



AutoForecastSolutions

Where are we Headed: ICE or EV?

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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

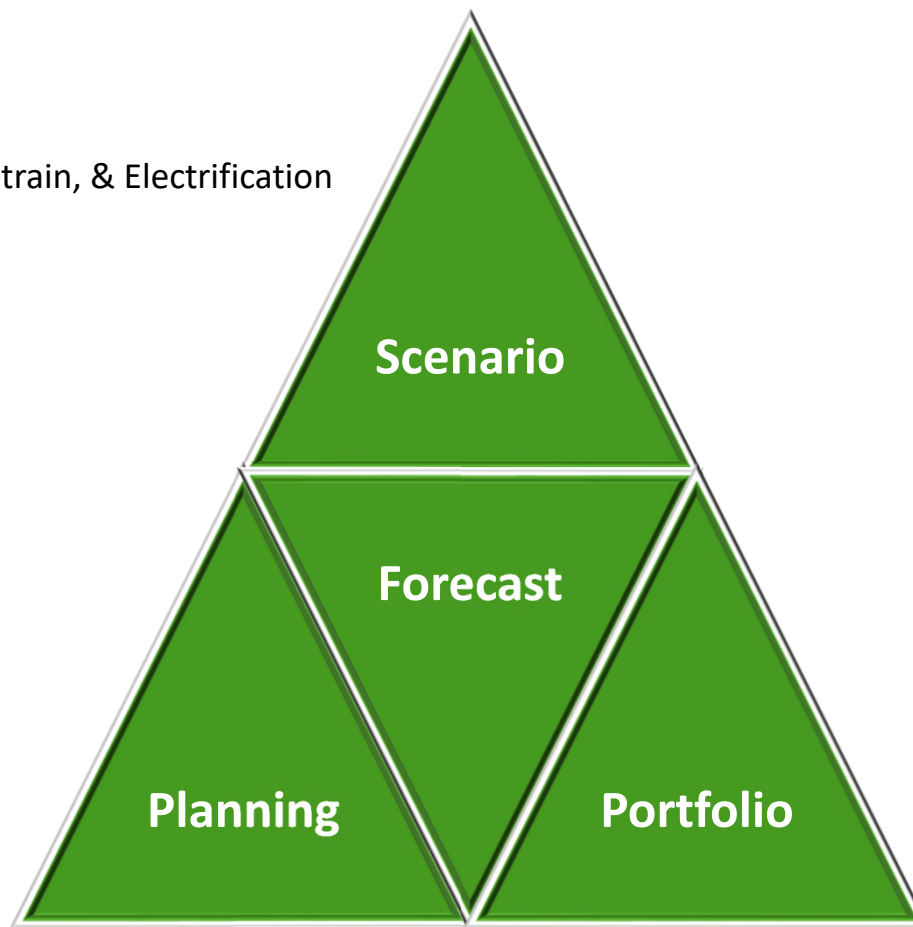
- Part Number, Pipeline/RFQ Management
- Real-Time Sales Forecasting
- Risk Assessment
- Opportunity Identification
- Budget vs. Current Analysis
- Capacity planning
- Secure, Web-based Interface
- Integrate with AFS Forecast & Scenario

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

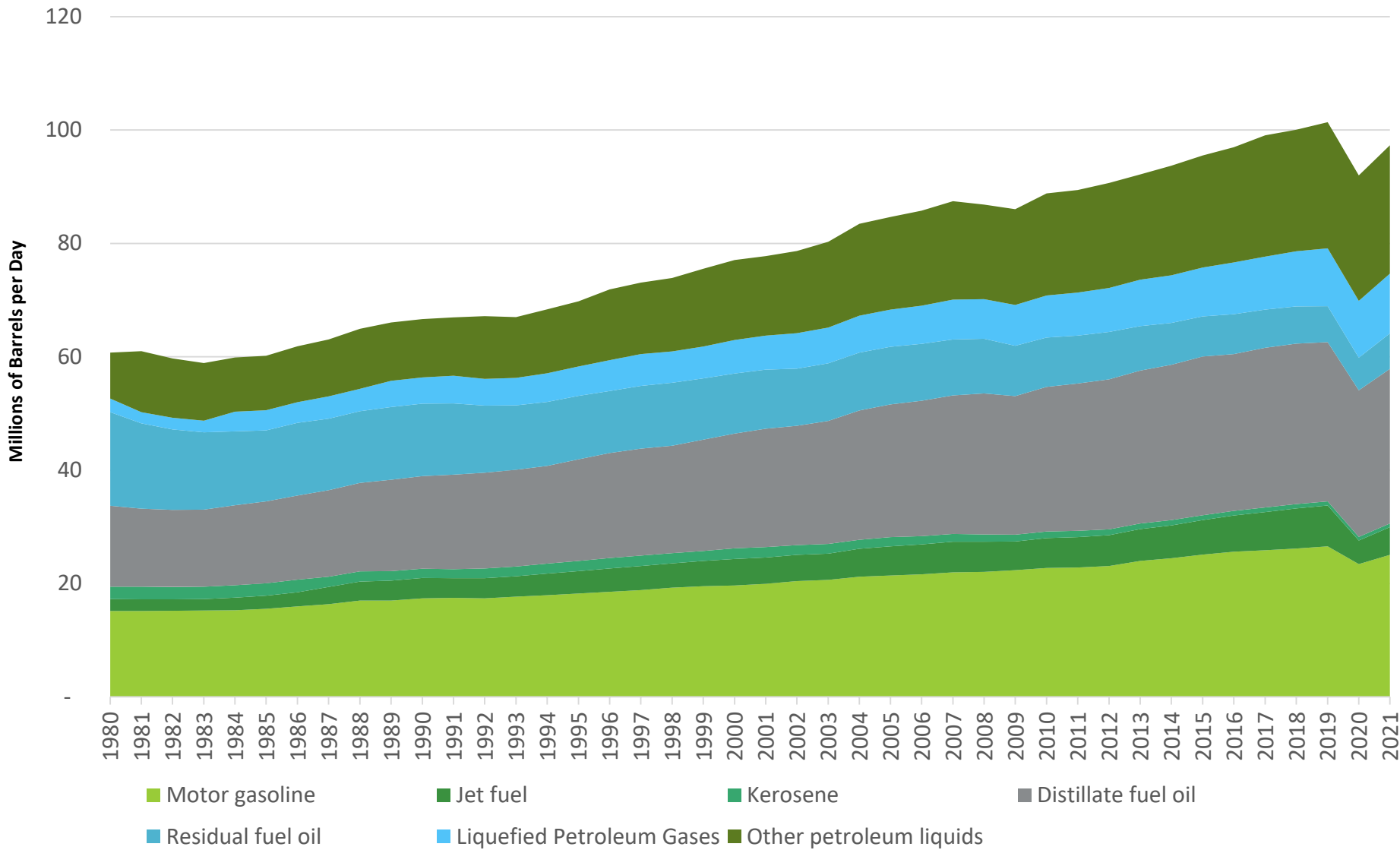
- Opportunity Identification
- Market Share Mapping
- Competitor Analysis
- Gap Analysis
- Secure, Web-Based Interface
- Integrate with AFS Forecast & Scenario



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

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Driving Data into Decisions.
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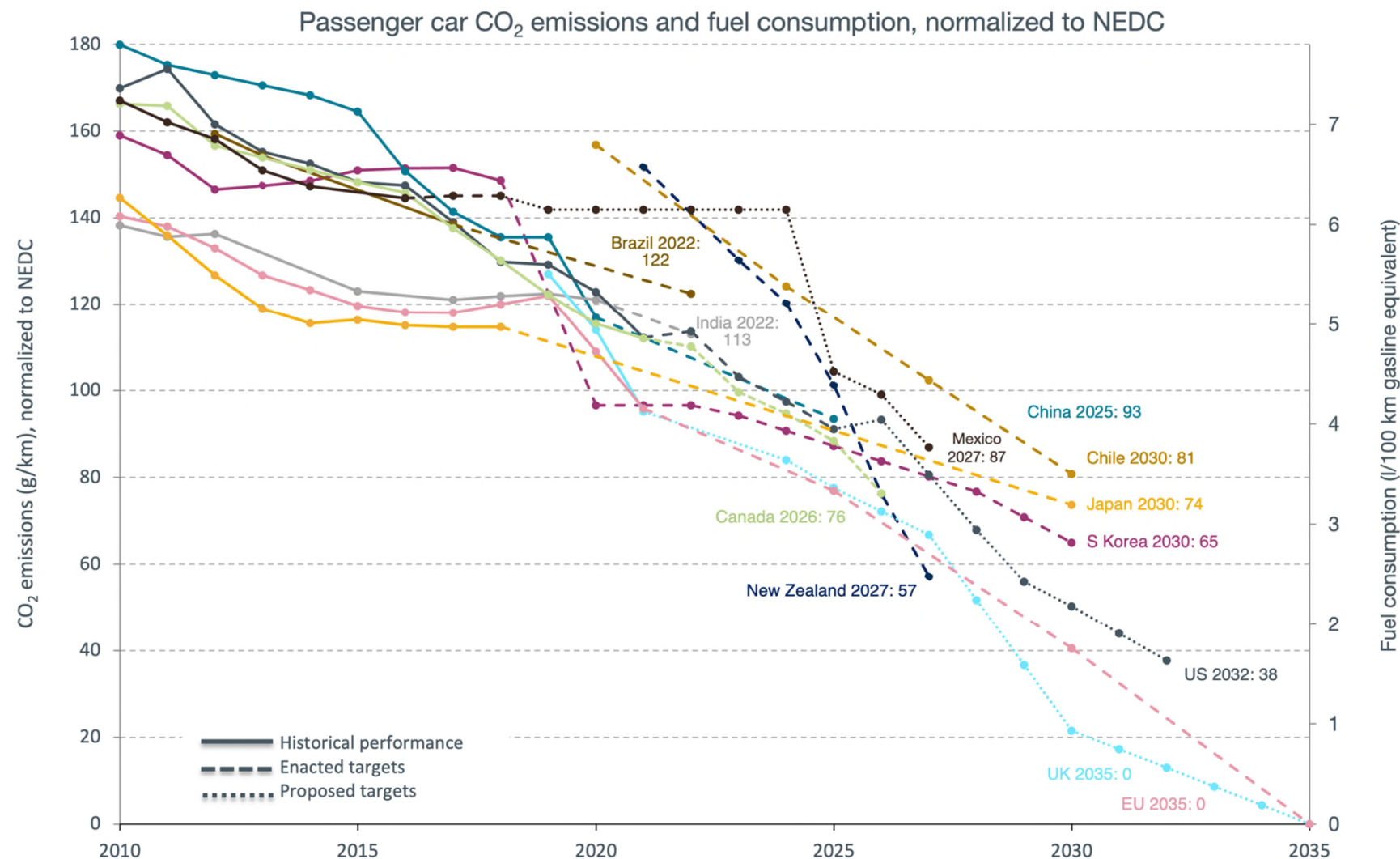
Global Petroleum Product Demand



- Gasoline and Diesel fuels represent ~50 MMb/d of global petroleum demand
- Primarily driven by the consumption of fuels in light-duty and heavy-duty vehicles
- Electrification of the global transportation fleet has the potential to have significant negative impact to fuel consumption rates

Source: EIA August 2023

Global GHG Regulations Drive Electrification

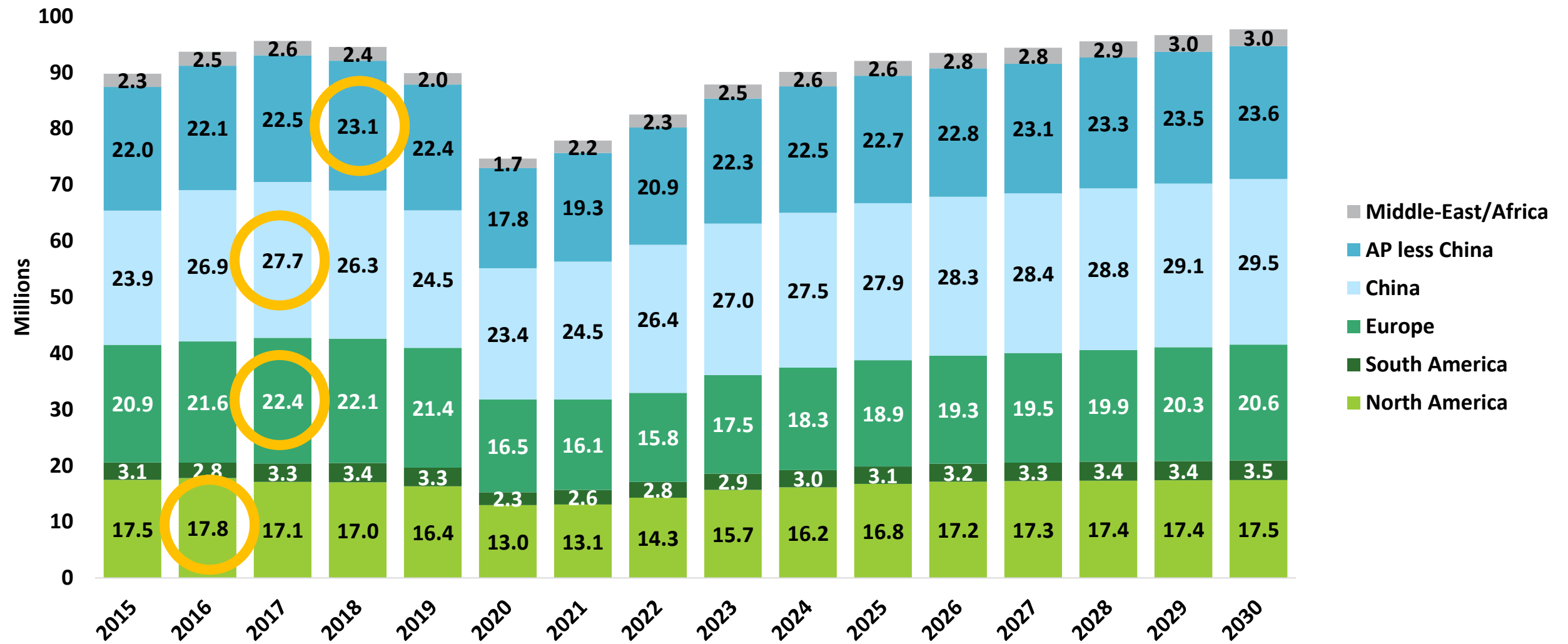


Note: U.S. 2026 target is adjusted in proposed standards for 2027 and later vehicles to reflect differences in various credits between the current rule and the proposal;
UK fleet-average targets estimated based on non-ZEV CO₂ emissions and ZEV mandate.

Updated June 2023
Details at <https://theicct.org/pv-fuel-economy/>

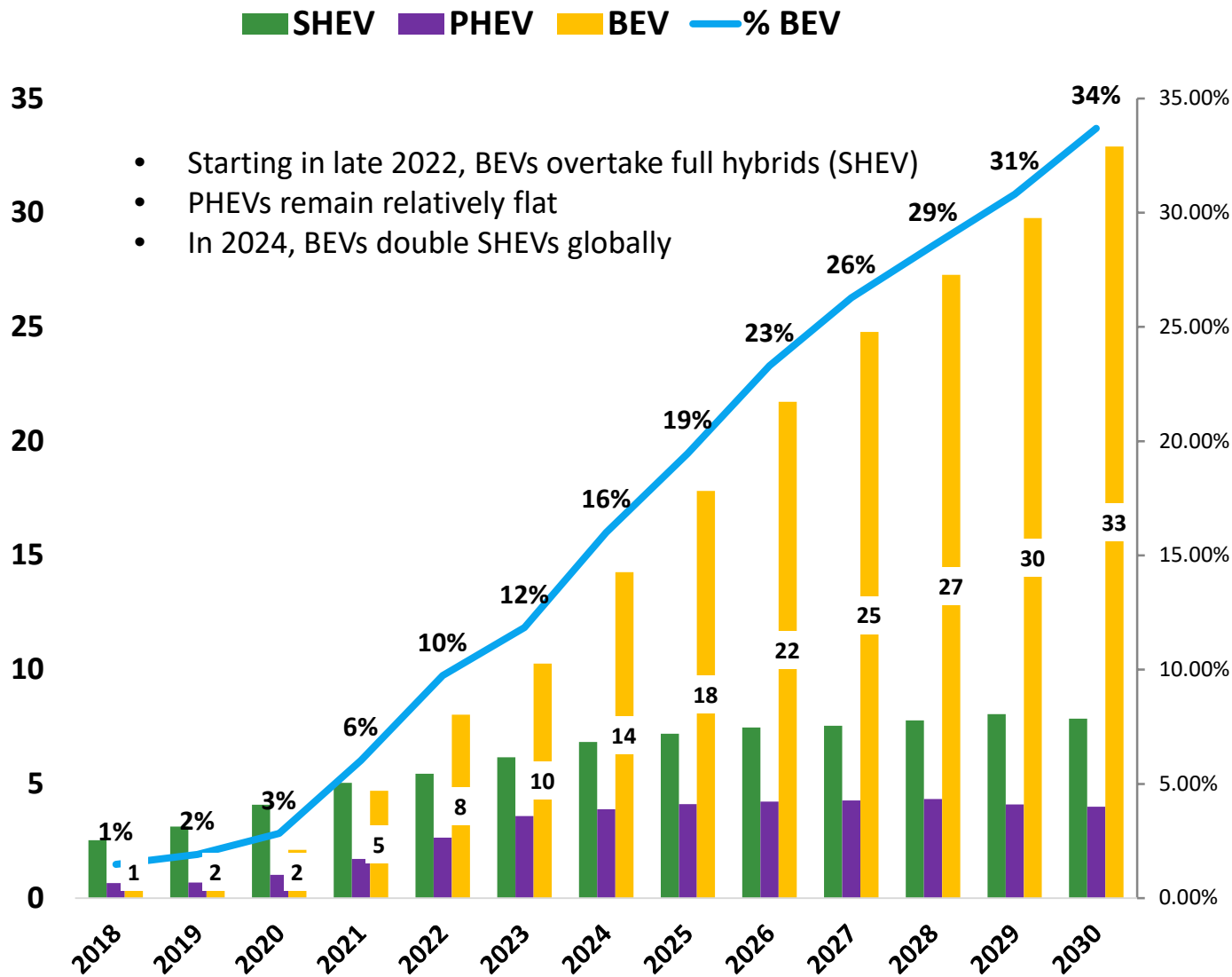
- Significant reductions in tailpipe CO₂ standards require BEVs to achieve
- US vehicles are much larger than the ROW leading to significant powertrain challenges in the region
- US Grid average CO₂ output for EVs = ~70g/km in real emissions

Global Light Vehicle Production Outlook

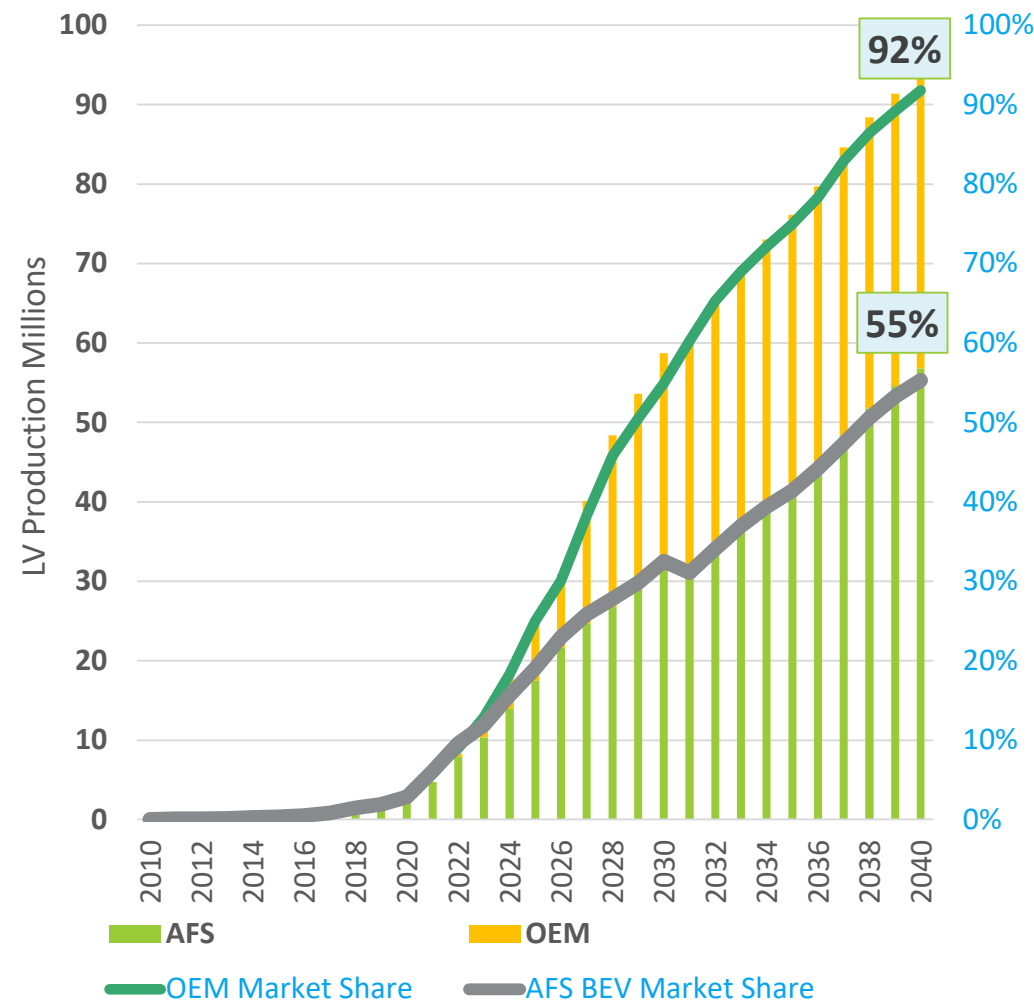


Source: AutoForecast Solutions

Global xEV Production Outlook



VM EV Production Scenarios



Source: AutoForecast Solutions

September 2023 (R2308)

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EV Adoption Concerns

The Macro Issues

Range Anxiety

Infrastructure

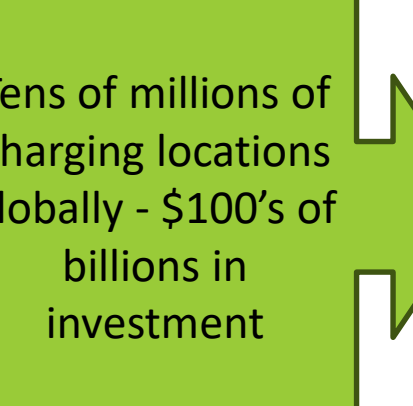
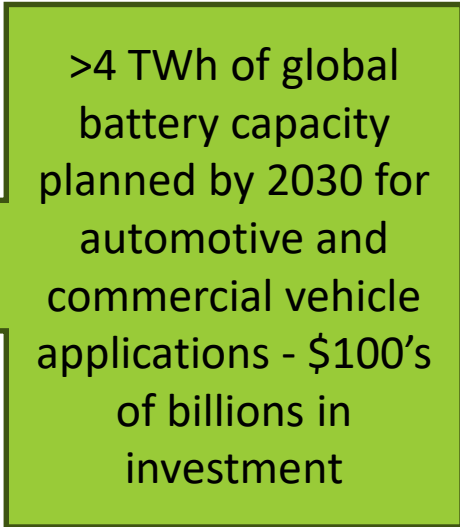
Cost Barriers

Resource Limitation

The Fine Print

- Identifying the stakeholders
- Supply chain/VM vertical integration
- Government involvement
- Standardization: regulations, rules, and emission targets
- Charging stations
 - Home and highways
- Financial incentives
 - Direct sale incentives
 - Tax incentives
- Logistics incentives
 - City center allowances
 - HOV use
- Sourcing
 - Inflation Reduction Act criteria for mineral/battery materials and manufacturing
- Material and manufacturing innovations
 - Rare earth metal availability
 - Current production capacity does NOT support EV build plans
 - The need for improved battery chemistry
 - Raw material prices not expected to decline substantially proportion to volume
 - Capturing Battery Value/Recycling
- Penalties
 - Consumer
 - Fuel tax
 - EV-consumer road use tax
 - Cost of personal time during charging
 - Manufacturer: Carbon credit mandates
- Altered revenue models & the new consumer
 - New players
 - Understanding the target consumer
 - Brand loyalty erosion
 - Lower sales
 - Transactional vs. Subscription-based model

Source: AutoForecast Solutions

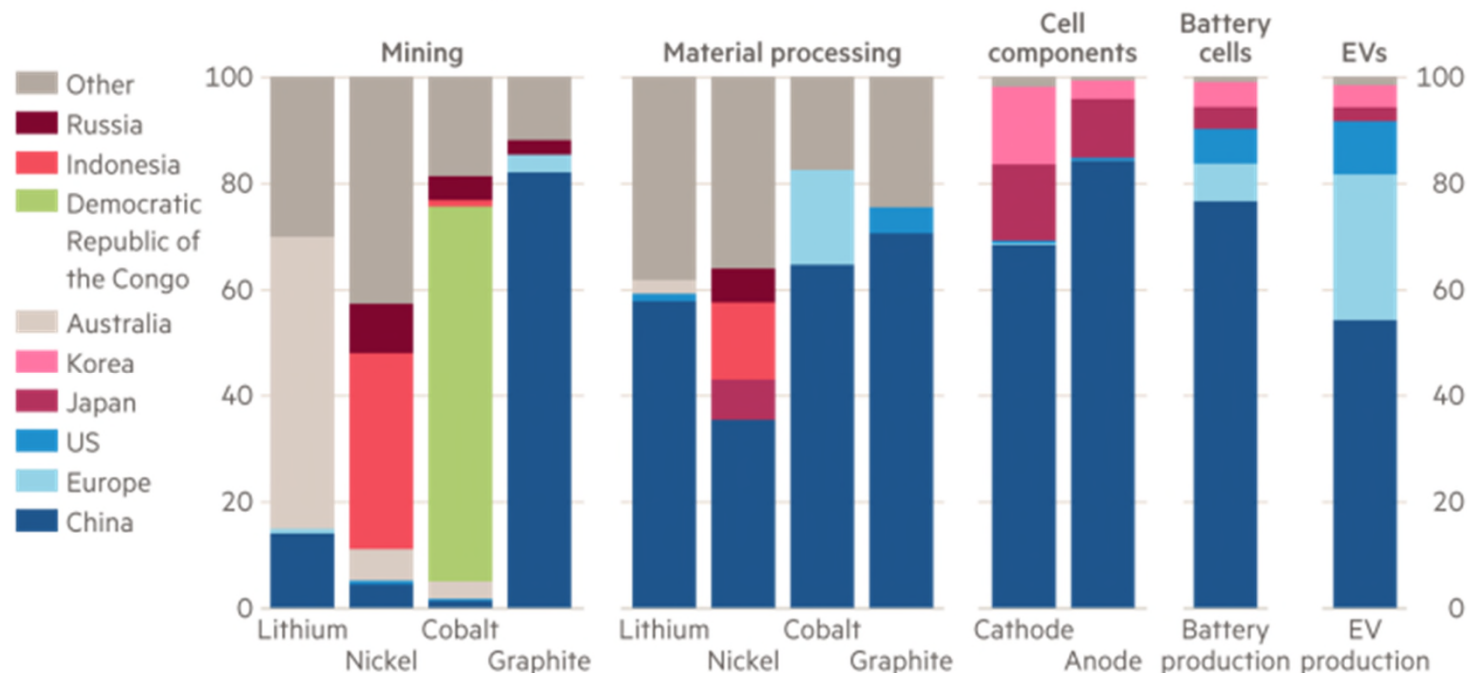


Tens of millions of
charging locations
globally - \$100's of
billions in
investment

IRA Sourcing Requirement Challenge

China dominates the entire downstream EV battery supply chain

Geographical distribution* of the global EV battery supply chain (%)



* Refers to the country where the production occurs

Mining is based on production data. Material processing is based on refining production capacity data. Cell component production is based on cathode and anode material production capacity data. Battery cell production is based on battery cell production capacity data. EV production is based on EV production data

Source: IEA

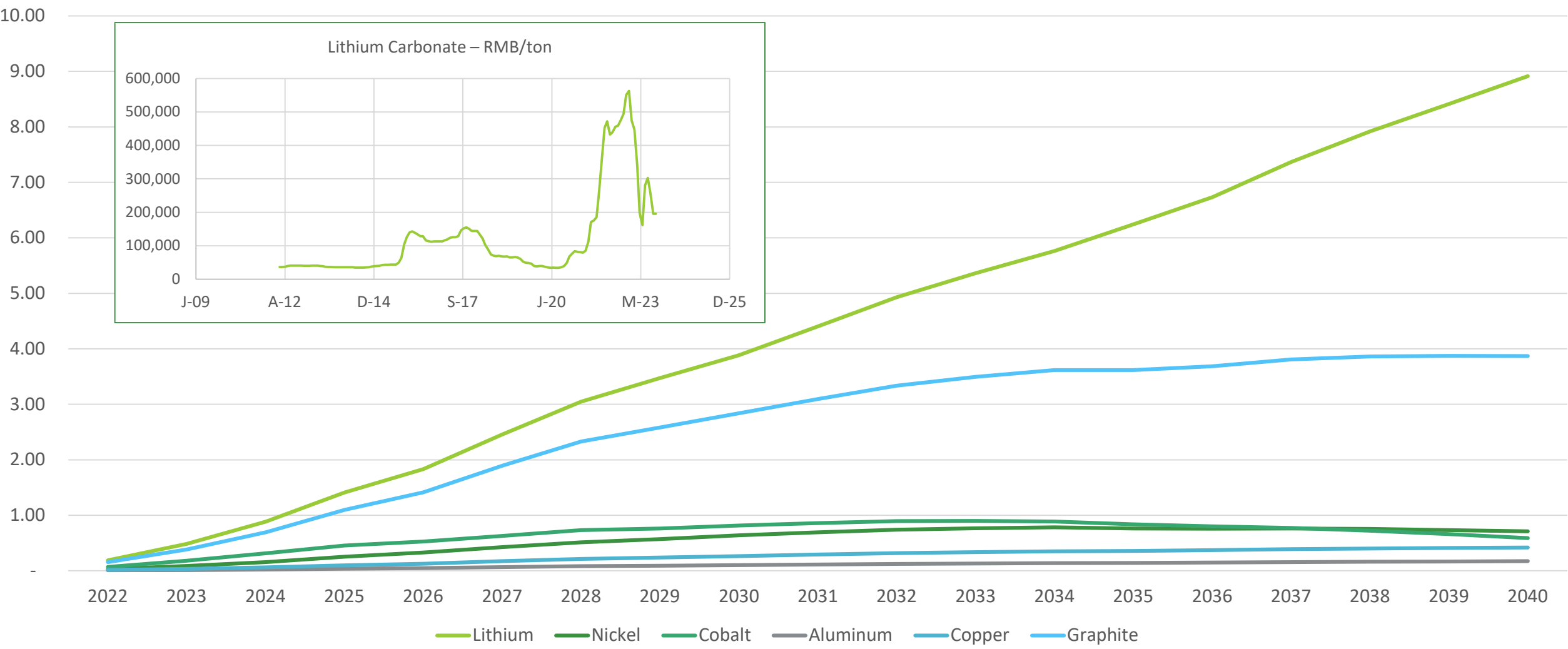
© FT

Chinese companies dominate the material processing value chain making near term IRA compliance credits difficult to achieve.

- Market will need to be developed in the US at an accelerated pace for OEMs to receive EV credits
- New technologies will need to be developed in order to limit the current country of origin impacts
- Value of IRA compliant material is increased

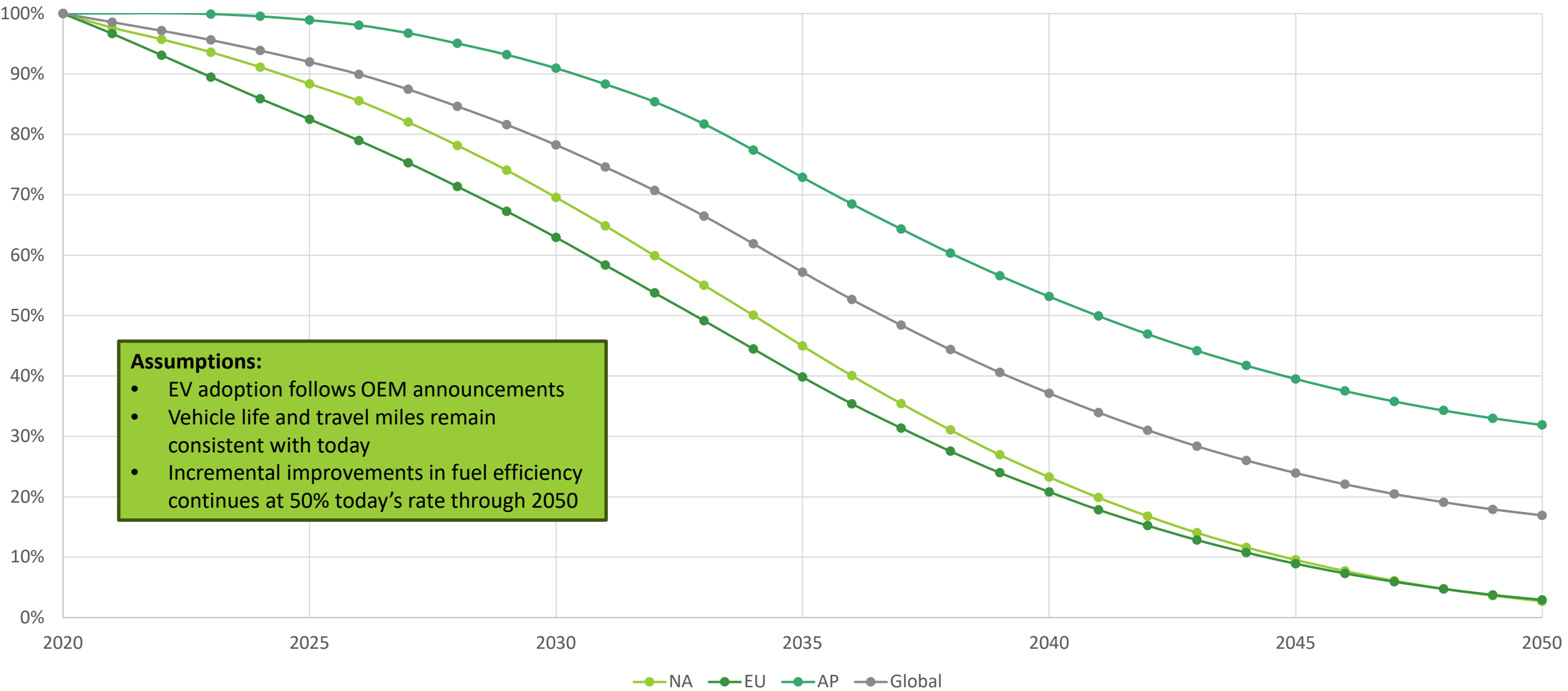
Key Raw Material Demand – OEM Scenario

Increase in Global Raw Material Production from 2021*



*Note: Does not include recycling effect

Light-Duty Transportation Fuel Demand Forecast



Where are we headed?

EV vs. ICE

- Electric vehicle development has reached critical mass
 - Not a matter of if or when but how many
- ICE's will continue to be consumed for decades
 - 50% ICE share through the 2030's

EV Hurdles Ahead

- Infrastructure development for batteries and charging
 - Mining and processing development speed
 - Electrical grid investments?

Transportation Fuels

- Governmental and automaker plans lead to an 80% global reduction by 2050
 - Market expectations for vehicle electrification are about half that
- What happens to the transportation fuel market with a massive global shift to electric vehicles?

Thank You

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