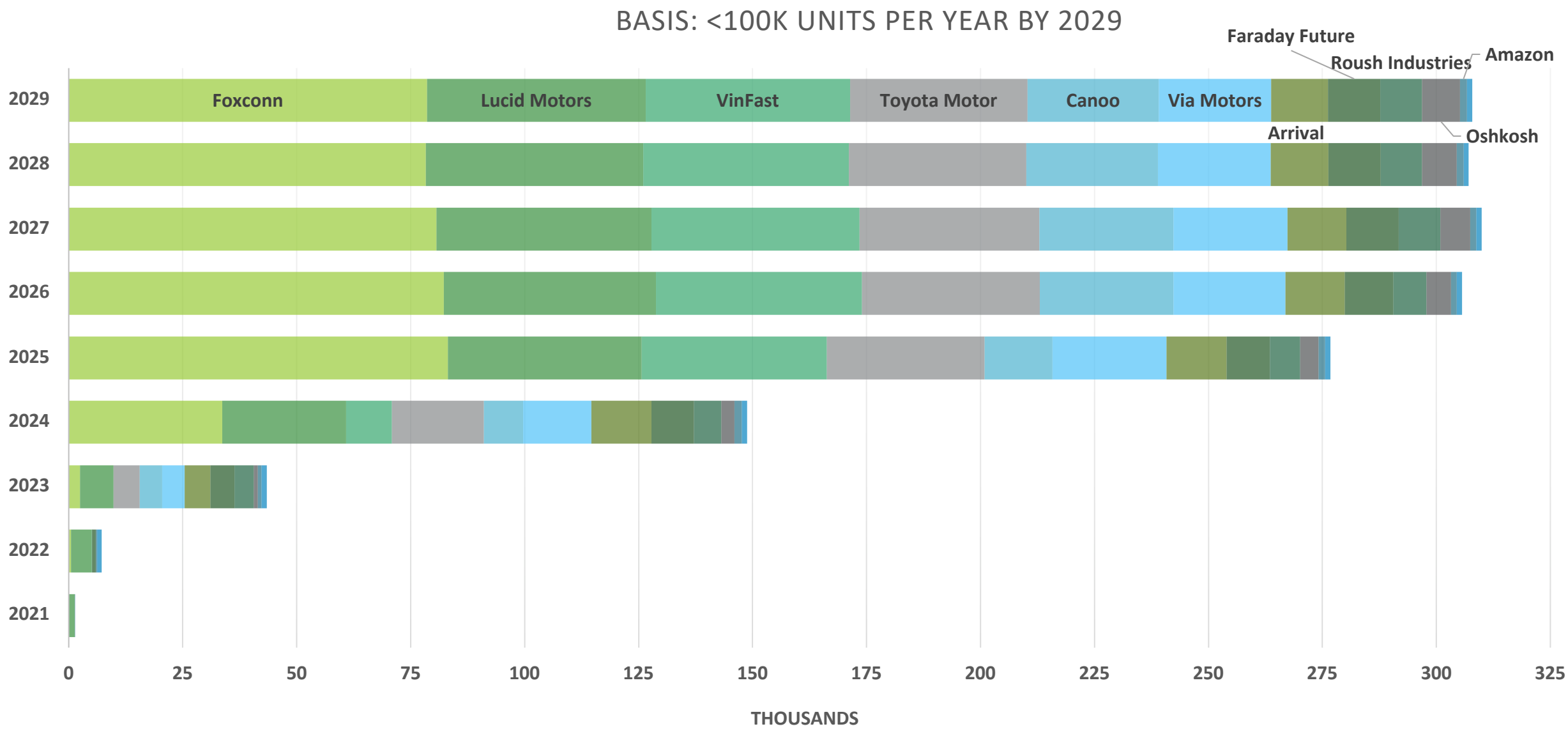


BEV Portfolio Production Mix %

VM	2022	2029
BMW	0%	40.7%
Ford	4.9%	35.3%
Geely	0%	100%
GM	2.5%	30.0%
Honda	0%	47.8%
Hyundai	0%	23.7%
Mercedes-Benz Group	4.0%	44.4%
Renault-Nissan-Mitsubishi	1.5%	17.7%
Rivian	100%	100%
Stellantis	0.1%	24.0%
Tesla	100%	100%
VW	3.7%	22.7%

LEGEND: Zero or near 0% in 2022

North America BEV Production By Vehicle Manufacturer (cont'd)



Top 10 BEV Brand Owner Production Comparison

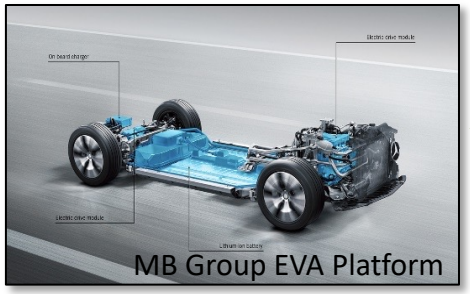
Brand Owner	2019 Production Volume
Tesla	365K
Renault-Nissan-Mitsubishi	190K
BYD	145K
Beijing Automotive Group	138K
Volkswagen	113K
SAIC-GM-Wuling	71K
Geely Group	60K
SAIC Motor	55K
Hyundai	53K
Chery	47K
Other	**495K**
TOTAL	**1.73M**

71%

Level up 2029

Level down 2029

New in 2029



Brand Owner	2029 Production Volume
Volkswagen	3.0M
Tesla	2.7M
Stellantis	2.5M
Geely Group	1.7M
Ford	1.7M
Hyundai	1.3M
GM	1.3M
Mercedes-Benz Group	1.2M
Renault-Nissan-Mitsubishi	1.2M
BMW	1.1M
Other	**7.5M**
TOTAL	**25.2M**

70%

Market leaders constantly changing

Source: AutoForecast Solutions

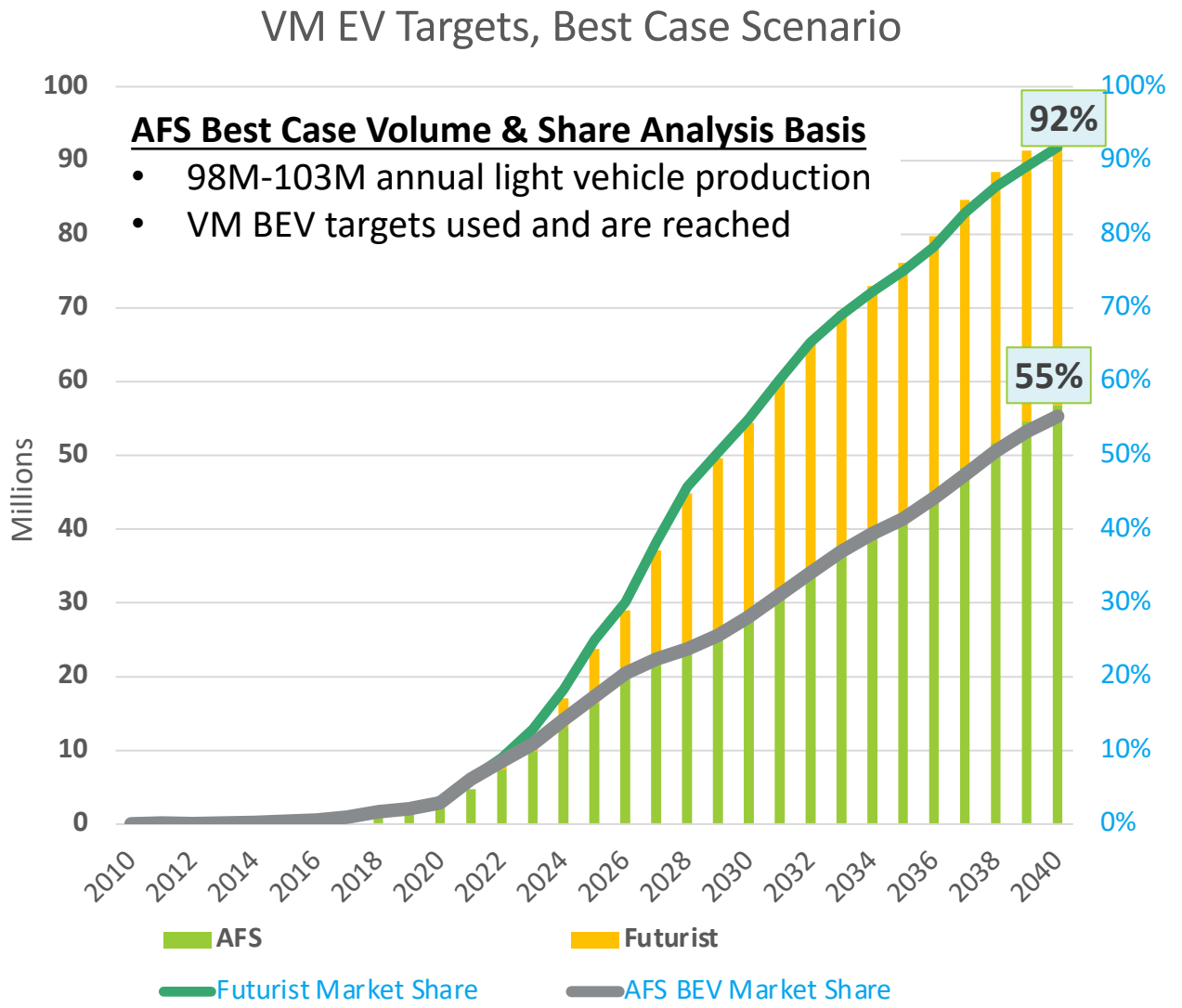
AFS Global Production Scenario: Long-term Outlook

Best Case: Potential Winners

- General Motors, Ford, Volkswagen
  - Aggressive targets are achievable
  - Consumer buying habits inline with VM investment strategies; mitigating financial losses
- Commercial Vehicle Startups
  - Delivery and fleet truck buyers are uniquely positioned to benefit from low-cost operation
- Government
  - Strong investment pays off politically

Base Case: Potential Winners

- Toyota, Mazda, Honda
  - Focusing on hybrids and fuel cells delays large investments on BEVs until the market is proven, saving billions of dollars
  - Recent Honda plans pushing for a significant conversion to BEVs

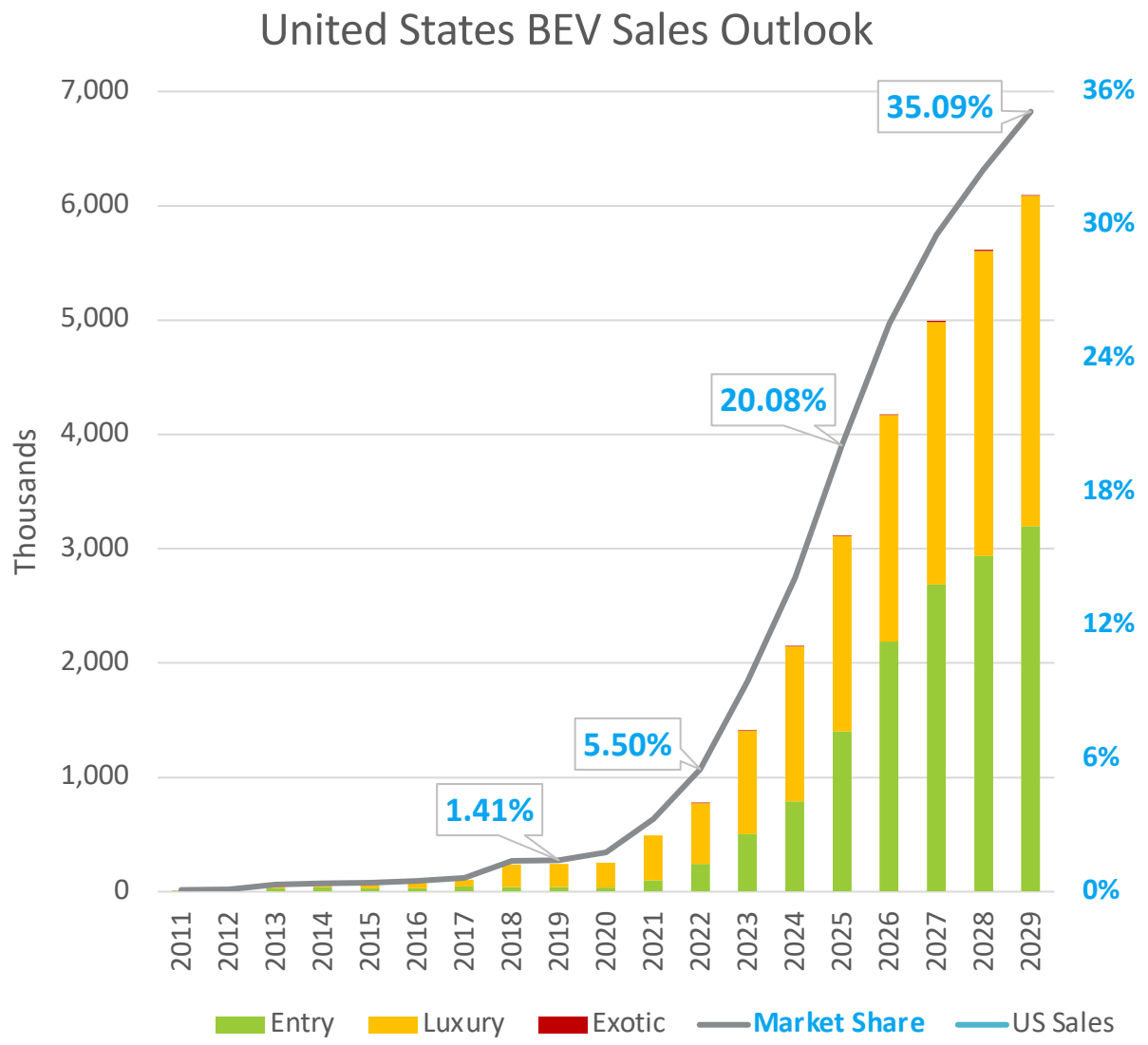


Source: AutoForecast Solutions

BEV Sales Outlook: United States

Analysis Assumptions:

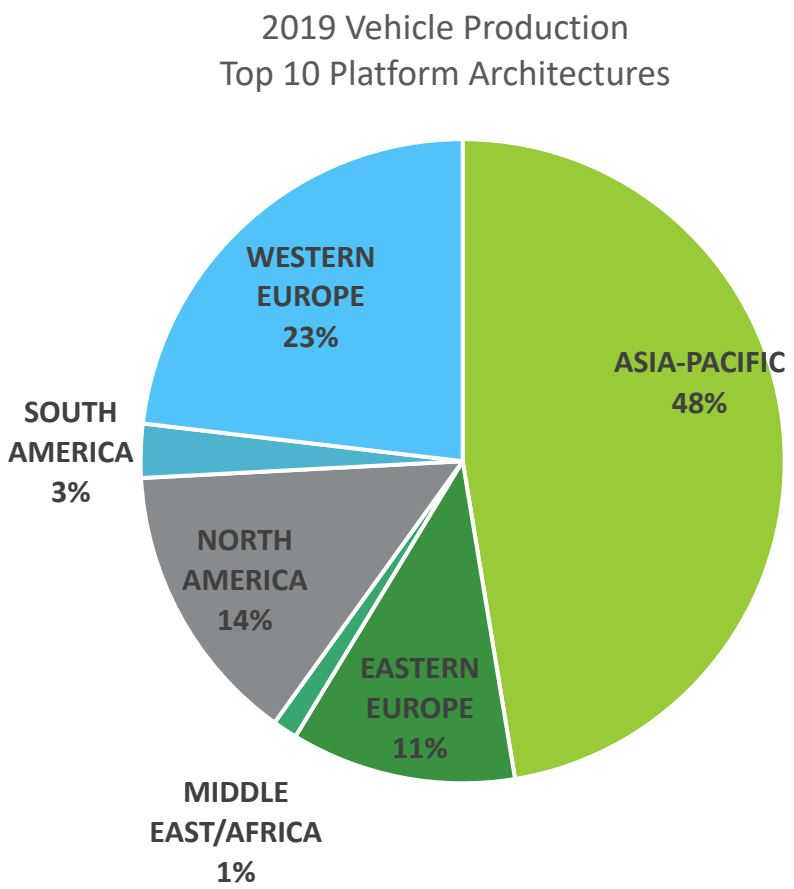
- Significant uptick starting in 2023
- Growth needs to accelerate to hit any VM-announced BEV targets in 2030+
- Nearly 100% of domestically-built BEVs are sold domestically
  - Production and sales alignment
  - Recycling and capturing the “battery value”
  - Proposed U.S. incentives for domestically-produced BEVs will make imports more expensive
  - The list of “known” players with a firm U.S. production footprint is volatile
- Imports largely limited to luxury/low-volume models
  - Existing imported BEVs will grow, potentially to the point where they will may be built domestically



Top 10 Global Vehicle Platform Architectures: 2019

Production in 36 Countries representing over 28% of global output

Platform Architecture	Platform Architecture Owner	2019 Vehicle Volume	% of Total Production
MQB	Volkswagen	7.0 million	7.8%
TNGA	Toyota Motor	4.0 million	4.4%
CMF	Renault-Nissan-Mitsubishi	3.0 million	3.3%
KP2	Hyundai Motor	1.9 million	2.1%
CCA	Honda Motor	1.7 million	1.9%
EMP2	Groupe PSA	1.6 million	1.8%
GSP	Honda Motors	1.6 million	1.7%
N	Hyundai Motors	1.5 million	1.7%
MLB	Volkswagen	1.4 million	1.5%
35up	BMW	1.4 million	1.5%
TOTAL		**25.0 million**	**27.8%**

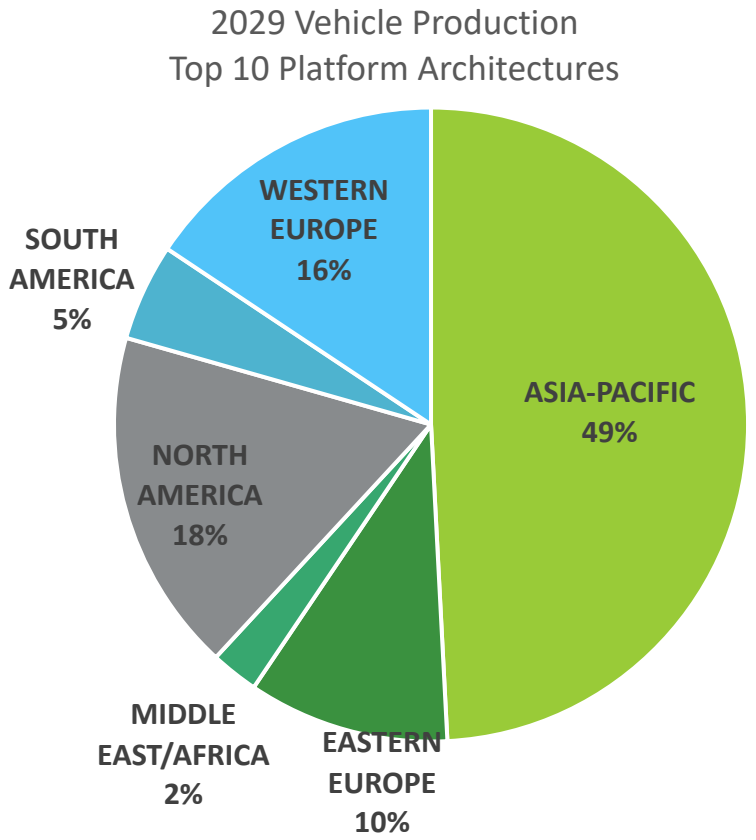


Source: AutoForecast Solutions

Top 10 Global Vehicle Platform Architectures: 2029

Production in 43 Countries representing over 40% of global output

Platform Architecture	Platform Architecture Owner	2029 Vehicle Volume	% of Total Production	% Electrified	% BEV
TNGA	Toyota Motor	8.9 million	9.2%	30.3%	2.3%
MQB	Volkswagen	5.8 million	5.9%	8.3%	0.3%
CMF	Renault-Nissan-Mitsubishi	5.6 million	5.8%	25.7%	17.3%
Honda Architecture	Honda Motors	4.3 million	4.4%	54.1%	19.1%
STLA	Stellantis	4.1 million	4.2%	73.4%	56.0%
GEN III	Tesla	2.4 million	2.5%	100%	100%
KP2	Hyundai	2.4 million	2.5%	3.5%	3.2%
VSS-F	GM	2.3 million	2.3%	9.4%	0%
N	Hyundai	2.1 million	2.2%	13.5%	0%
SSP	Volkswagen	1.8 million	1.8%	100%	100%
TOTAL		**39.7 million**	**41.0%**		



All have electrified applications - but only two at 100% BEV

Source: AutoForecast Solutions

Final Thoughts

The Changing Landscape

Evaluate current methodologies & rethink how to plan for the future

The Changing Consumer

- Brand loyalty erosion
- Build-to-order strategy: minimize need for trim level pre-builds and inventory-based selling
- Subscription-based vs. transactional-based purchases
- Socially motivated buying decisions

The China Effect

- It's not "if" but when there will be a North America presence
- Electrification and collaboration
- Inflation Reduction Act designed to mitigate reliance by North America

The Supply Chain / Logistics

- Evaluating and rethinking just-in-time processes
- Vertical integration of key materials and products
- Investigating secondary & tertiary supply sources
- Import and domestic logistics to be impacted due to IRA
- New customers looking to the U.S. will need guidance to succeed

Electrification

- Shareholder Value: a too-big-to-fail strategy
- Reduction in parts and manufacturing complexity
  - Labor & volume reduction; more automation

The Existing Players

- GM and Ford electrifying entire line
  - How to improve margin through changing "car ownership" and battery reuse
- Partnerships & new brands indicate contract manufacturing direction
  - GM & Honda / Ford & VW
  - GM BrightDrop
  - Mercedes & Rivian

The New Players

- EVs and SPAC money provides easier entry of new, unexperienced VMs; all looking for help
  - Elimination of ICE greatly reduces cost and time to market entry
  - Compressed time to market when you can eliminate the ICE components is a game changer
  - Time to be proactive in your planning – reactive approach can limit growth and competitiveness

Disruption creates opportunity

Thank You,

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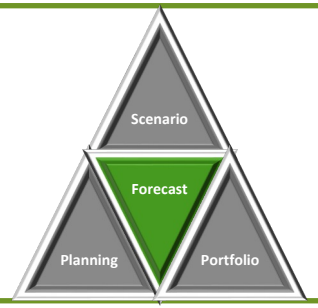
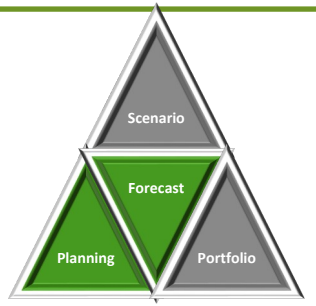
Driving Data into Decisions.
www.AutoForecastSolutions.com

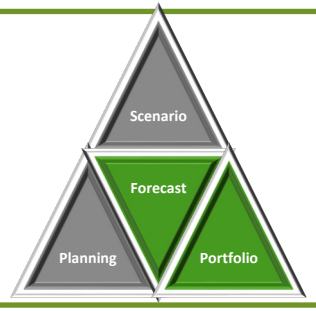


AFS Forecast is a comprehensive automotive production forecast database and at the heart of the AFS value proposition. Detailed monthly vehicle data: *Light Vehicle, Powertrain, Drivetrain, and Alternative Propulsion*. Updated and provided in a user-friendly, web-based, solution; on a monthly basis. Historical production volumes and an eight-year planning window of forecast volumes are updated every month on a global basis – with proven automotive subject matter expertise and support. Supplemental weekly and monthly market reports analyze and pinpoint changes that help improve your company's competitive position.



AFS Planning is a fully integrated quote management and revenue planning solution specifically designed for an automotive supplier. Track and analyze your sales, customers, products, production capacity, and more at a detailed monthly part number level. Used also by the financial and investment community for due diligence and revenue performance analysis.
Your company's global footprint in a live database - integrated directly with the AFS Forecast database for accurate and timely planning, analysis, and opportunity identification. For further intelligence, add-on AFS Scenario.

AFS Scenario is the only tool available in the industry designed to create custom light vehicle and powertrain forecasts; on a regional basis for the global automotive market. Adjustments to annual, quarterly, and monthly production volumes can be done from the top down (total region) to the Vehicle/plant level – and all levels in-between (OEM, Platform, Program, etc.). Supported by a full suite of analysis reports to understand forecast changes over time.



AFS Portfolio is designed to allow an organization understand and track their competitive landscape. Customize around your products and services; track your product mix, volumes, competitive position, and identify your market share both from a volume and revenue perspective in the global automotive marketplace. Automatically updated every month to support a proactive approach in strengthening your core operations while identifying opportunities for growth.

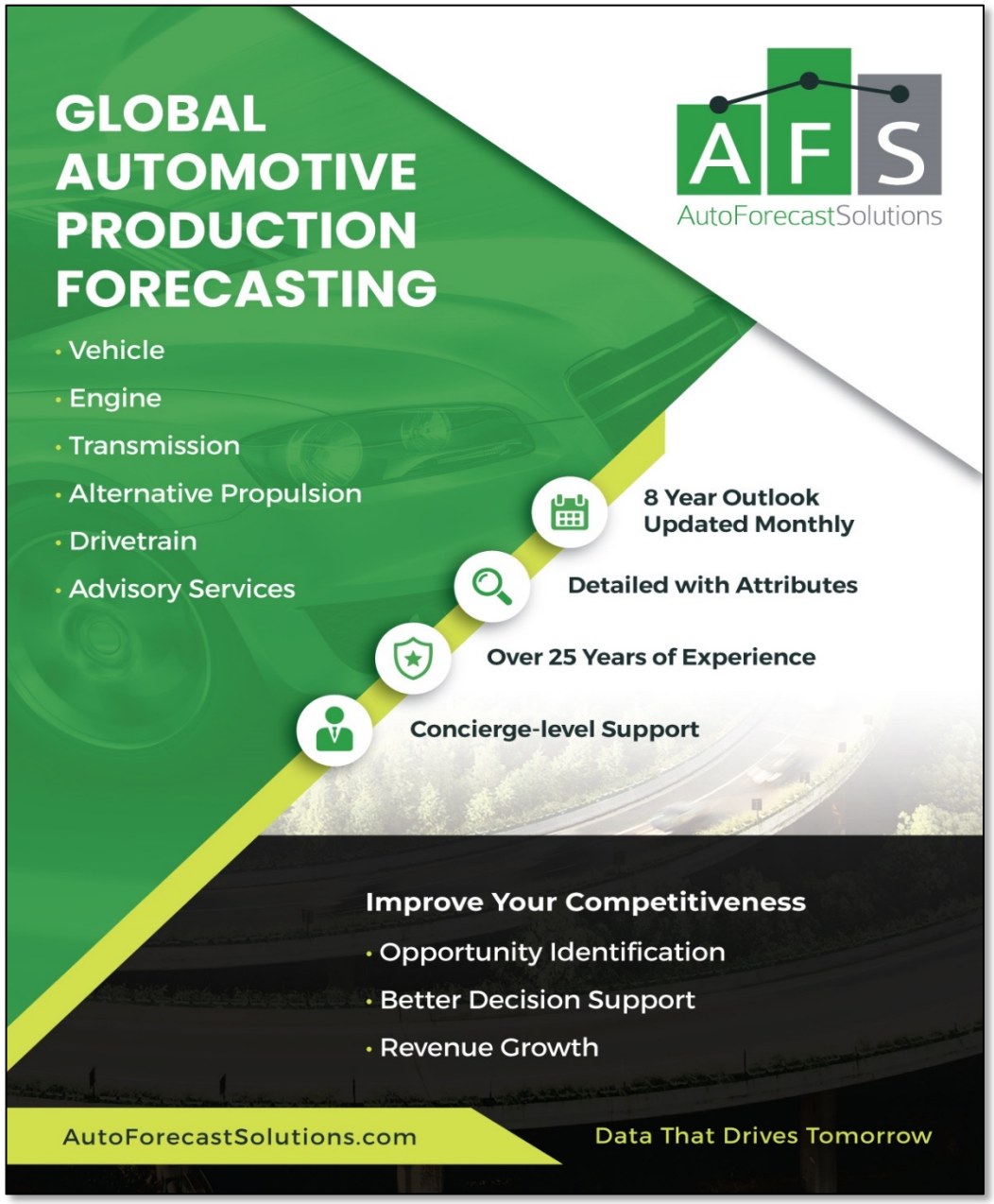
Detailed Global Automotive Coverage

- Global light vehicle & powertrain coverage: 6 regions – 60 countries
- Complete light vehicle, engine, transmission, electric motor, & alternative propulsion detail – updated monthly
- Historical production volumes PLUS an eight-year outlook at a monthly level.
- Special reports on a weekly and monthly basis highlighting production timing changes, industry issues, opportunities & risks, and much more
- Dozens of fields updated monthly for the entire production outlook.
- Web-based interface to enhance and accelerate forecasting and planning efforts
- Concierge Support: Direct access to the AFS subject matter experts to ask the key questions to improve your competitiveness. Our team becomes an extension of your team.

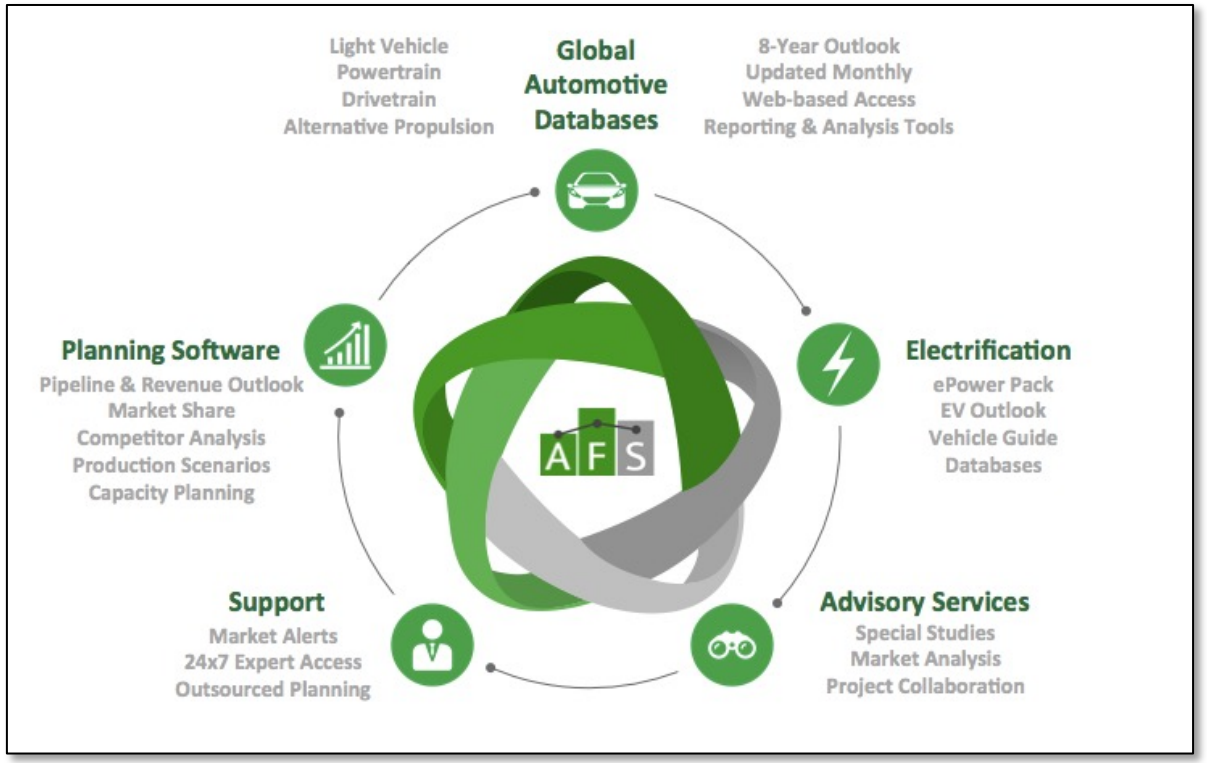
Primary AFS Data Fields Updated Monthly and Accessible from the AFS Services web-based interface

Vehicle	Engine	Transmission	Electric Motor
Region	Family, RPO Codes, * Other Description Fields		
Country	Type (IC Only, BEV, eREV, PHEV, SHEV, and Fuel Cell)		
Assembly Plant & Location	Production Manufacturer, Region, Country, & Plant		
Vehicle Manufacturer	Vehicle Application Detail		
Brand Owner	Start/End of Powertrain Package Application to Vehicle		
Nameplate	Displacement (L, CC, CI)	Number of Forward Gears	Motor Type
Vehicle Type & Segment	Cylinder Configuration	Transmission Type	Motor Location
Platform Architecture	Number of Cylinders	Transmission Design	Max Voltage
Platform	Fuel Types / Flex Fuel	Clutch Actuation	Number of Phases
Program	Valvetrain	Case Material	Voltage Type
Start/End of Production	Aspiration	Transaxle	
Plant Coordinates	Fuel Delivery Types	Torque Converter	
	Valves per Cylinder / Valve Timing		
	Block/Head Material		

Note: Many other attribute and code fields provided to customers for system integration



AutoForecast Solutions (AFS) is the only fully integrated solutions provider of ***vehicle, powertrain, and drivetrain production forecasting, business planning software,*** and ***advisory services*** to the global automotive industry.



AFS helps our customer…

Understand *the opportunities*
Develop *a value proposition to defend core operations*
Identify *areas for growth.*