



EV Seminar Series 2020

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Host:

Roger Atkins

Managing Director,
EV Outlook Ltd



Speaker:

Adam Panayi

Managing Director,
Rho Motion

Running time, 40-45 mins

Agenda:

- Introduction and opening remarks from Roger
- Presentation from Adam
- Q&A
- Closing remarks

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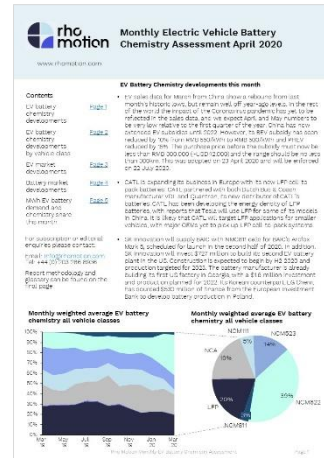
The Coronavirus Impact: EV & Battery markets after the pandemic

Rho Motion provides analysis on EV market development and downstream battery demand

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What we do

Monthly
Assessments



Quarterly
outlooks



How we do it

OEM strategy

Focus on pack sizes & battery chemistry

EV model-by-model, bottom-up analysis

Impact of emissions legislation and targets

Vehicle price & performance, charging infrastructure

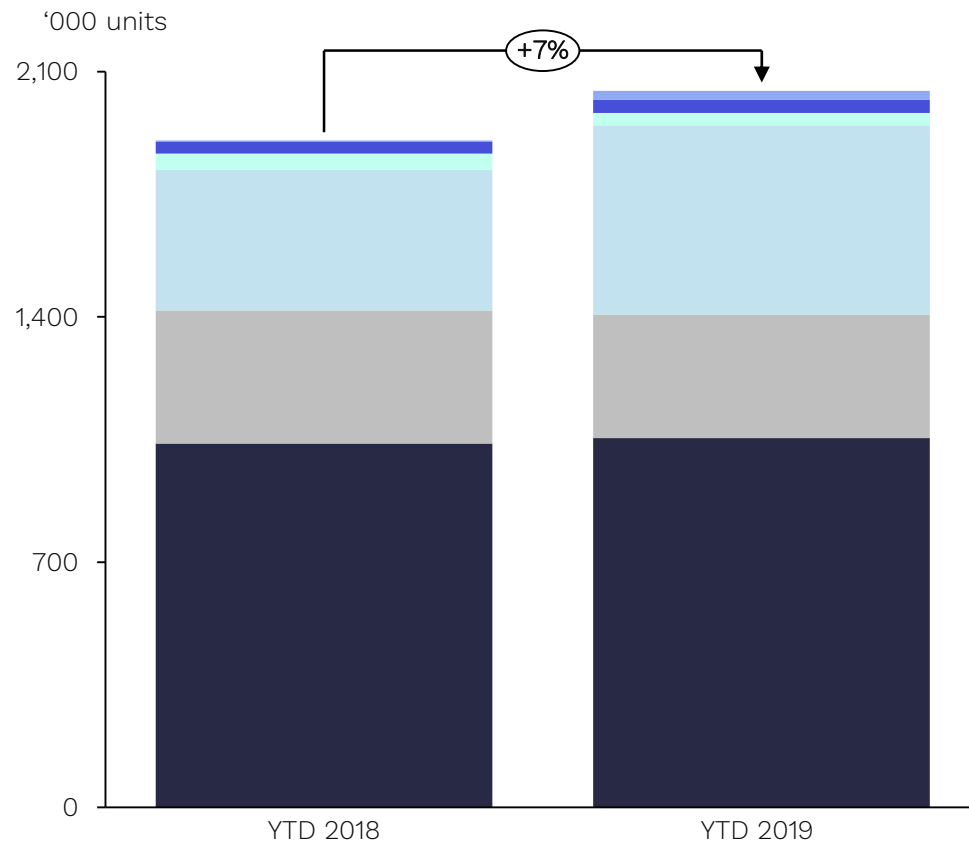
Three aspects to the coronavirus impact

- **Supply side impact** – OEM plant shutdowns and supply chain disturbance
- **Demand side impact** – access to dealerships, potential longer-term impact arising from an increase in unemployment and reduced GDP
- **Legacy impact** – longer term issues arising from the crisis, timescale for punitive emissions legislation and EV investments and roll out

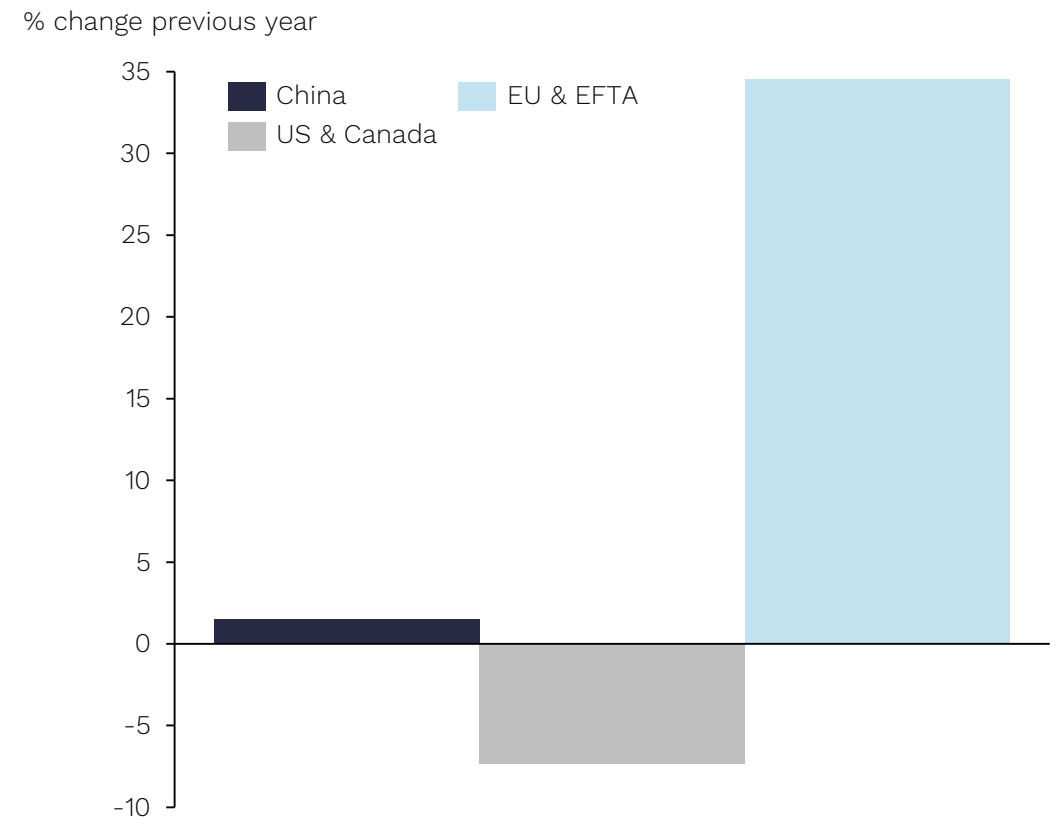
The market underperformed against expectations in 2019

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Regional Full-Year PC & LDV EV sales

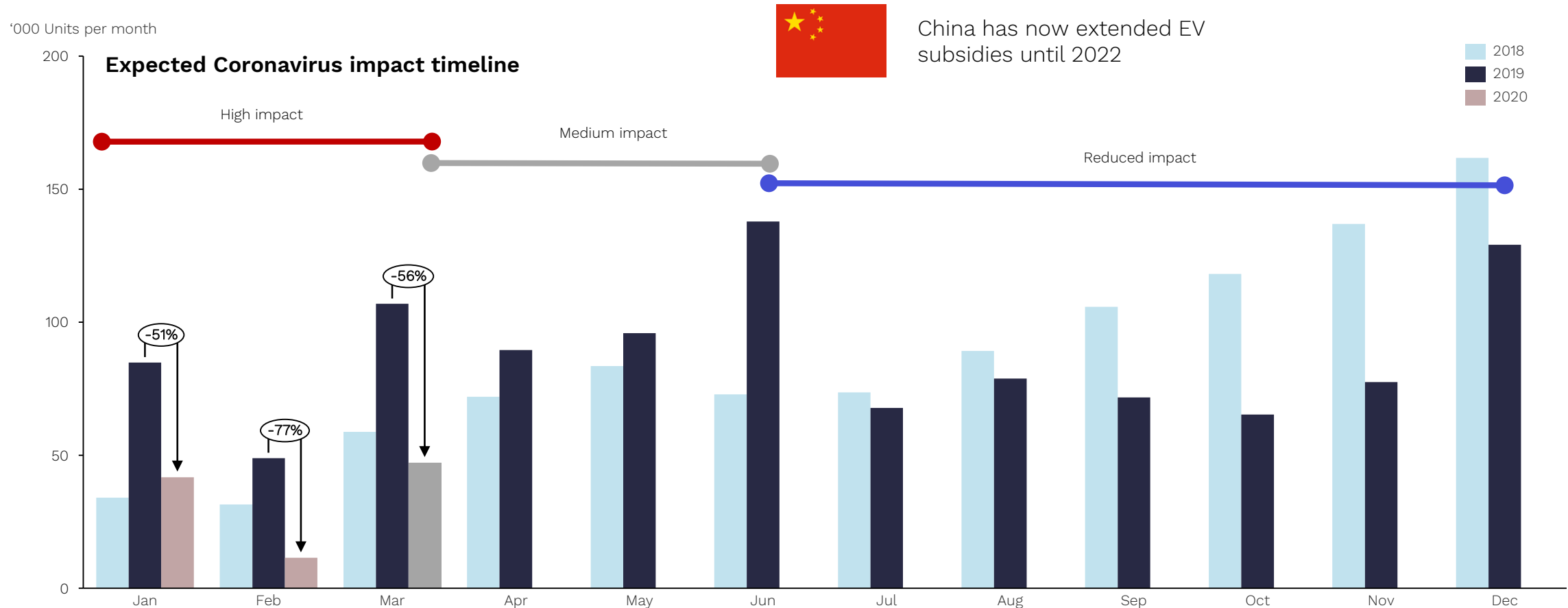


Regional Full-Year-to-date PC & LDV EV sales % change y-o-y



China is the key leading indicator we have for the impact of the virus so far

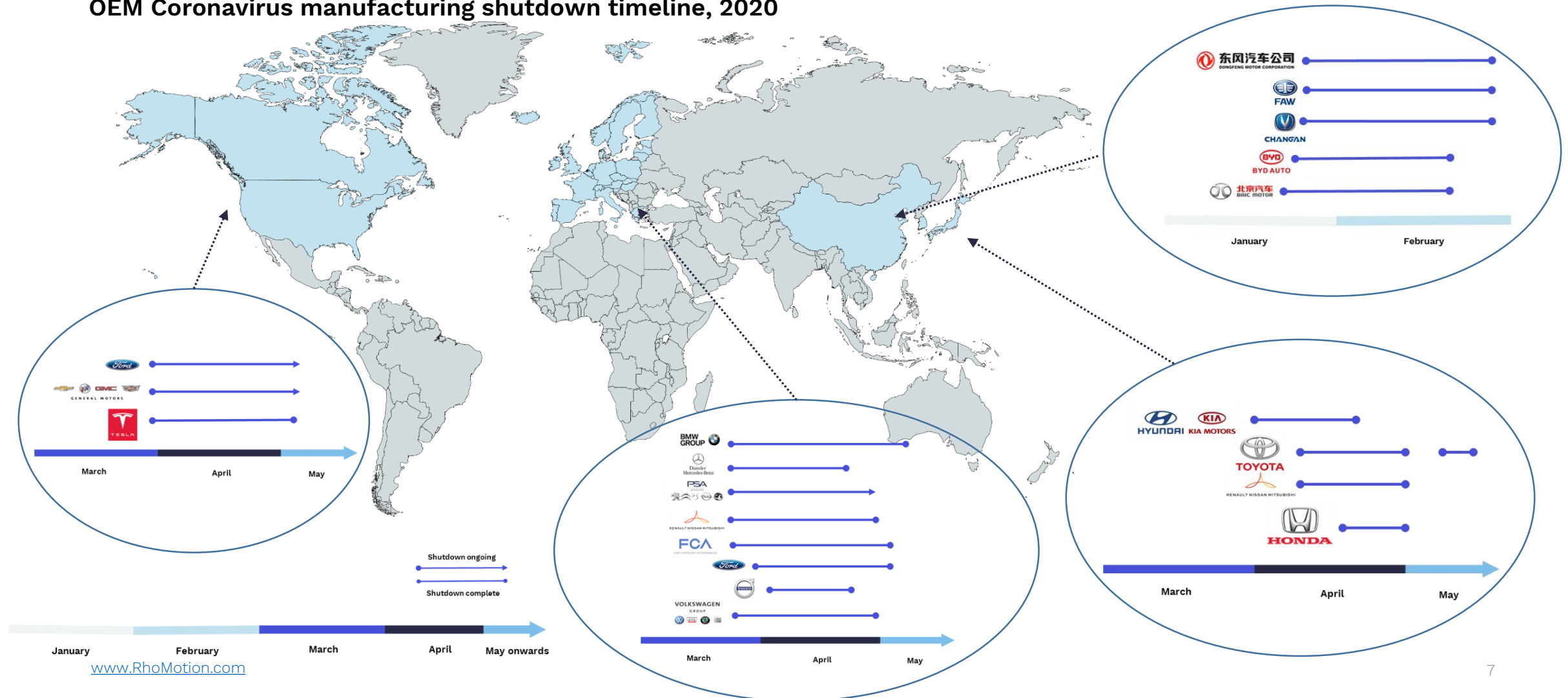
China passenger car BEV & PHEV Sales by month, 2018 – 2020 ytd



OEMs are reopening, but utilization rates will be down for a sustained period

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OEM Coronavirus manufacturing shutdown timeline, 2020



Rising EV penetration rates in 2020 will shield the market from the worst of the impact

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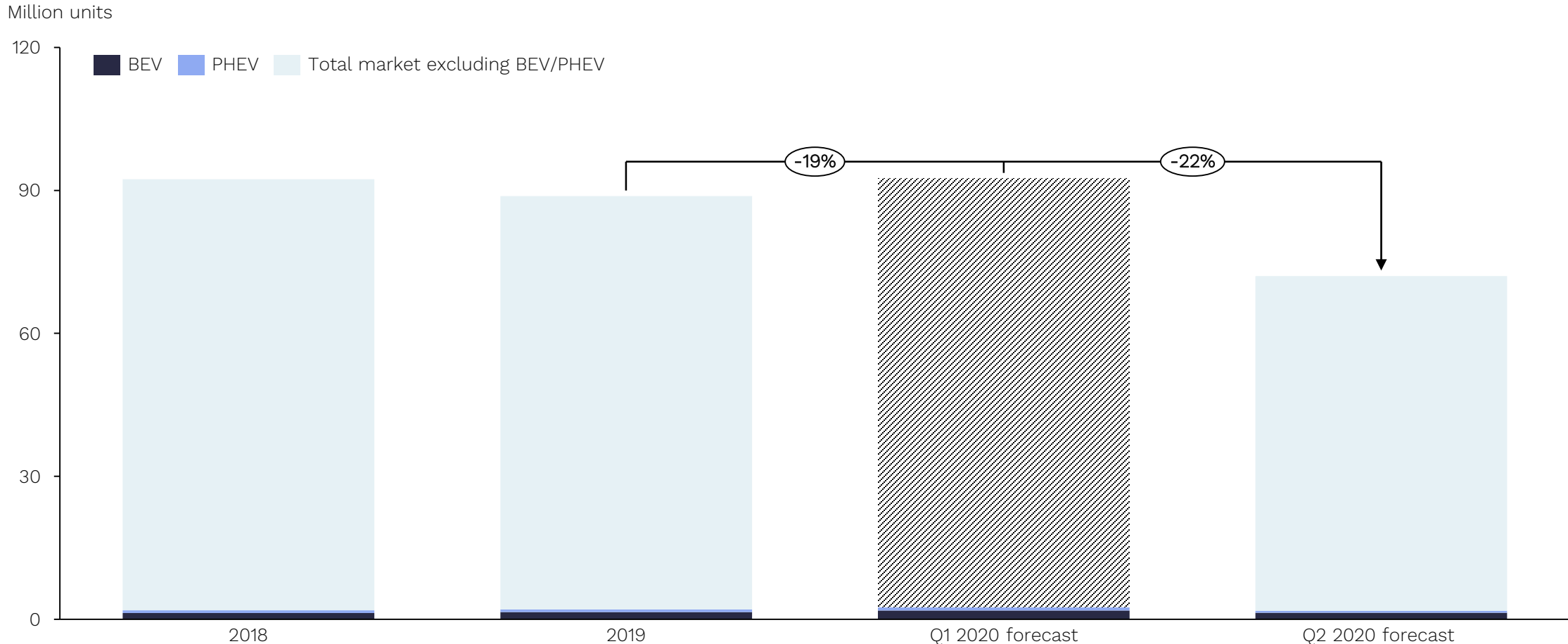
EV penetration rates, %, 2019 vs Q1 2020



As such we are forecasting larger declines in the total vehicle market than for EV

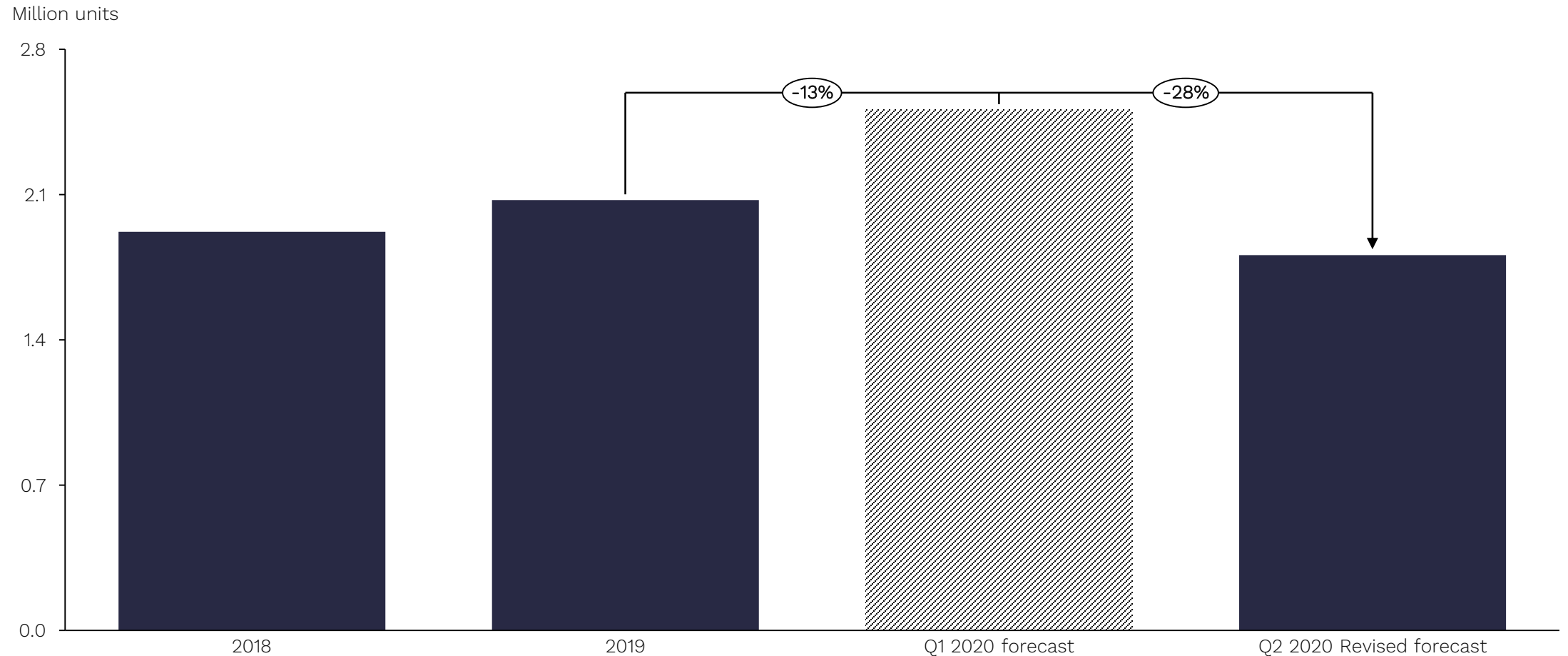


Total PC & LDV Vehicle Market Sales, 2018-2020



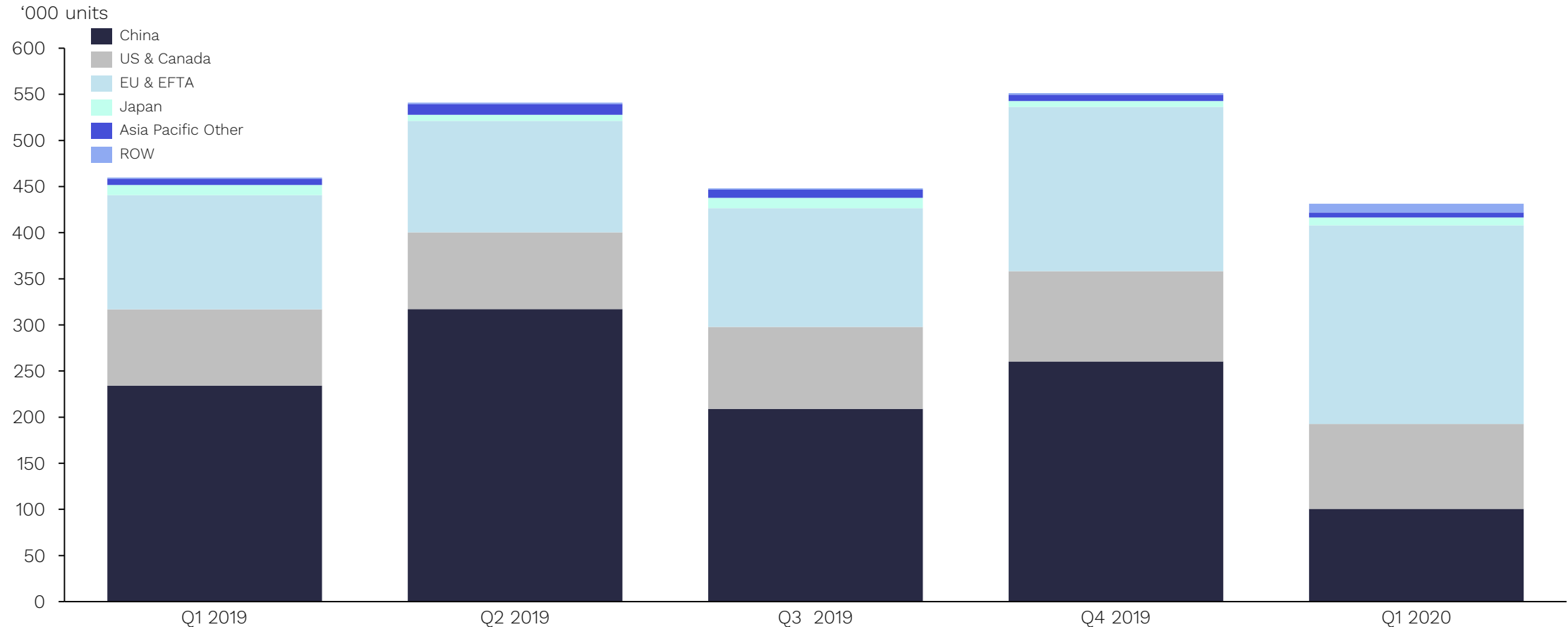
The impact will still be significant for EVs

BEV & PHEV PC & LDV Vehicle Market Sales, 2018-2020



Changing patterns in regional sales have an impact on battery market dynamics

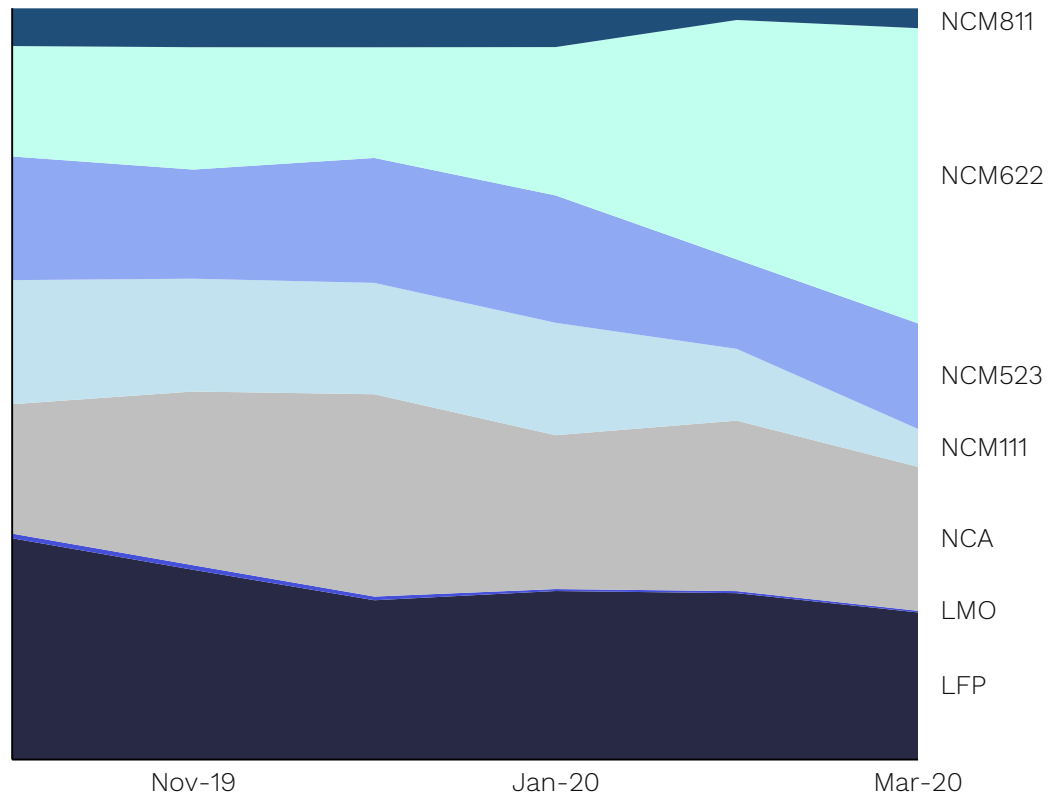
Quarterly PC & LDV BEV & PHEV sales 2018 – 2020 by region



We expect these impacts to be relatively short-lived

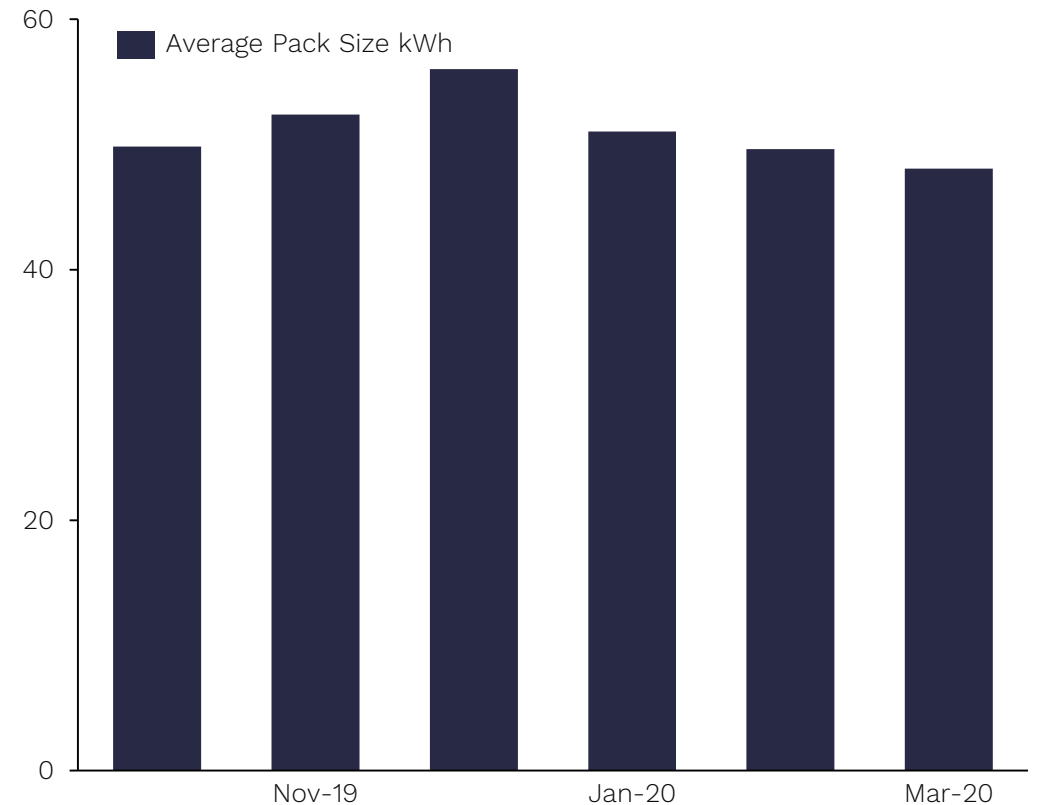
Monthly weighted average EV battery chemistry all vehicle classes

100%



Monthly Sales weighted average EV battery pack sizes all vehicle classes

kWh



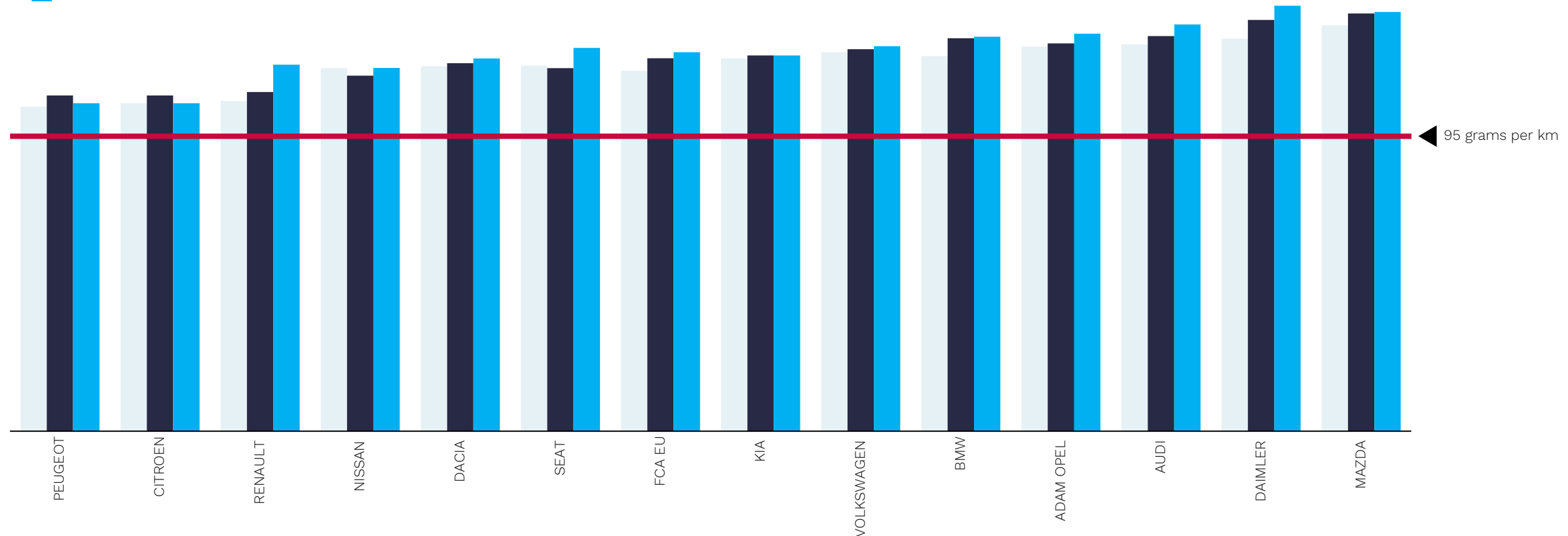
OEMs will struggle to meet European targets, and to pay fines

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Selected OEM fleet average CO₂ emissions, 2017 - 2019

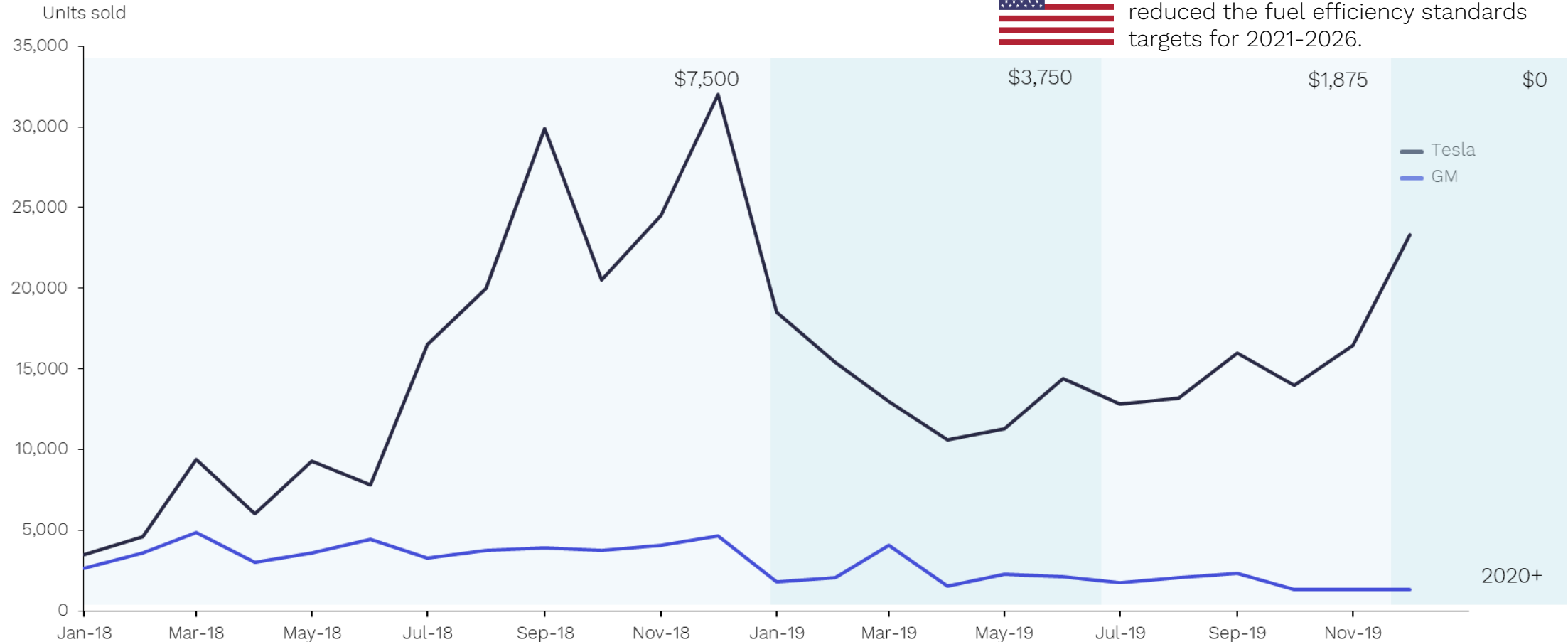
CO₂ grams per km

2017
2018
2019



Policy matters, Government intervention has a big impact in a young market

US tax credits and EV sales, 2018 - 2019

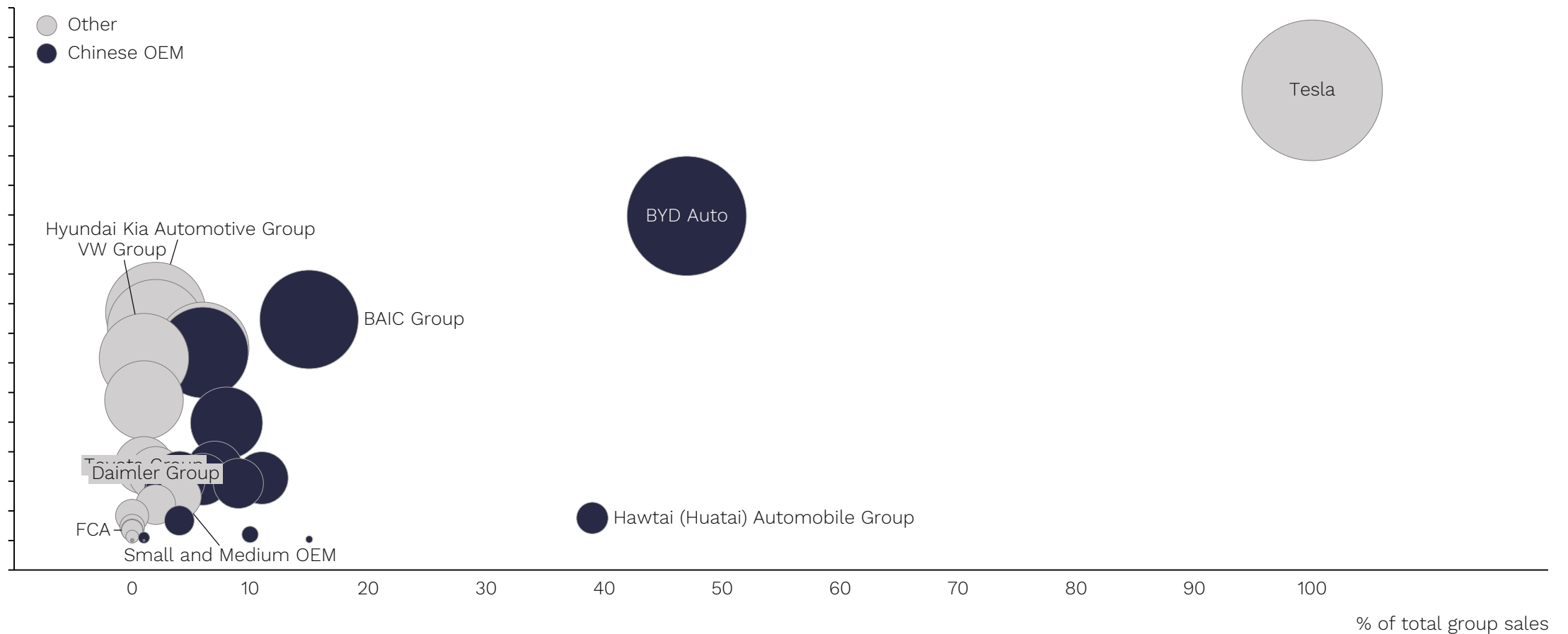


The Trump administration has also reduced the fuel efficiency standards targets for 2021-2026.

Excluding Tesla, Chinese OEMs have been the leaders in the market to date

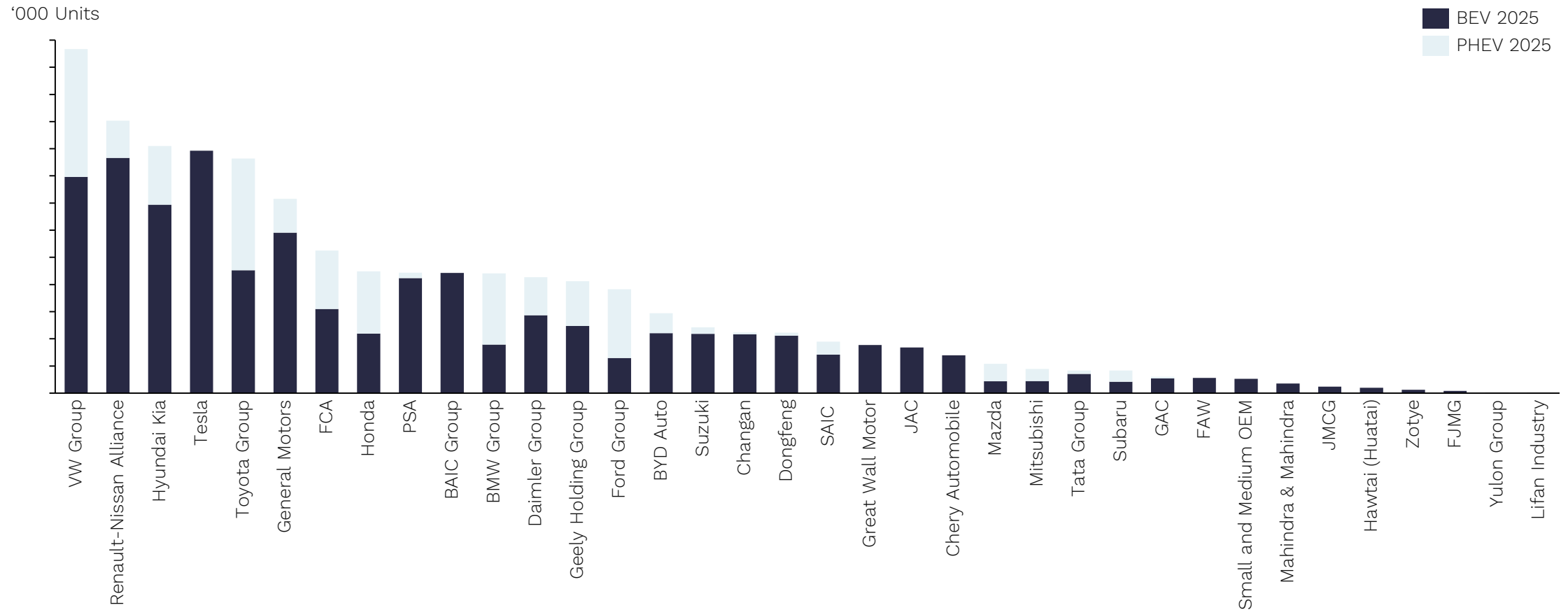
BEV & PHEV Sales by OEM, and % of total sales, 2019

'000 BEV/PHEV Sales



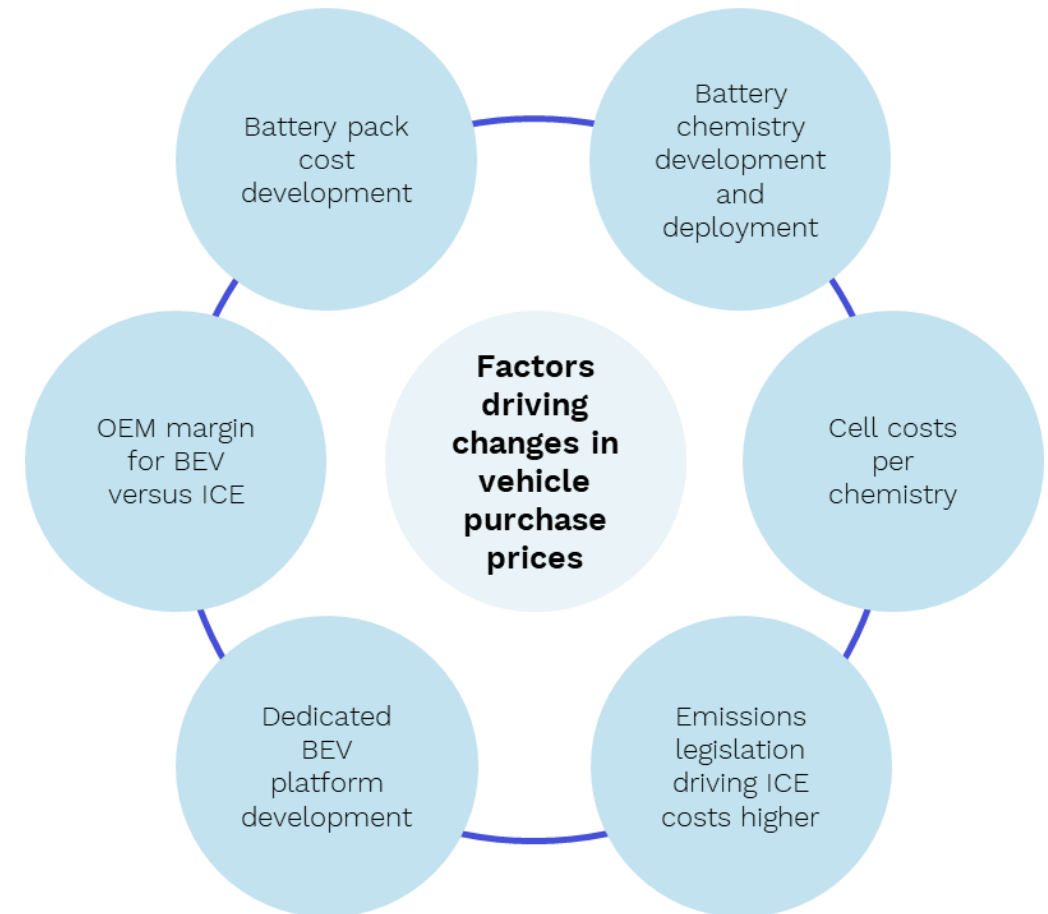
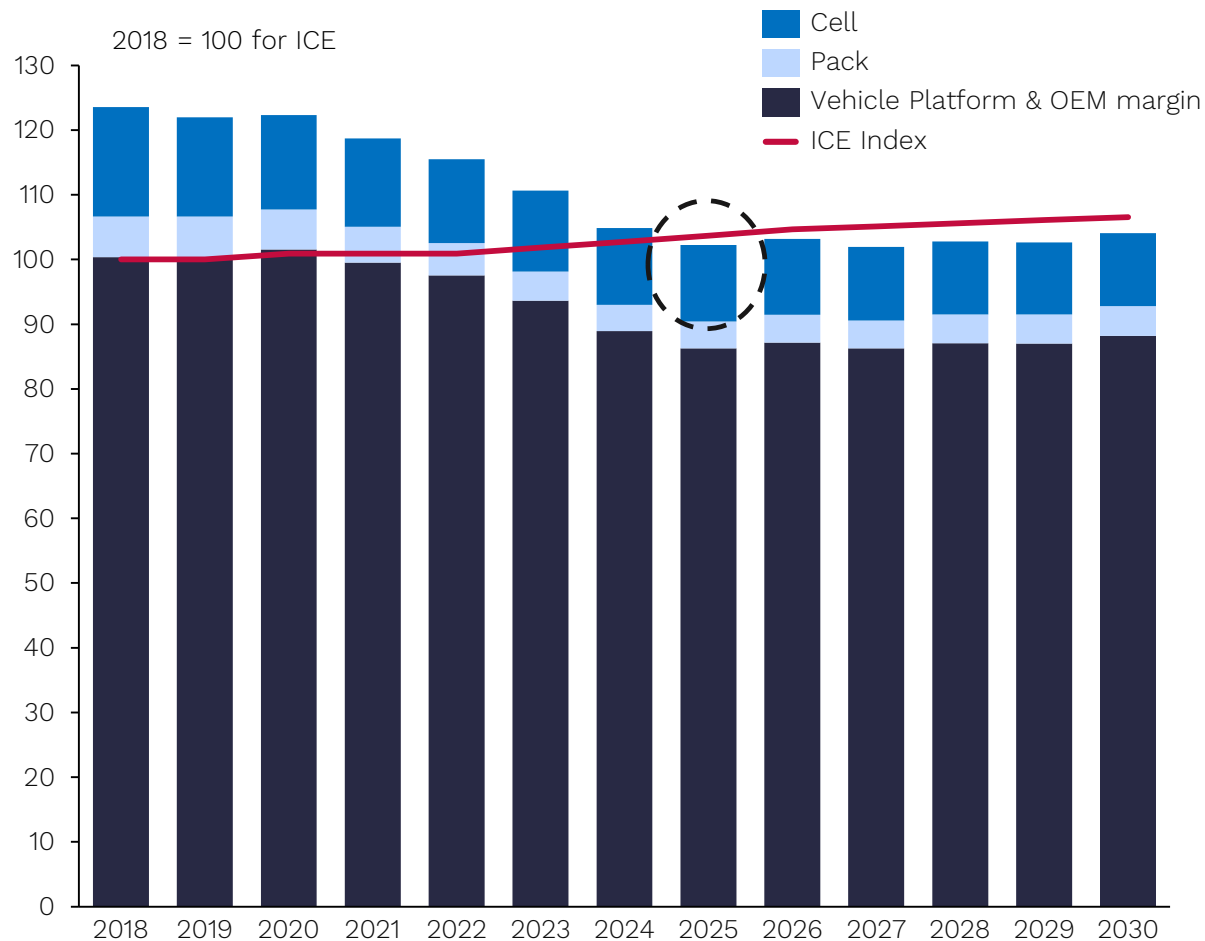
OEM investments are unlikely to be significantly effected in the longer-term

BEV & PHEV Sales by OEM, forecast, 2025



But roll-out delays will slow the timeline for cost and price parity

Indexed BEV & ICE pricing, new model releases



Key Features of the EV & Battery Quarterly Outlook

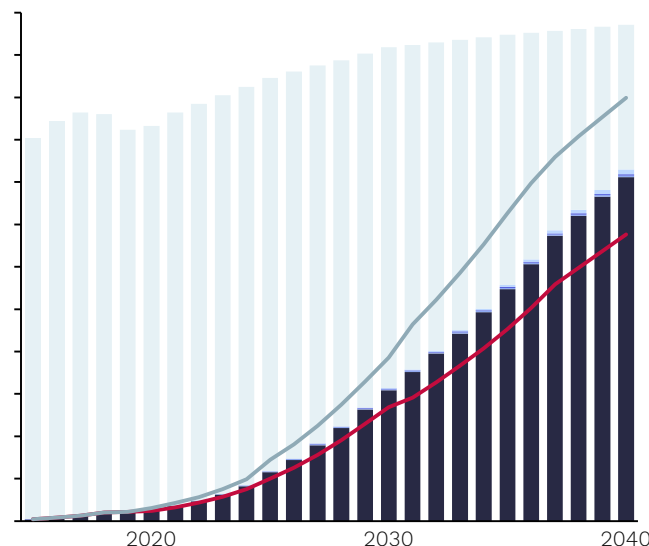
Our quarterly outlook provides long-term forecasts for EV penetration, battery pack size and chemistry by vehicle class, based on robust and informed methodologies.

The three key deliverables from EV & Battery Quarterly Outlook are:

- BEV and PHEV outlook by vehicle class to 2040, by OEM to 2030
- Battery pack size outlook by vehicle class to 2040
- Battery demand outlook by anode and cathode chemistry by vehicle class to 2040

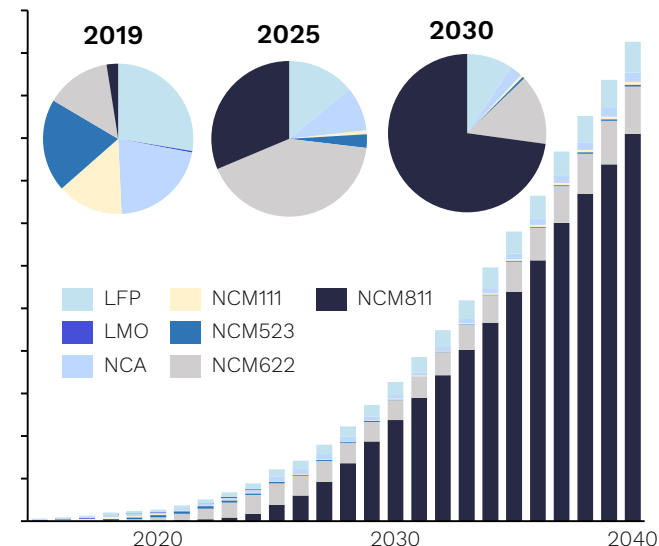
EV sales outlook by vehicle class

Million units



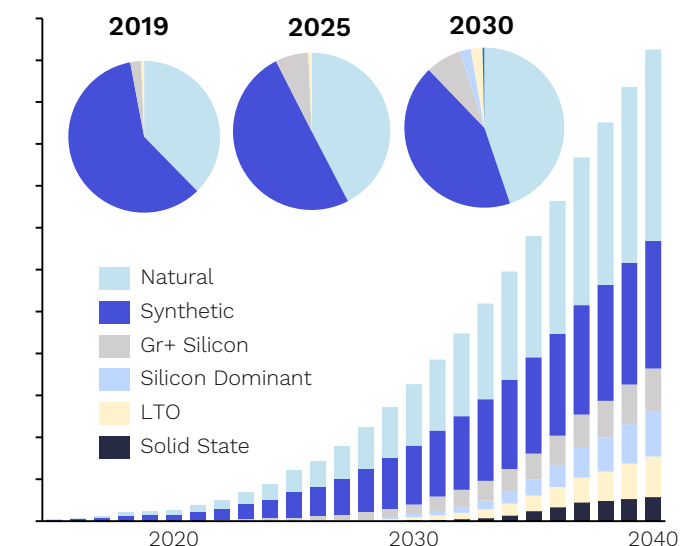
EV cathode demand outlook by battery chemistry

GWh



EV anode demand outlook by battery chemistry

GWh



The report is designed to be used as both an analytical and reference tool, and can be read as a whole or in part as needed

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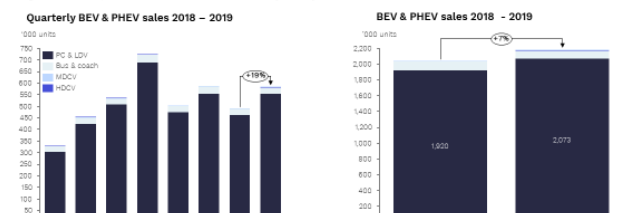
Section 1 provides an update on the latest developments in the EV and Battery markets for the last quarter, as well as an overview of our outlook for EV sales and battery markets

Section 2 provides detail on our outlook assumptions and key drivers of both the EV sales and battery demand outlooks.
Section 3 covers our outlook results in detail at a regional and vehicle class level

Sections 4&5 have been included for reference and provide information on 20+ OEM strategies, and country level legislation, subsidies and incentives for 20+ of the largest vehicle markets in the world

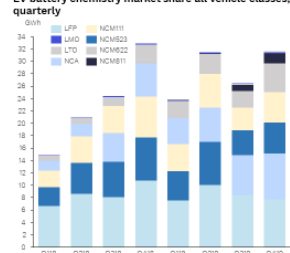
1.1 EV market update and outlook

The fourth quarter saw fairly robust sales numbers versus Q3 2019, however much of this effect is seasonal, as vehicle sales tend to end the year strongly in China. In North America there was also a small pre-buy effect ahead of tax credit cuts for Tesla. In Europe sales grew strongly throughout the year and ended the year in the region of 60,000 units per month, almost twice their January level. For context, against the same quarter in 2018 the market was down 18% year-on-year.

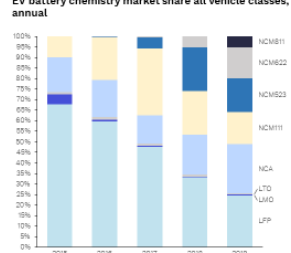


1.2 EV battery market update and outlook

EV battery chemistry market share all vehicle classes, quarterly

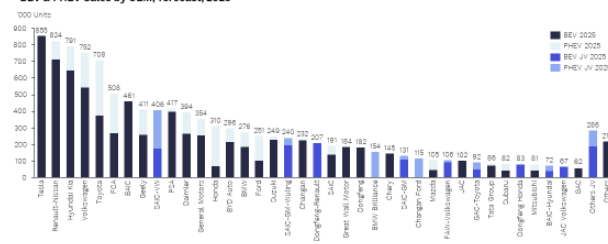


EV battery chemistry market share all vehicle classes, annual



2.3 OEM strategy including JVs

BEV & PHEV Sales by OEM, forecast, 2025



2.3 OEM strategy analysis

The chart on the right illustrates the relative importance of EVs at present to each OEM in terms of actual sales volume and percentage of their total sales.

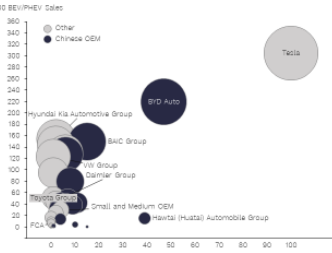
In the following slides we outline our expectations for how this will develop in the period to 2030. This forecast is based on our interpretation of each OEM's stated plans, and our own estimation of what is likely to be achievable. Full details for each major OEM can be found in section 4.

The key takeaway from this analysis is that the balance of market share moves away from Chinese OEMs and start-ups, for example Tesla, towards major OEMs who are now committing significant resources to re-gearing production to incorporate electrification.

Another important point is that hybridisation is a key part of most major OEMs transition planning over the coming 3-5 years.

We now include forecasts at a joint venture level to provide greater depth and clearly outline the direction of OEMs at an individual level and at its Chinese JV counterpart level, i.e. VW & SAIC-VW.

BEV & PHEV Sales by OEM, and % of total sales, 2019



OEM Strategy: Tesla

- Tesla is a leading electric vehicle automotive and energy company head quartered in Palo Alto, California, USA. It produced just over 300,000 vehicles in 2018, led heavily by the Model 3. The company operates production and assembly plants, notably Gigafactory 1 near Reno, Nevada, and its main vehicle manufacturing plant in Fremont, California. It recently completed construction of Gigafactory 3, Tesla's facility in Shanghai, China, that produces battery cells alongside the Tesla Model 3 and Tesla Model Y. Tesla confirmed in January 2020 that it has signed supply agreements with both LG Chem and CATL for its Chinese vehicle production. As of December 2018, the Chinese plant started delivering its first models. The plant therefore allows Tesla to avoid the 25% import duty it would face delivery its models to China from the US.
- Tesla's EV range includes the Model S, Model X, and Model 3 cars. Upcoming launches include Model Y and Roadster due for rollout in 2020 and Semi (truck) full electric vehicles. Tesla also sells Powerwall, Powerpack, and Megapack batteries and solar panels. In late 2020, Tesla unveiled its Cybertruck which is expected to be available in late 2021. It claims the range will be up to 800km with the Tri Motor version.
- Tesla is now beginning to construct its Gigafactory 4 near Berlin, Germany. It recently received permission to acquire the land for \$45 million and is in very early stages. Tesla plan to have the plant online by July 2021 and plan to produce up to 500,000 electric vehicles annually.
- The Tesla Semi is an all-electric battery-powered Class 8 semi-trailer truck prototype which was unveiled on November 2017 and planned for production by the end of 2020. The company initially announced that the truck would have a 500 miles range on a full charge and with its new batteries it would be able to run for 400 miles after an 80% charge in 30 minutes using a solar-powered "Tesla Megacharger" charging station. The company is involved in installing a global network of "Megachargers" that would be solar-powered and would be able to recharge a truck's batteries in 30 minutes to a capacity to travel 400 miles (640 km).
- In addition to producing a range of headline capturing electric vehicles, Tesla is one of the leading players in the charging infrastructure space. They have installed a network of 100kV Superchargers, charging stations that are available to all Tesla vehicles.

Legislation, Subsidies and Incentives: India

Legislation

India will move from its Bharat Stage IV (similar to Euro 4) to Bharat Stage VI (similar to Euro 6) emission standards. BS-VI standards have been in place for all manufactured four-wheeled vehicles since 1 April 2017. However, the Ministry of Road Transport and Highways report India will bypass stage V and go straight to BS-VI on 1 April 2020. This will bring Indian vehicle regulations in line with EU regulations for passenger cars, commercial vehicles, heavy-trucks, buses and two wheelers.

Subsidies

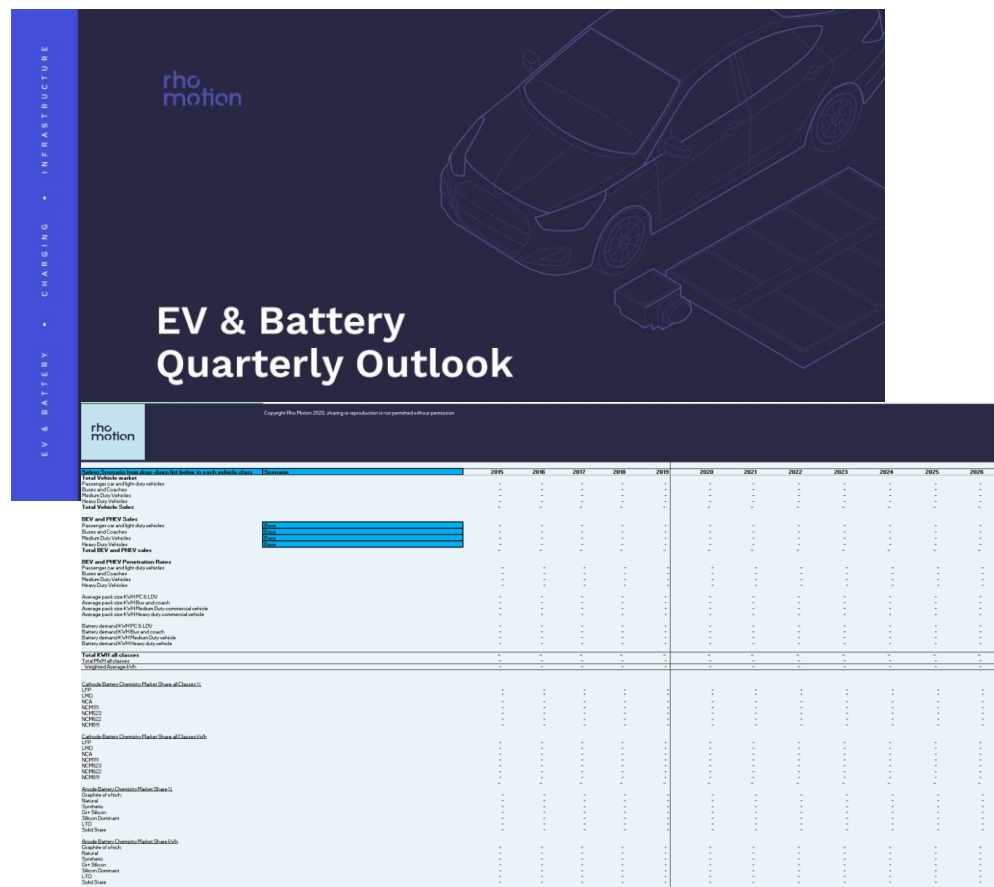
- India's 2018 scheme Faster Adoption and Manufacturing of Electric Vehicles II (FAME II) promises to lay out \$1.4 billion in subsidies over the next three years for electric buses, three-wheelers, four-wheelers that are registered as commercial vehicles, and private motorcycles and scooters. Of the \$1.4 billion, \$1.2 billion is earmarked for subsidies, \$140 million for charging infrastructure and \$5 million for administration and advertising.
- Subsidies are available for 1 million two-wheelers, 500,000 three-wheelers, 35,000 cars, 20,000 strong hybrids and 7,000 buses.
- Only vehicles that cost less than \$21,777 are eligible for the subsidy.
- The subsidy amounts to 10,000 rupees (\$143) for each kWh of battery capacity (20,000 rupees for buses). This is up to 50% of battery cost.

Incentives

- The Indian government has formally proposed amendments to the country's transport regulations to include incentives for EVs. These include:
 - Income tax rebates of up to \$18 lakh (\$2,500) who are customers on interest paid loans that purchase electric vehicles – total exemption reaching \$2.5 lakh (\$3,500) over entire loan period.
 - Custom duty on imported buses and trucks (this will be doubled to 50% from April 2020), and imported partially assembled units will be doubled to 30 30%.
 - A major reduction in the goods and services tax rate on EVs from 12% to 5%, and EV chargers to 5% from 18%.

Key Report deliverables

- Quarterly PDF summarising key updates and forecast results
- Quarterly Excel workbook detailing forecast results and input data



The image shows the cover of the 'EV & Battery Quarterly Outlook' report and a screenshot of the Excel workbook. The cover features the RhoMotion logo and a stylized car. The Excel workbook displays a detailed forecast table with columns for years from 2015 to 2026 and rows for various vehicle categories and metrics.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Total Vehicle market												
Passenger car and light duty vehicles												
Bus and Coach												
Medium Duty Vehicle												
Heavy Duty Vehicle												
Total Vehicle Sales												
BEV and PHEV Sales												
Passenger car and light duty vehicles												
Bus and Coach												
Medium Duty Vehicle												
Heavy Duty Vehicle												
Total BEV and PHEV Sales												
BEV and PHEV Penetration Rates												
Passenger car and light duty vehicles												
Bus and Coach												
Medium Duty Vehicle												
Heavy Duty Vehicle												
Average pack size (kWh) BEV & LDV												
Average pack size (kWh) BEV and Coach												
Average pack size (kWh) BEV and Medium Duty Vehicle												
Average pack size (kWh) BEV and Heavy Duty Vehicle												
Battery demand (GWh) BEV & LDV												
Battery demand (GWh) BEV and Coach												
Battery demand (GWh) BEV and Medium Duty Vehicle												
Battery demand (GWh) BEV and Heavy Duty Vehicle												
Total kWh of classes												
Light Duty classes												
Medium Duty classes												
Heavy Duty classes												
Global Battery Capacity (GWh)												
Global Battery Capacity (MWh) by Class												
Global Battery Capacity (MWh) by Region												
Global Battery Capacity (MWh) by Country												
Global Battery Capacity (MWh) by Vehicle Type												
Global Battery Capacity (MWh) by Battery Chemistry												
Global Battery Capacity (MWh) by Battery Voltage												
Global Battery Capacity (MWh) by Battery Energy Density												
Global Battery Capacity (MWh) by Battery Cycle Life												
Global Battery Capacity (MWh) by Battery Temperature												
Global Battery Capacity (MWh) by Battery Safety												
Global Battery Capacity (MWh) by Battery Manufacturing Process												
Global Battery Capacity (MWh) by Battery Recycling Rate												
Global Battery Capacity (MWh) by Battery End-of-Life Management												
Global Battery Capacity (MWh) by Battery Environmental Impact												
Global Battery Capacity (MWh) by Battery Social Impact												
Global Battery Capacity (MWh) by Battery Governance												
Global Battery Capacity (MWh) by Battery Policy												
Global Battery Capacity (MWh) by Battery Regulation												
Global Battery Capacity (MWh) by Battery Standard												
Global Battery Capacity (MWh) by Battery Certification												
Global Battery Capacity (MWh) by Battery Testing												
Global Battery Capacity (MWh) by Battery Research and Development												
Global Battery Capacity (MWh) by Battery Innovation												
Global Battery Capacity (MWh) by Battery Future Outlook												

Section 1: Executive summary and key developments this quarter

- 1.1 EV market update and outlook
- 1.2 EV battery market update and outlook

Section 2: EV & battery forecast assumptions

- 2.1 EV & Battery Outlook methodology
- 2.2 Legislation, subsidy and incentive analysis
- 2.3 OEM strategy analysis
- 2.4 EV cost and pricing analysis
- 2.5 Battery pack size analysis
- 2.6 Battery chemistry analysis

Section 3: EV & battery forecast results

- 3.1 EV & Battery outlook results introduction
- 3.2 PC & LDV EV & Battery outlook
- 3.3 Bus & Coach EV & Battery outlook
- 3.4 MDCV EV & Battery outlook
- 3.5 HDCV EV & Battery outlook

Section 4: OEM EV strategies

- Analysis for 20+ OEMs including all major Chinese automakers

Section 5: Legislation, subsidies and incentives

- Analysis for the 20 largest vehicle markets



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Question Time



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**Thank you for being with
us, we will be back on
the 26th May**