

EXECUTIVE SUMMARY

Automotive Battery Tracker: 2020 Update

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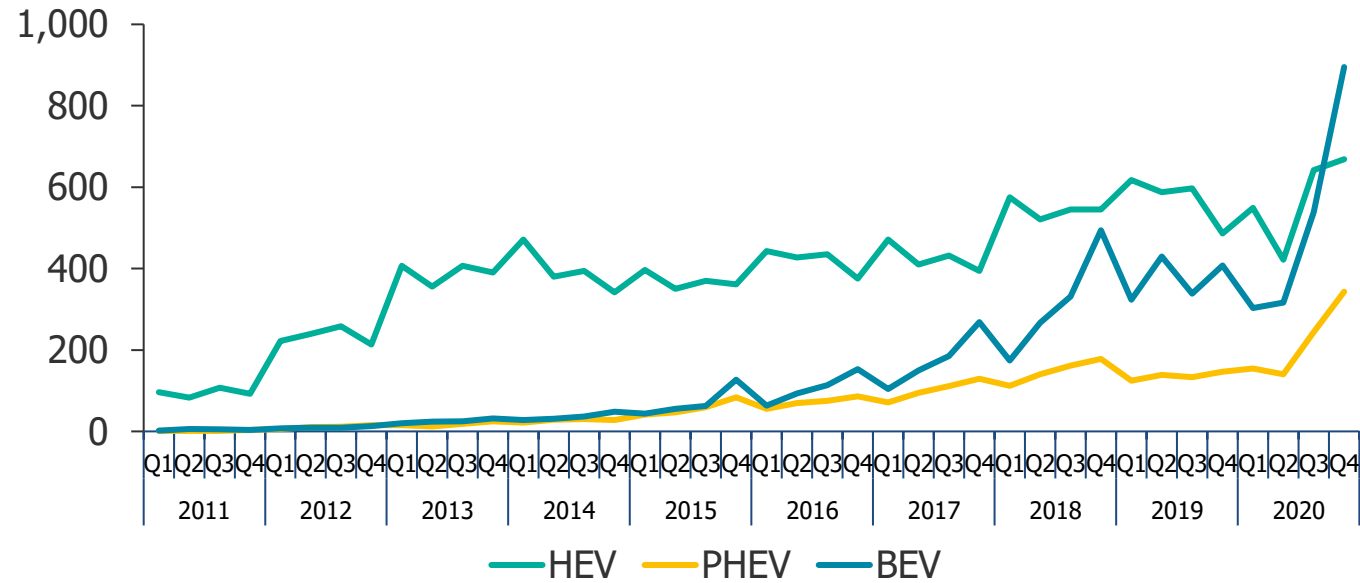
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Executive Summary

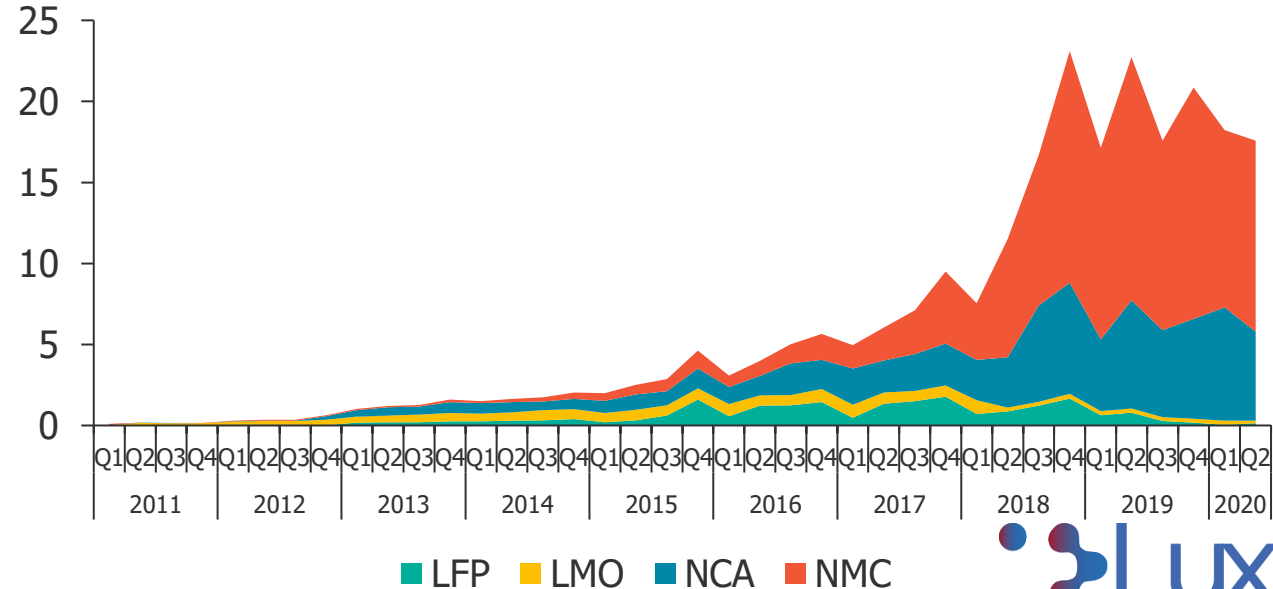
Despite the COVID-19 pandemic causing a sluggish start to 2020, electric vehicles emerged as the lone bright spot in an otherwise down automotive market.

- Combined BEV and PHEV sales increased 37% in 2020 compared to 2019, led by 140% growth in Europe as the BEV market took off in several countries.
- Tesla remains the most popular BEV maker, but its choice of cells from LG Energy Solutions in China means Panasonic lost the market share crown it had held since 2013.
- Ni-based cathode chemistries, including NCA (23.9%) and NMC (73.0%), dominate the BEV market today, but future cell-to-pack designs and supply chain concerns will likely see LFP increase market share in the future.

Quarterly vehicle sales (thousands of units)



Quarterly battery demand (GWh)



METHODOLOGY

Quantified, structured data with high confidence

Covers all auto markets	Covers the drivers of advanced battery sales	Granular, segmented sales data	Covers all key technologies	Supply chain analysis
<ul style="list-style-type: none">• U.S.• Japan• China• Germany• U.K.• France• Norway• <i>Includes 61 other individual markets</i>	<ul style="list-style-type: none">• Hybrid electric vehicles (HEVs)• Plug-in hybrids (PHEVs)• Electric vehicles (EVs)• Fuel cell vehicles (FCVs)	<ul style="list-style-type: none">• Vehicle make• Vehicle category• Vehicle year• Country sold in• Updated biannually• Data back to 2011• Compared to overall auto market (take rate)	<ul style="list-style-type: none">• Lithium-ion batteries• NiMH batteries• Solid-state batteries• Battery pack sizes• Cathode technologies (NCA, NMC, LMO, LFP, LCO, and others)	<ul style="list-style-type: none">• Cell suppliers• OEMs• Market share• Trends• Future outlook

Analysis based on several vehicle sales data sources, combined with accurate technical specifications for vehicles. The Automotive Battery Tracker helps you unearth valuable information about battery trends, key OEMs, or suppliers.

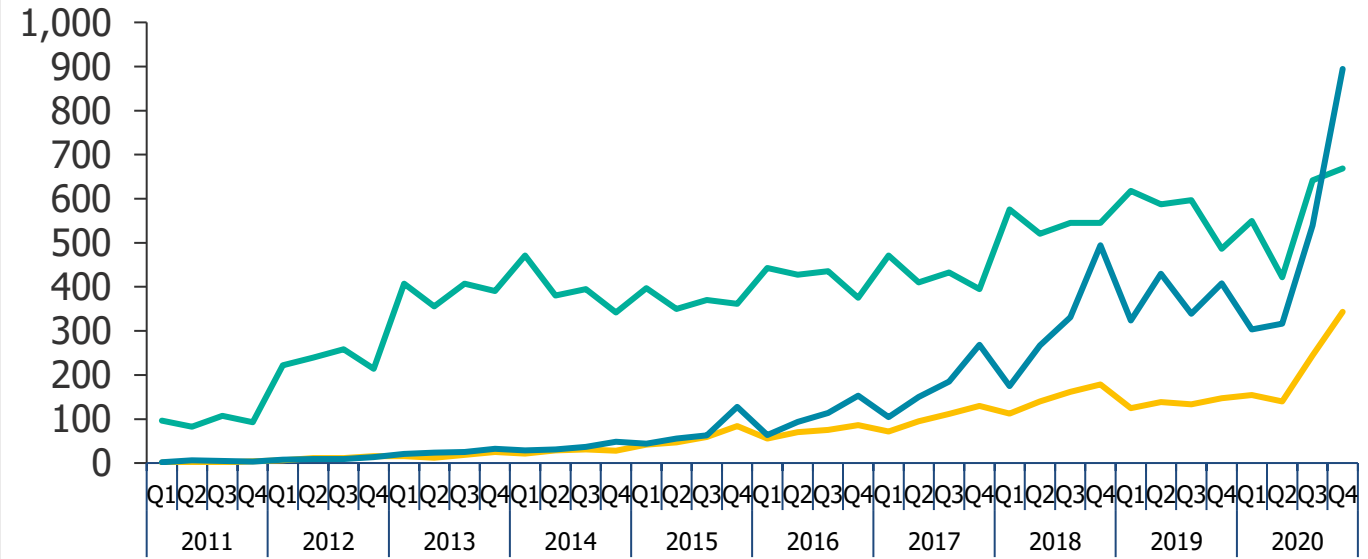
Global historical powertrain adoption

The COVID-19 pandemic caused significant disruptions to the automotive industry, and in the early stages of the pandemic, electrified powertrain demand fell. However, despite a 17.7% YoY decrease in BEV sales in H1, a 92% YoY increase in H2 resulted in overall BEV sales growing 37% in 2020 compared to 2019. Less electrified powertrains, such as HEV, saw a slight decline in 2020 sales compared to 2019.

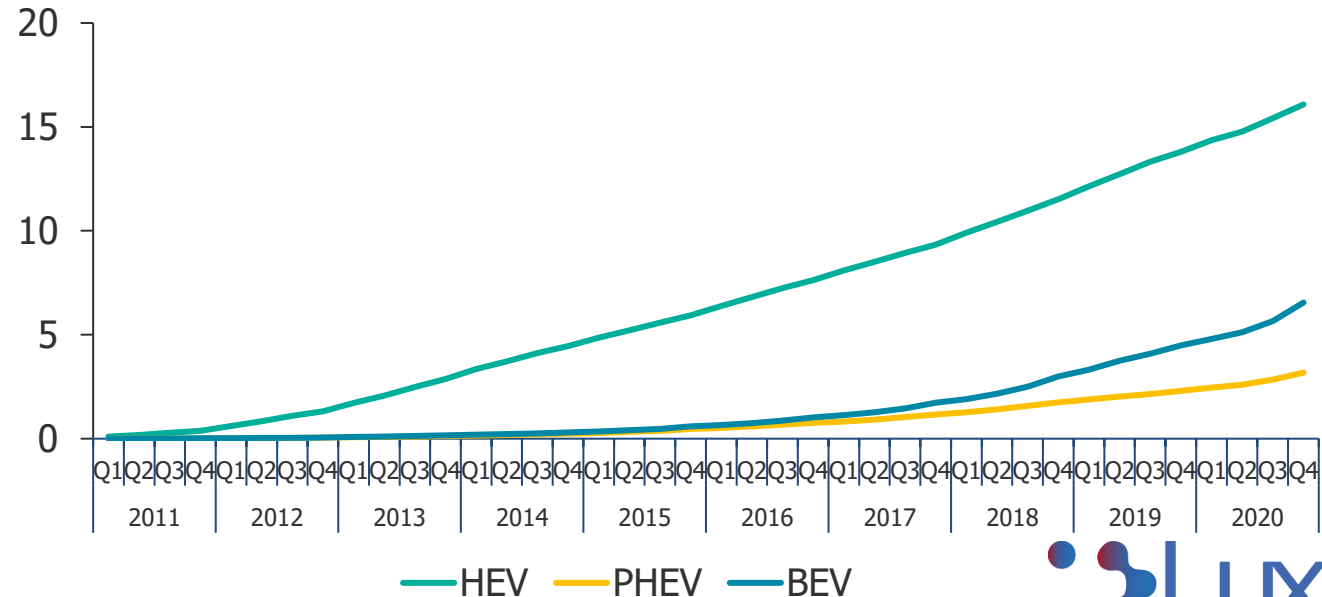
Each drivetrain has sold the following number of vehicles since 2011:

- **HEV:** 16.09 million
- **PHEV:** 3.18 million
- **BEV:** 6.55 million

Quarterly vehicle sales (thousands of units)



Cumulative vehicle sales (millions of units)

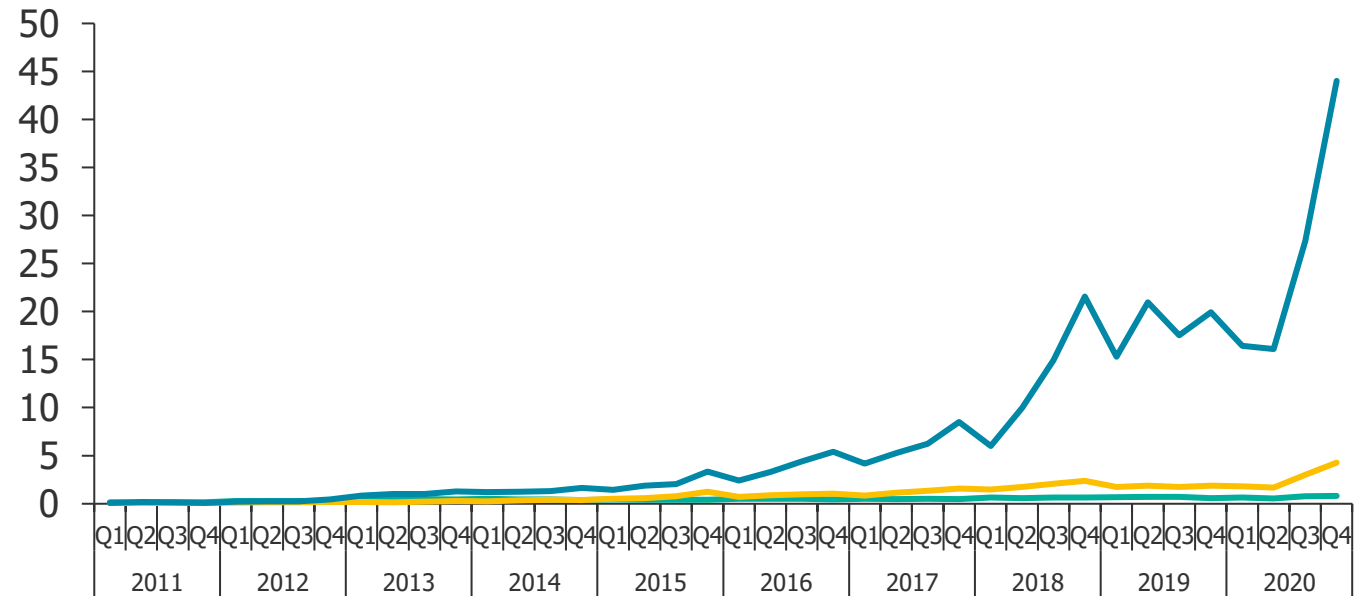


Global battery demand by powertrain

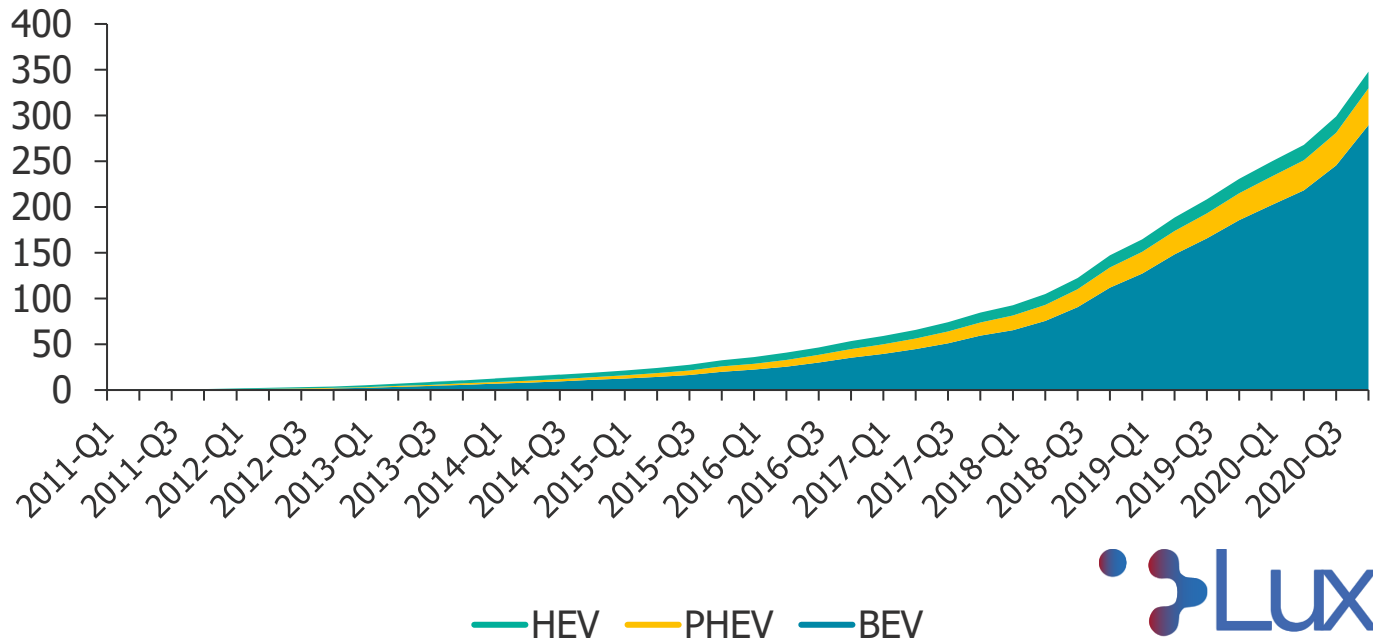
BEV powertrains continued to drive the vast majority of demand for advanced batteries, accounting for 103.9 GWh of 117.4 GWh used across all powertrains in 2020. The rate of growth in pack sizes is slowing for BEVs (see slide 29), meaning it can't offset a decrease in volumes. Although battery demand from plug-in vehicles declined by 10.1% in H1 2020 compared to H1 2019, overall demand increased by 40% in 2020 compared to 2019.

With smaller pack sizes and smaller growth rates, both HEV and PHEV powertrains are no longer influential on the broader battery market. New BEV projects will dictate added manufacturing capacity, with most capacity being added in Asia; however, a strong push to develop local battery ecosystems is underway in other regions, led by politicians aiming to prevent an overreliance on Asian countries.

Quarterly battery demand (GWh)



Cumulative battery demand (GWh)



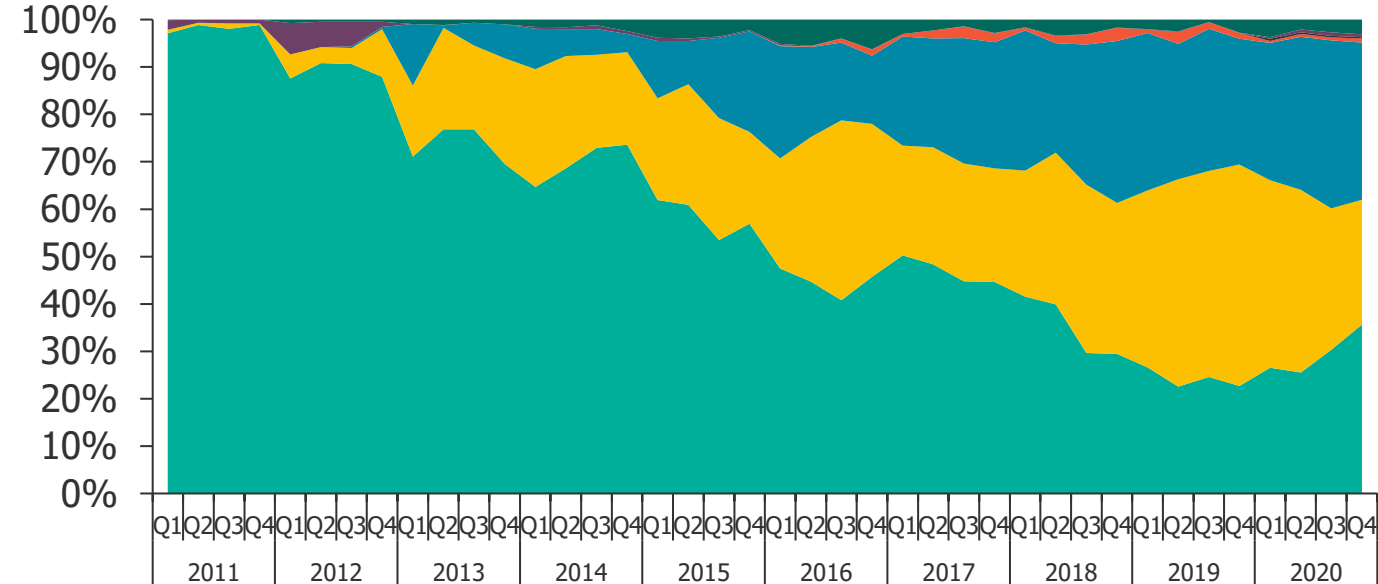
Plug-in vehicle sales by vehicle type

In the early 2010s, battery prices were near \$1,000/kWh, and many OEMs focused on small efficient vehicles like hatchbacks to maximize range from smaller battery packs. As leading OEMs are procuring or manufacturing cells closer to the \$100/kWh threshold, OEMs have increased options in more popular segments like SUVs and sedans.

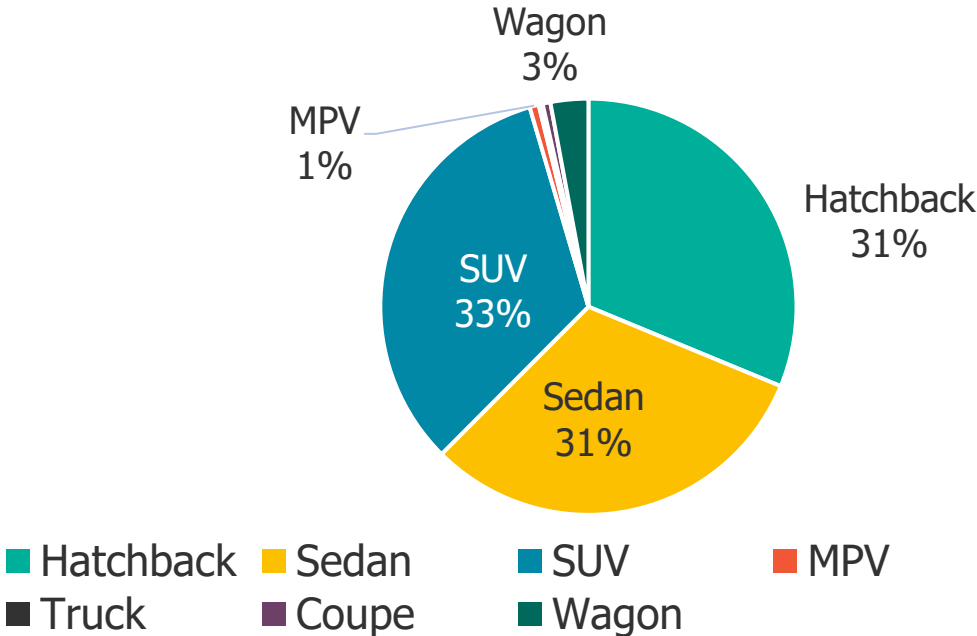
Tesla sold 373,451 Model 3 sedans in 2020, and the vehicle has singularly shifted the market share of sedans since its release in 2017 and driven up average pack sizes.

Looking ahead, clients should expect larger segments, including SUVs but also trucks, to increase market share as North American automakers plan electrified versions of the most popular vehicles like the F-150.

Plug-in vehicle market share by vehicle type



2020 global plug-in vehicle sales

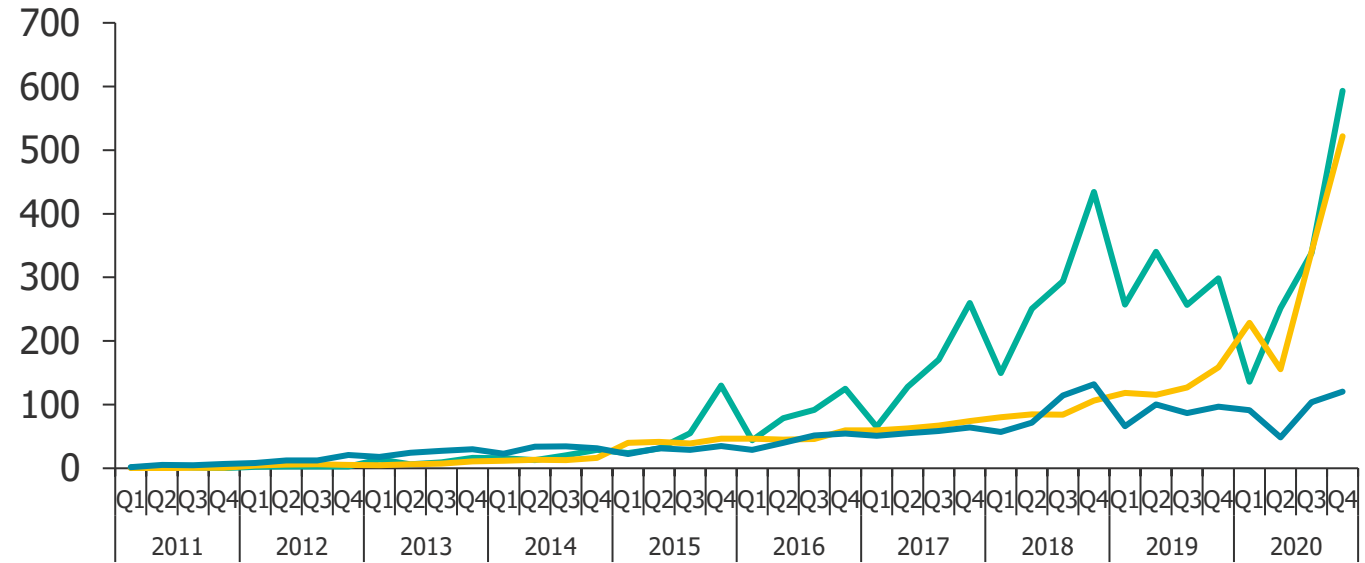


Regional plug-in vehicle sales

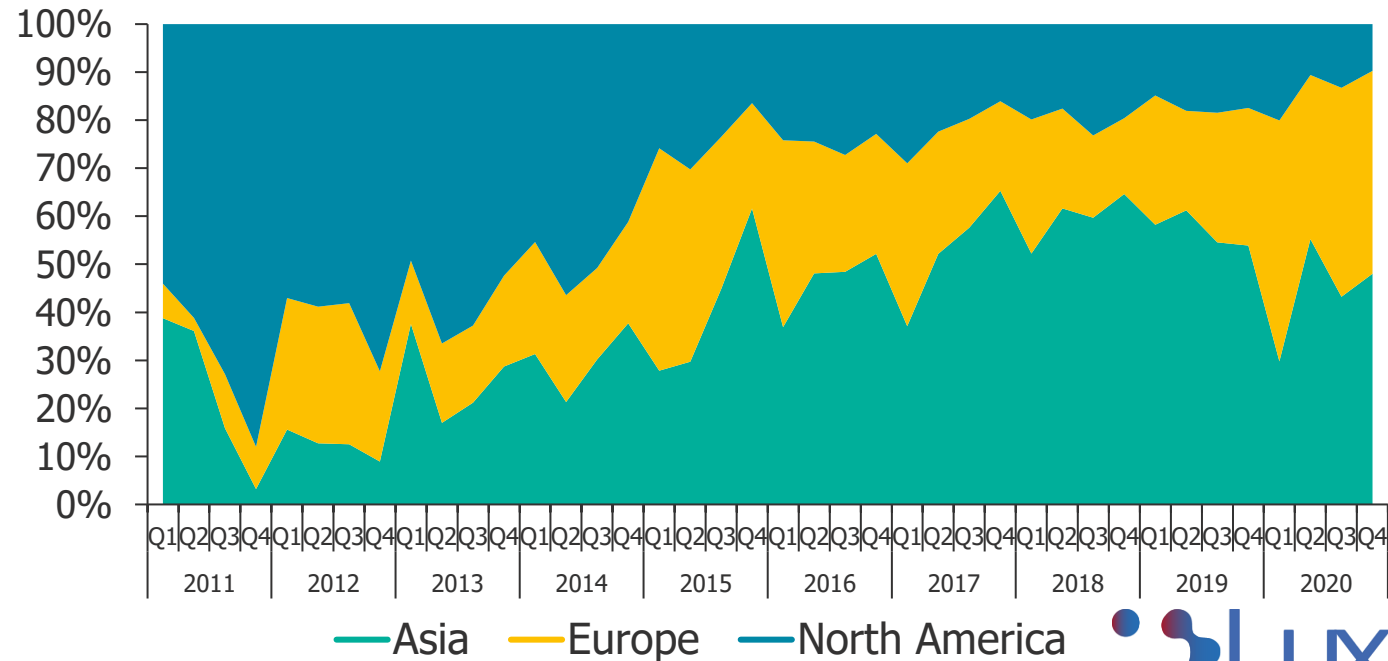
Sales data from the full year show COVID-19 had a strong impact in Asia in Q1 2020 and North America and Europe in Q2 2020. However, all regions rebounded in the second half of the year, with quarterly sales records set in both Europe and Asia in Q4 2020.

Looking ahead, many policymakers have extended support for electric vehicles as part of post-COVID recovery measures. China's two-year extension of subsidy payments will have the most impact on battery demand globally. Automakers pushing to meet the 95 g CO₂/km targets in Europe and a Biden administration that has publicly expressed support for electrification mean each area will see growth.

Quarterly plug-in vehicle sales (thousands of units)



Quarterly plug-in vehicle sales

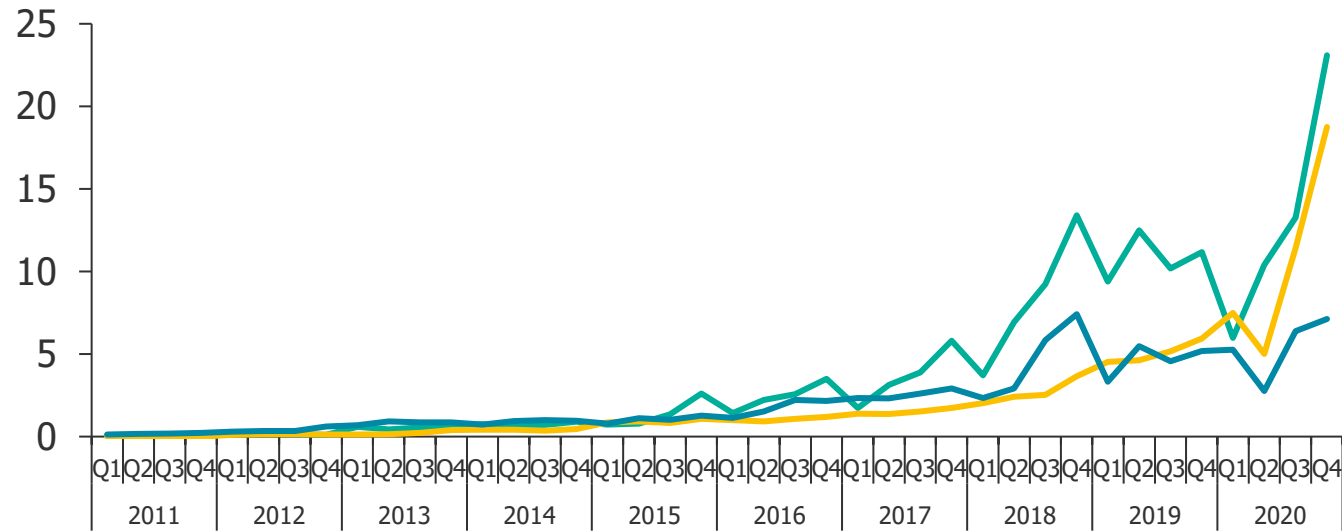


Global battery demand by region

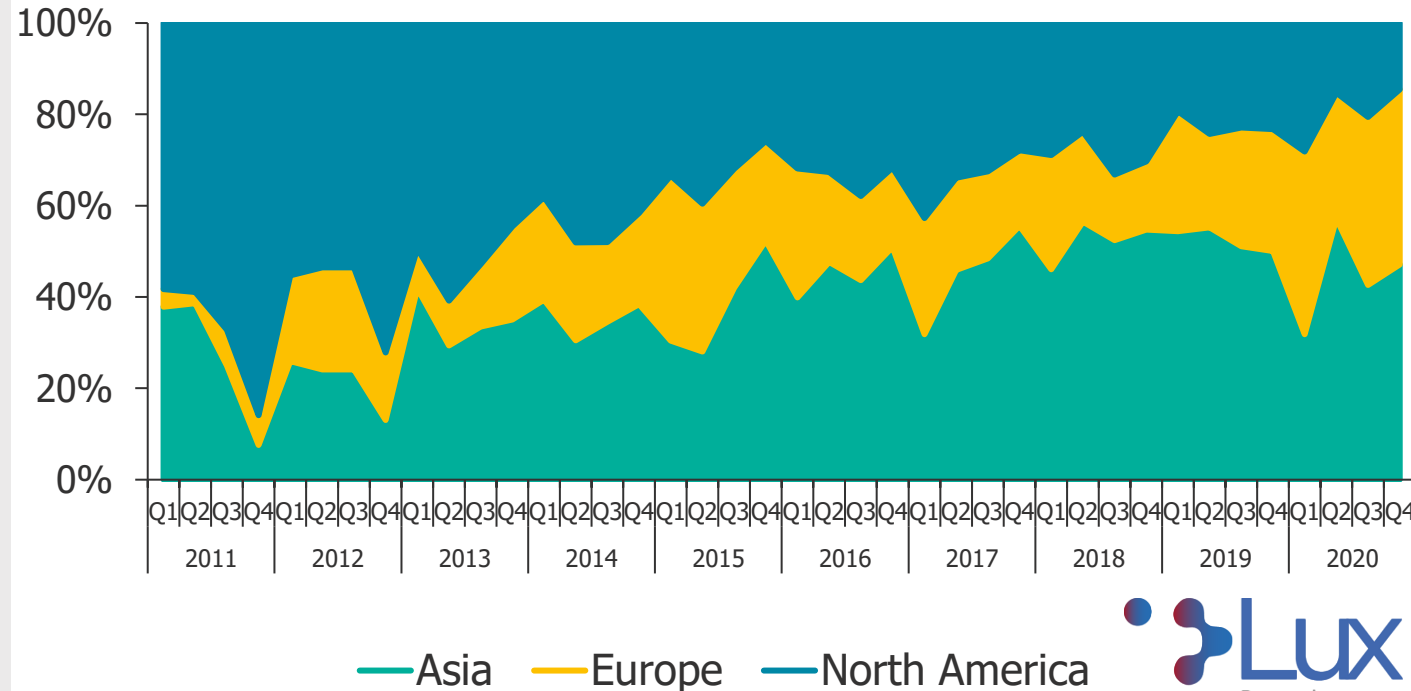
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Quarterly battery demand (GWh)



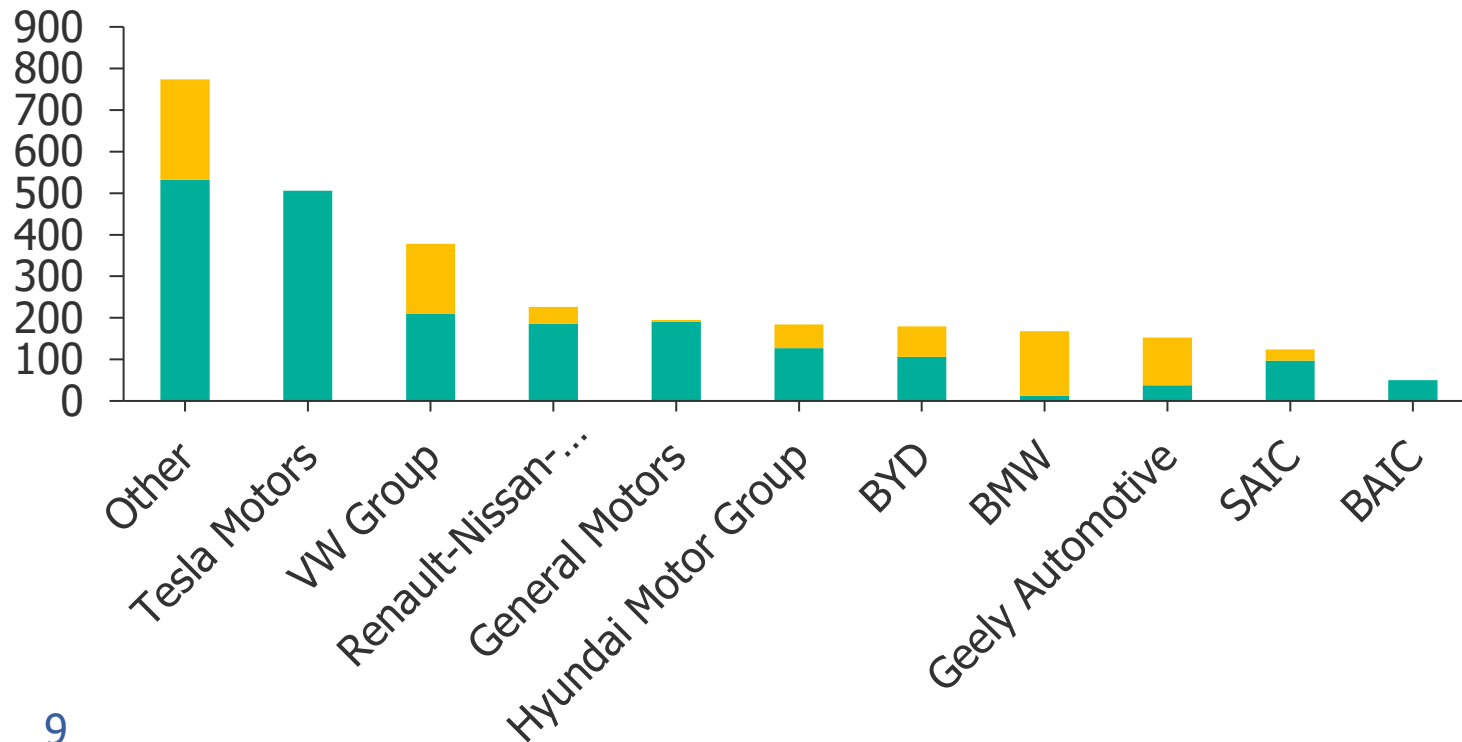
Quarterly battery demand (GWh)



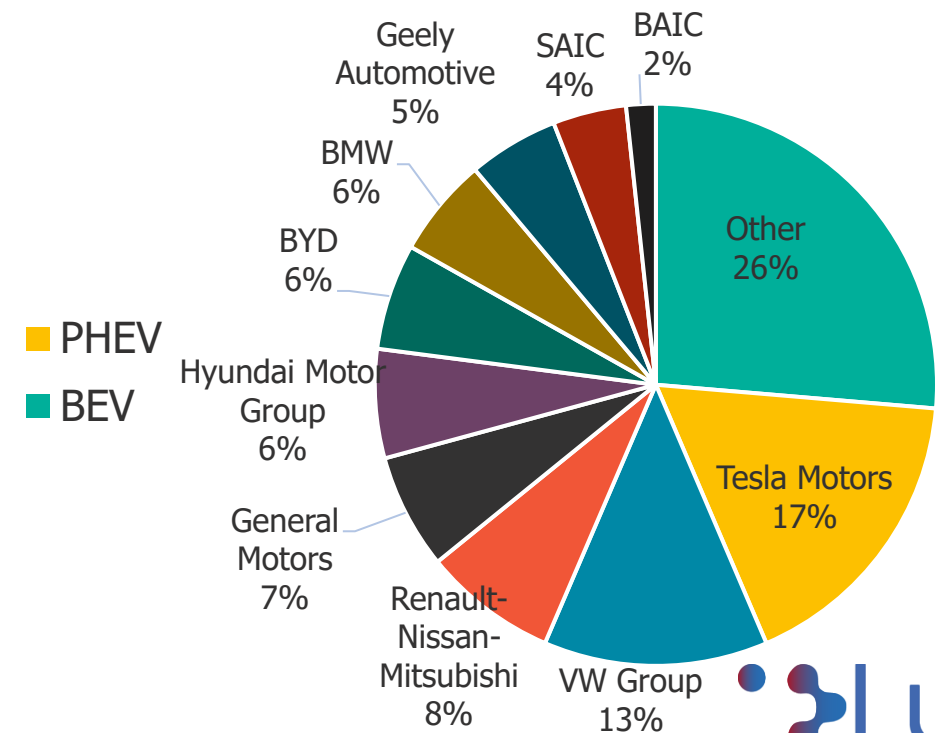
Tesla continues to lead all other manufacturers in plug-in vehicle sales, capturing 17% market share in 2020

Tesla has grown its market share, as it captured 17% of the plug-in vehicles sold globally in 2020 – a 2% increase from 2019. Tesla’s 17% market share in 2020 beat out VW Group (12.9%) and the Renault-Nissan-Mitsubishi Alliance (7.7%), and among all manufacturers, there were no major changes from 2019 to 2020.

2020 Plug-in vehicle sales (thousands of units)



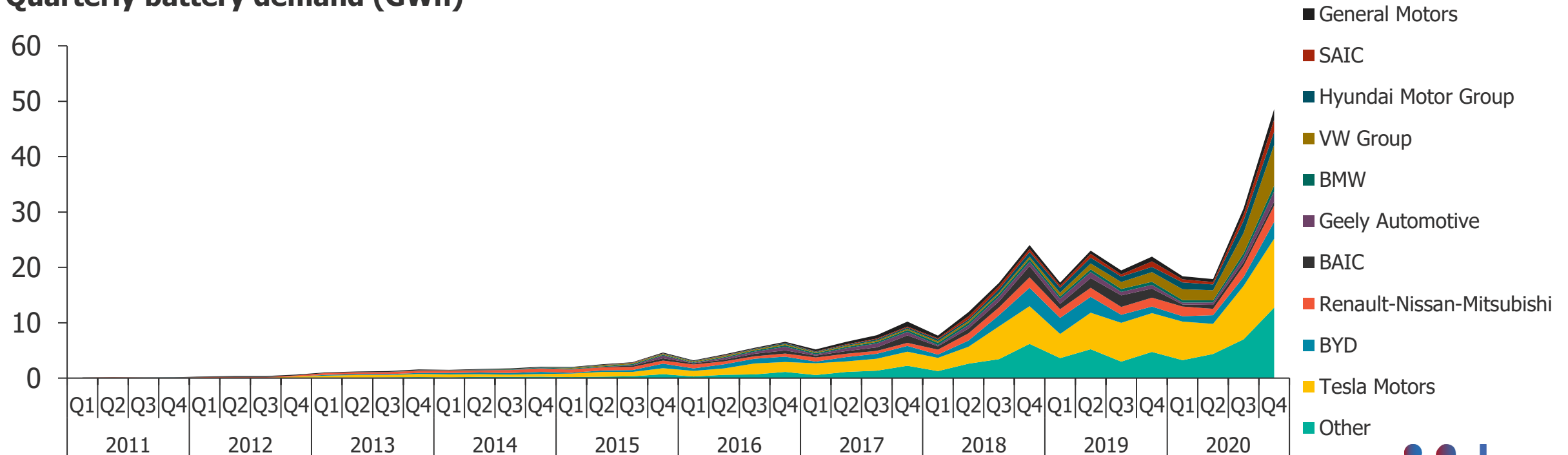
2020 Plug-in vehicle sales



Tesla's large average pack sizes and strong sales led to the company using 29.8% of all batteries used in 2020

In our 2017 battery tracker update, all manufacturers combined used 29.7 GWh of batteries; just three years later, Tesla alone used 34.5 GWh in 2020, and it has continued that momentum, capturing 29.8% of all batteries used in 2020. No other manufacturer consumed nearly as many batteries, with VW Group (12.9%) and Renault-Nissan-Mitsubishi (6.8%) coming in second and third, respectively.

Quarterly battery demand (GWh)

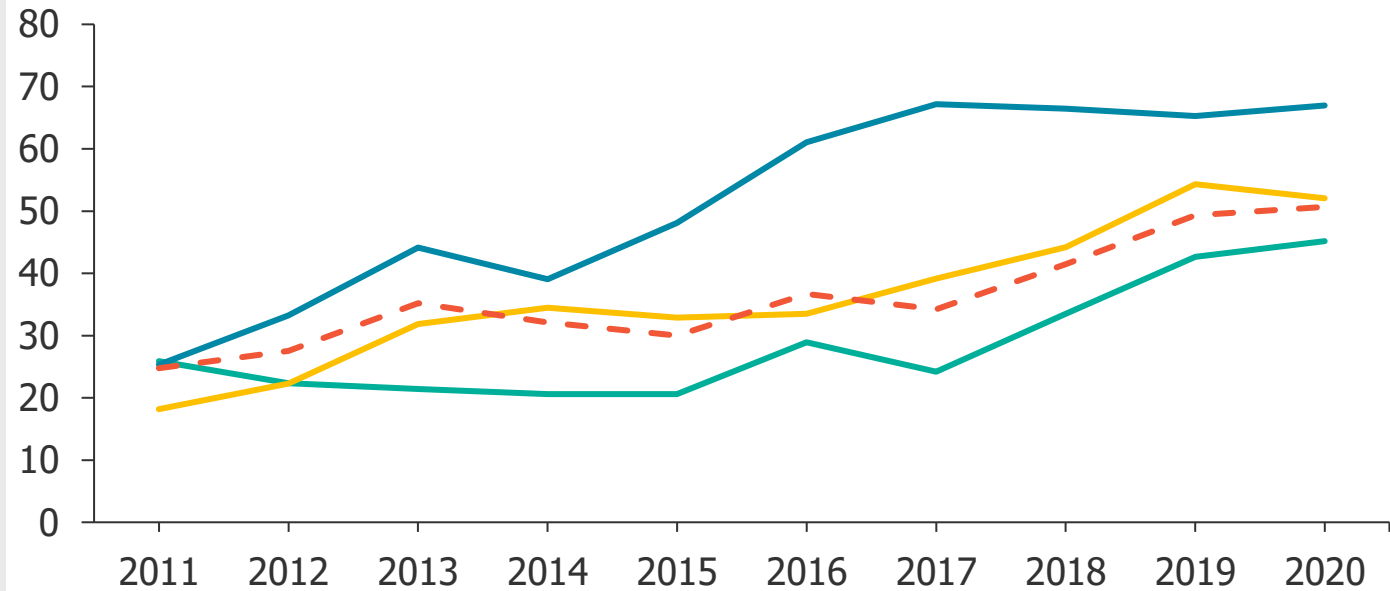


Average vehicle pack size

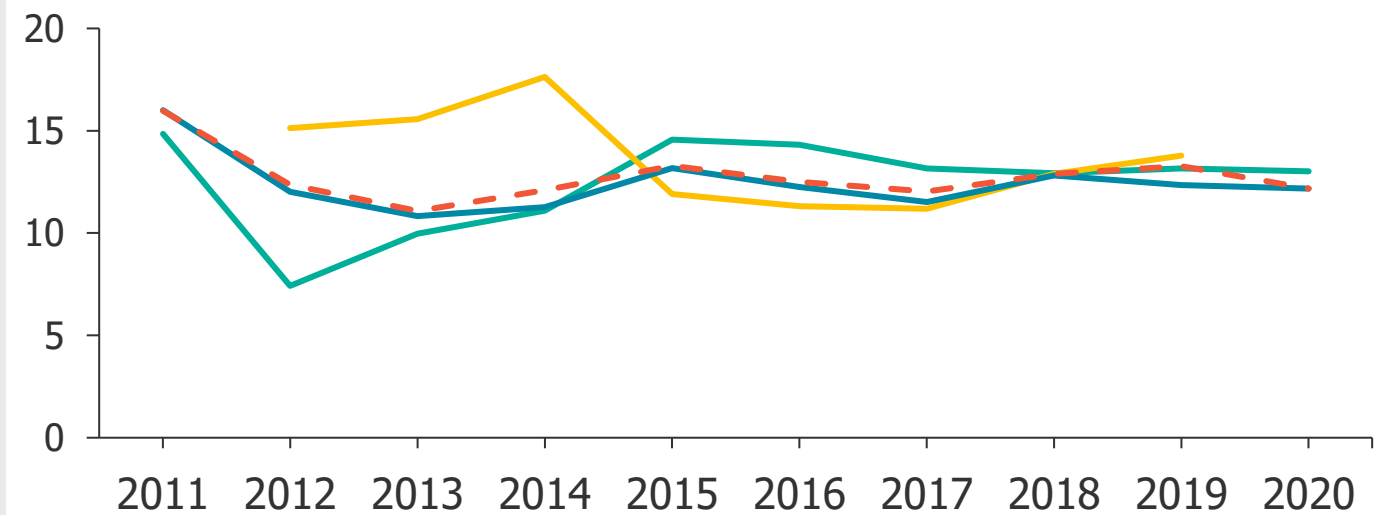
Average pack sizes continue to trend upward globally. China continues to have smaller average pack sizes compared to its global peers, although revisions in range requirements for subsidies and the credit mandate have steadily driven its average BEV pack size upward.

Looking ahead, we expect North America's average pack size to remain consistent, with Europe and Asia continuing to increase closer in line with North America. Within PHEVs, most regions have steadily averaged between 12 kWh and 14 kWh.

Average BEV pack size (kWh)



Average PHEV pack size (kWh)

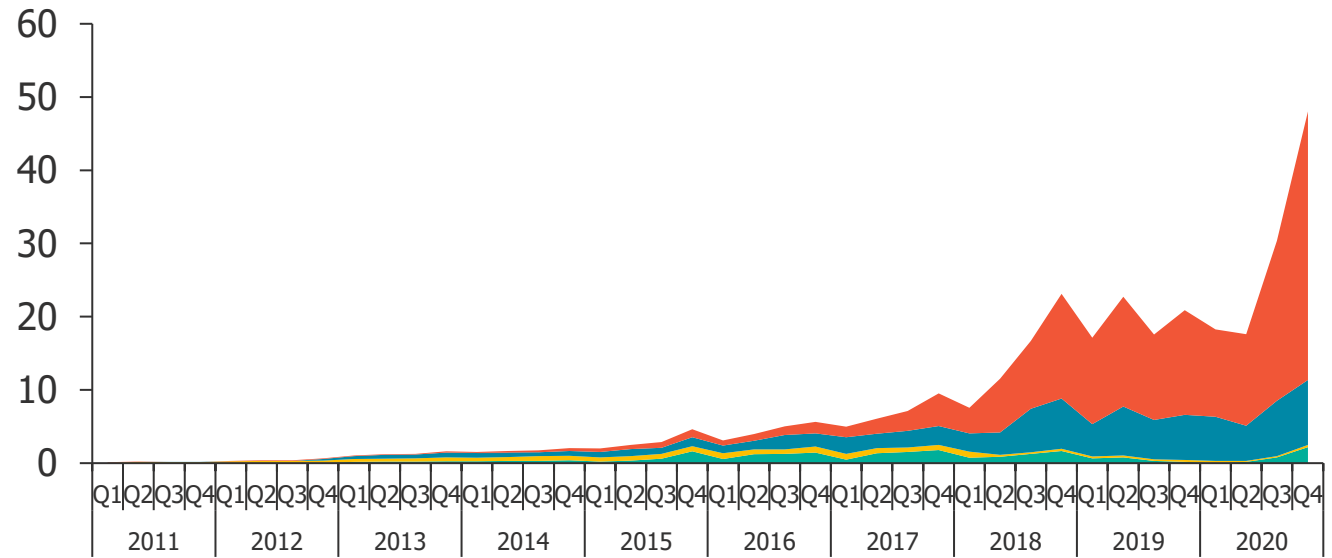


Li-ion batteries and NMC cathodes remain dominant

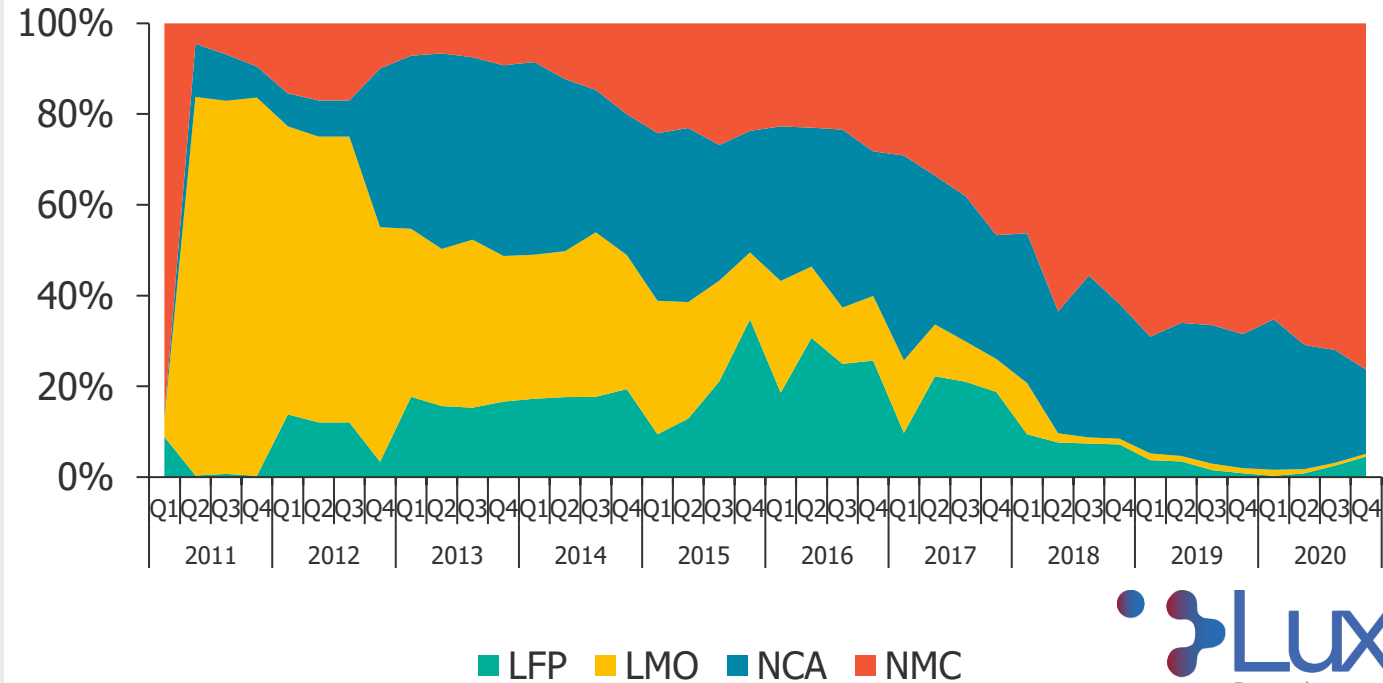
Li-ion batteries are clearly the technology of choice in electrified vehicles, as all BEVs and PHEVs use Li-ion cells, with their market share in HEVs continuing to increase.

Cathode chemistries also continue to converge around two chemistries: NCA and NMC. NCA-type cathodes captured 23.9% market share, and NMC-type cathodes captured 73% market share, in 2020. Within NMC, most cathodes are 622 or 532 formulations, with 811 likely to see the most growth moving forward. As cell-to-pack technology is commercialized and supply chain concerns over nickel arise, LFP will gain market share in future years.

Quarterly battery demand (GWh)



Cathode market share

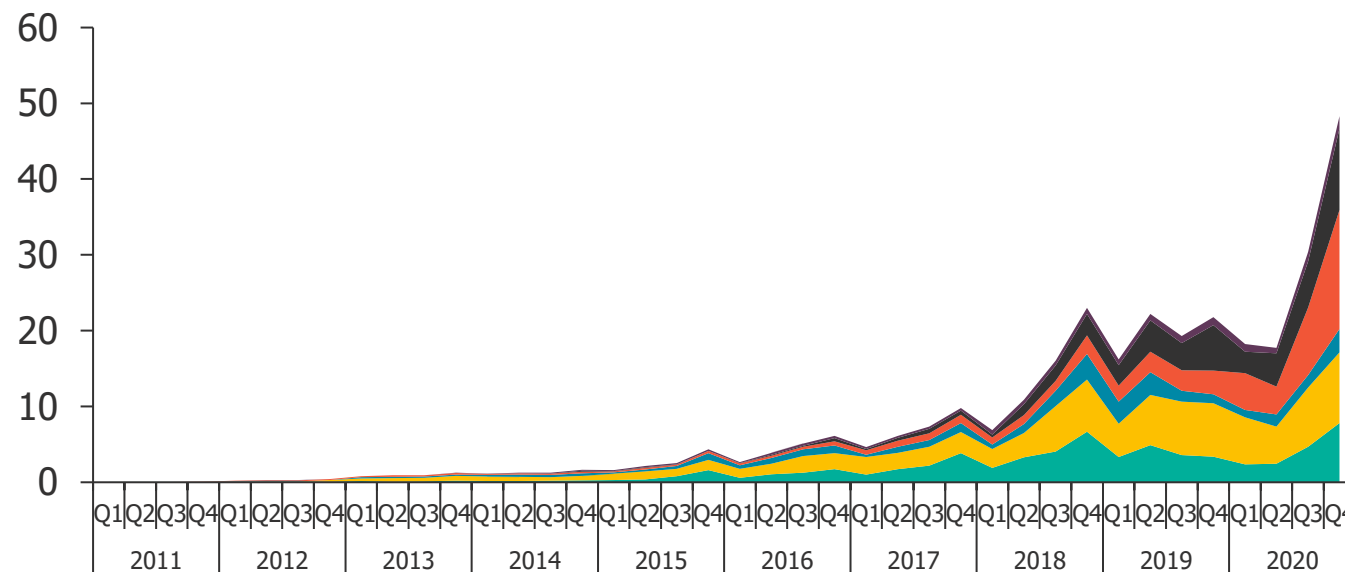


LG Energy Solutions finally surpasses Panasonic's market share

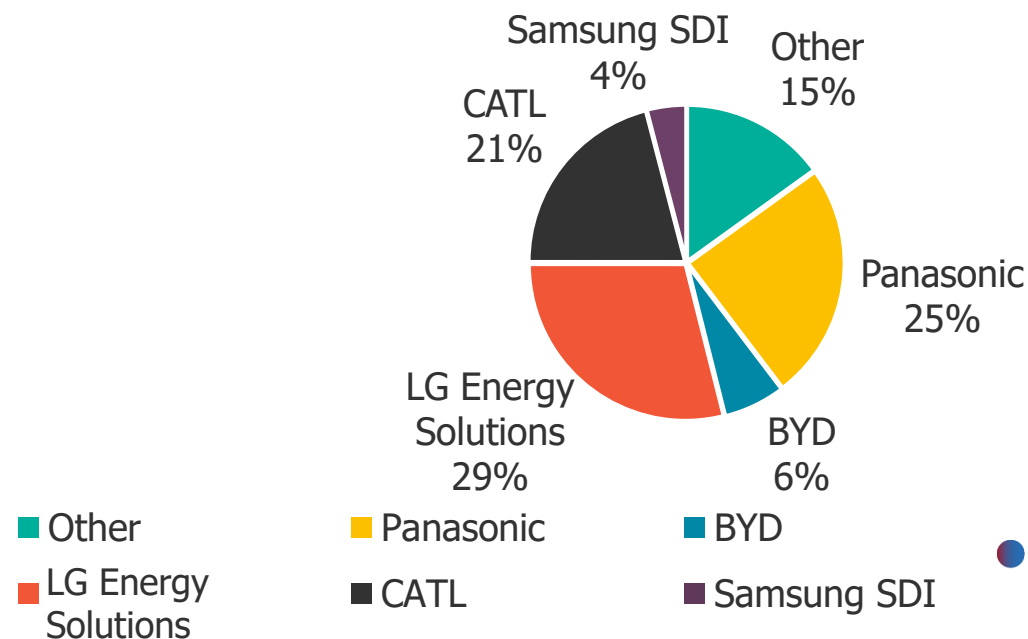
Tesla's use of Panasonic cells has seen the battery manufacturer retain the BEV crown for quite some time, but that's [finally changed](#), as LG Energy Solutions (formerly LG Chem) distributed 33.2 GWh of batteries (29%) in 2020 compared to Panasonic's 28.2 GWh (25%). CATL wasn't far behind with 24 GWh (21%), and all three suppliers have a reasonable shot at the passenger vehicle throne in 2021.

The shift is primarily due to Tesla's use of LG Energy Solutions and CATL cells in the Chinese-made Teslas, but LG's other incumbent automaker clients also fueled growing demand. As LFP once again gains popularity, suppliers like CATL and BYD with established LFP supply chains are most likely to benefit.

Quarterly battery demand (GWh)



2020 battery sales by supplier

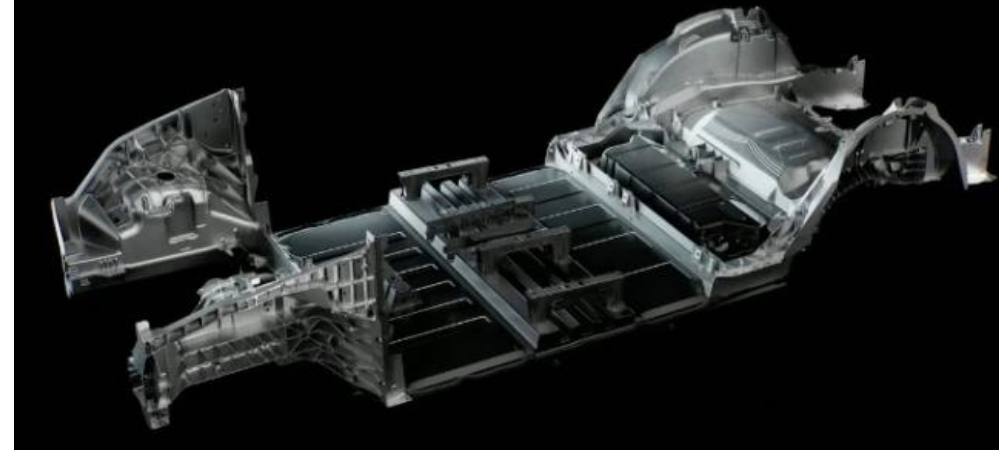


Outlook

In our last battery tracker update, we noted that COVID-19 shouldn't cause pessimism for the future outlook of electric vehicles, as automakers had already invested large sums to build BEV platforms and governments were still pushing for decarbonization. The dramatic close to 2020 proved this point to be true, although admittedly, Lux missed the mark in timing, as the market came back much faster than expected – and in the process set new quarterly sales and market share records.

We've reached a pivotal point in battery electric vehicles, as the "hockey stick" demand inflection point looks to have occurred in 2020. Automakers will be releasing models built on dedicated platforms built from the ground up for electrification, including, most notably, Hyundai's E-GMP platform, GM's BEV3 platform, and VW's MEB platform. Clients should closely watch BEV sales volumes, as rapid growth will strain battery supply chains in coming years and push automakers to diversify battery chemistries and suppliers.

Future short-range Tesla passenger vehicles will use LFP-based cells, with the company citing supply chain concerns over nickel behind the choice. Next-generation vehicles will also take advantage of the more durable cathode material as automakers looks to make batteries a structural member of the vehicle, further driving down costs.





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