State of Charge:

EVs, Batteries and Battery Materials

Adamas Intelligence

7th Biannual, 2022 H1

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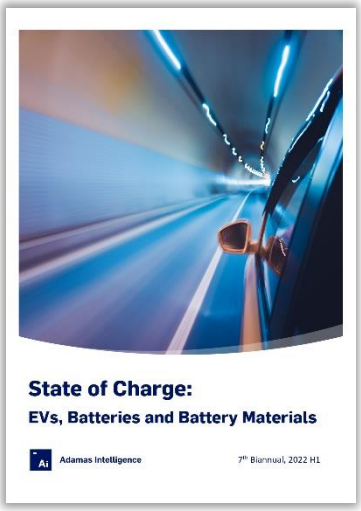

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CONTENTS

State of Charge in 2022 H1

In this biannual 'State of Charge' report, we provide an informative overview of the global EV market's performance over the past half-year (in this case "2022 H1") and its implications on the ever-evolving battery and battery materials supply chains.

This overview draws on research and data available to clients through our subscription-based monthly reports and web-based trackers.

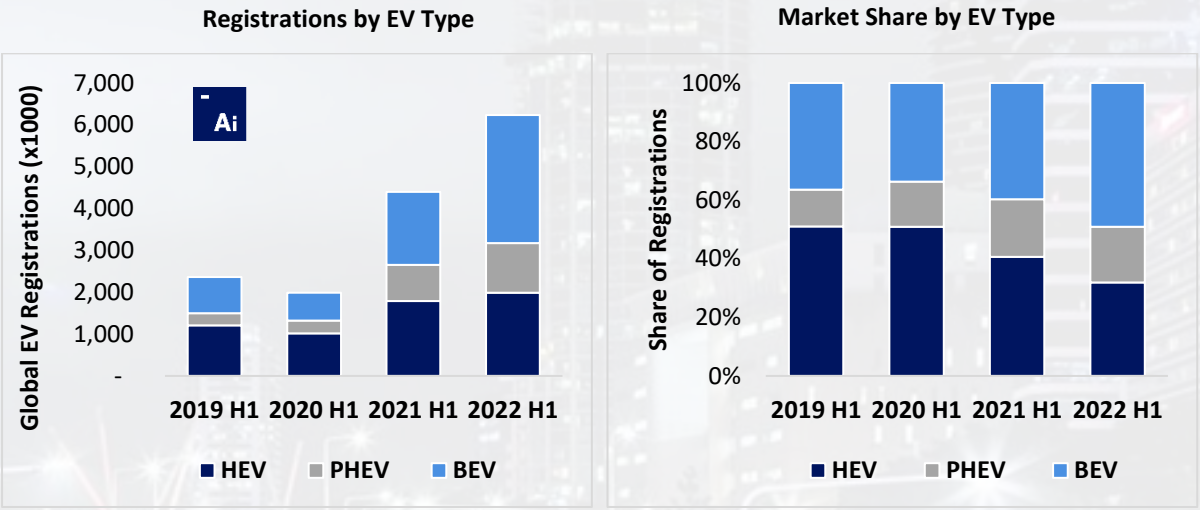
Among the findings of the latest report:

- In 2022 H1 global passenger EV registrations jumped 42% over the same period the year prior, amounting to 6.23 million units, up from 4.40 million units in 2021 H1. This increase was driven by surging sales growth in Asia Pacific (up 75% year-over-year) coupled with modest growth in the Americas (up 19% year-over-year) and Europe (up 10% year-over-year).
- In the Asia Pacific region specifically, a 75% increase in EV sales year-over-year in 2022 H1 translated to a massive 118% increase in watt-hours of battery capacity deployed onto roads over the same period the year prior, and a corresponding 113% increase in lithium, 69% increase in nickel and 74% increase in cobalt consumption over the same period.
- In 2022 H1, total global battery capacity deployed onto roads in all regions combined amounted to a hefty 195.5 GWh, 79% more than was deployed globally in 2021 H1.
- In 2022 H1, Tesla continued to 'lead the pack' by battery capacity deployed onto roads globally, installing nearly as many watt-hours into newly sold EVs as its four closest competitors combined.
- Just seven cell suppliers globally (CATL, LG Energy Solution, Panasonic, BYD, SK On, Samsung SDI and CALB) were collectively responsible for more than 82% of all battery capacity and battery metals deployed onto roads globally in passenger EVs in 2022 H1.
- In 2022 H1, global leader CATL deployed 123% more watt-hours of battery capacity onto roads worldwide than the same period the year prior, translating to a 116% increase in lithium, 98% increase in nickel, and 77% increase in cobalt deployed onto roads over the same period.
- In 2022 H1, deployment of LFP cells (in watt-hours) increased 237% over 2021 H1, supressing nickel and cobalt use per vehicle sold, on average.
- In 2022 H1, 117,200 tonnes of lithium carbonate equivalent ("LCE") were deployed onto roads globally in the batteries of all newly sold passenger EVs combined, 76% more than were deployed globally in 2021 H1. In 2022 H1, 59% of all LCE units were deployed as carbonate, 41% as hydroxide.
- Similarly, in 2022 H1, 88,200 tonnes of nickel were deployed onto roads globally in the batteries of all newly sold passenger EVs combined, 50% more than were deployed globally in 2021 H1.
- Lastly, in 2022 H1, 18,500 tonnes of cobalt were deployed onto roads globally in the batteries of all newly sold passenger EVs combined, 44% more than were deployed globally in 2021 H1.

Passenger EV Registrations

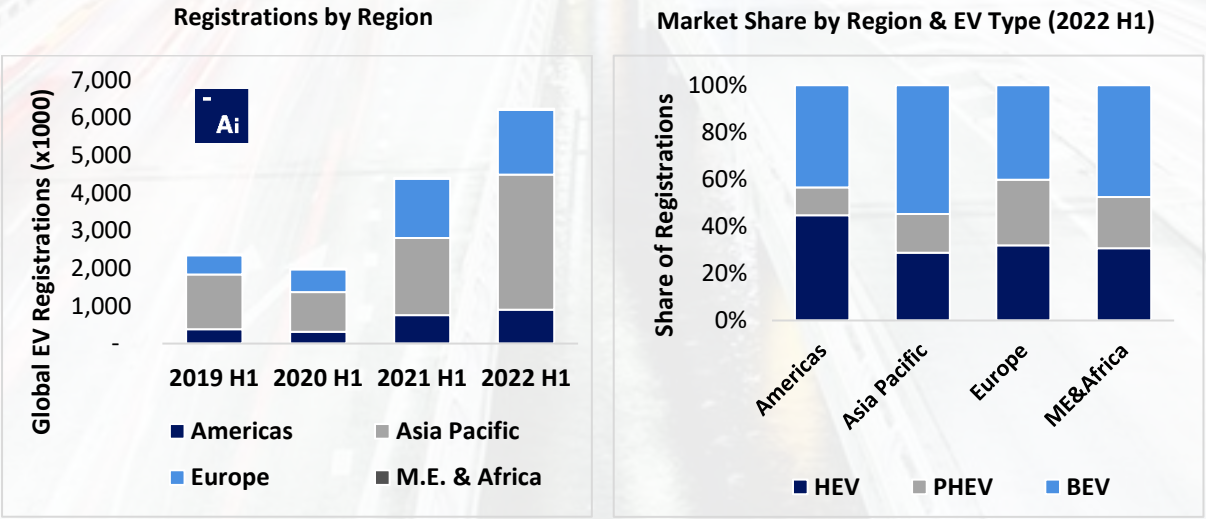
In 2022 H1 global passenger EV registrations jumped 42% over the same period the year prior, amounting to 6.23 million units versus 4.40 million units in 2021 H1. This increase was driven by a boom in Asia Pacific (up 75% year-over-year), despite ongoing lockdowns, coupled with a modest rise in the Americas (up 19% year-over-year) and Europe (up 10% year-over-year).

Overall, BEVs made up 49% of total global passenger EV registrations in 2022 H1, up from 40% in 2021 H1 and 34% in 2020 H1. PHEVs made up 19% of total global passenger EV registrations in 2022 H1, down from 20% the year prior, while HEVs made up 32% in 2022 H1, down from 41% the year prior.



Source: Marklines, EV-Volumes, CAAM, Gasgoo, ACEA, Adamas Intelligence research

In 2022 H1 Asia Pacific posted year-over-year EV sales growth of 75% owing to roaring BEV and PHEV sales in the region. Although Japanese HEVs still drive over 25% of the region's sales volume, sales of Chinese BEVs and PHEVs from the likes of BYD, Cherry, GAC and SGMW continue to drive the majority. Tesla is the only foreign automaker with major EV production volume in the region. In 2022 H1, the Americas and Europe posted modest year-over-year EV sales growth of 19% and 10%, respectively.



Source: Marklines, EV-Volumes, CAAM, Gasgoo, ACEA, Adamas Intelligence research

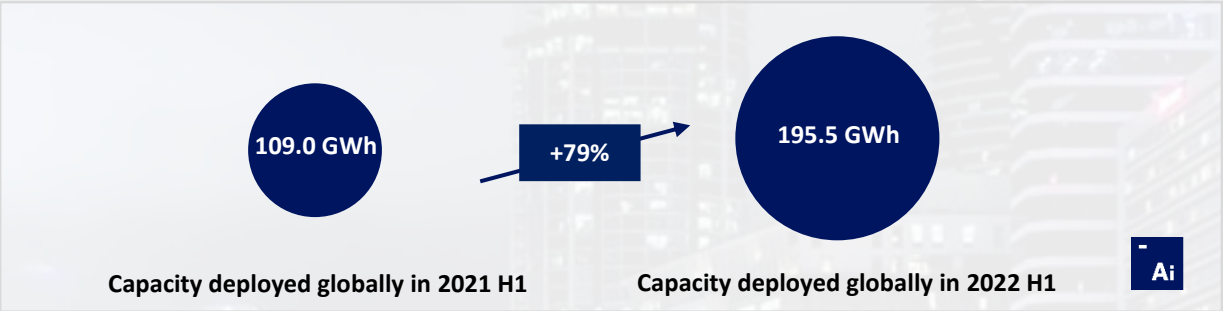
Battery Capacity Deployed

OVERVIEW

In 2022 H1, global battery capacity deployed in all newly sold passenger EVs combined amounted to 195.5 GWh, a massive increase of 79% over the same period the year prior. This rise is attributed to a surge in EV (and in particular BEV and PHEV) sales growth over the same period.

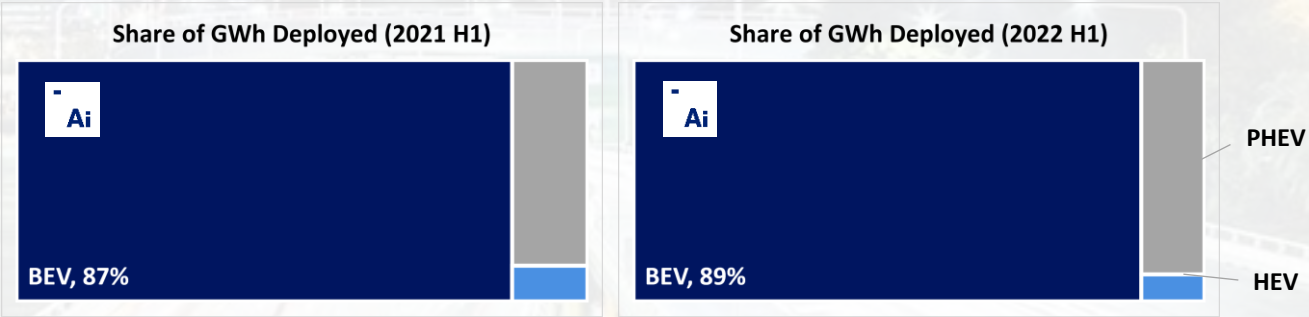
Tesla deployed nearly as much battery capacity onto roads than its four closest competitors combined.

By cell supplier, CATL continued to lead globally in 2022 H1 by battery capacity (GWh) deployed stemming from strong global sales of LFP-powered Tesla Model 3s and Ys, along with a growing list of over 150 of other EVs globally that CATL supplies cells to.



BY EV TYPE

BEVs were responsible for 89% of all battery capacity deployed globally in 2022 H1 (up from 87% in 2021 H1), PHEVs were responsible for 10% (down from 11% in 2021 H1) and HEVs were responsible for 1% (down from 2% in 2021 H1).

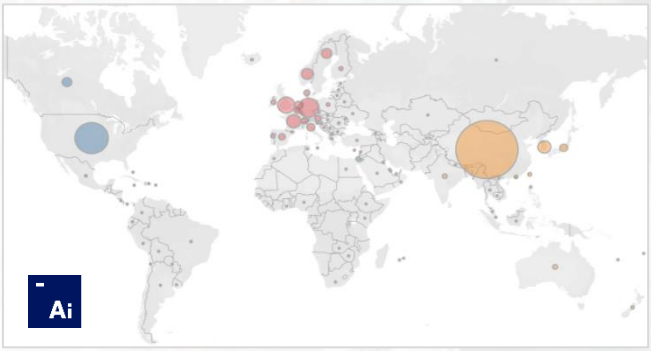


BY REGION

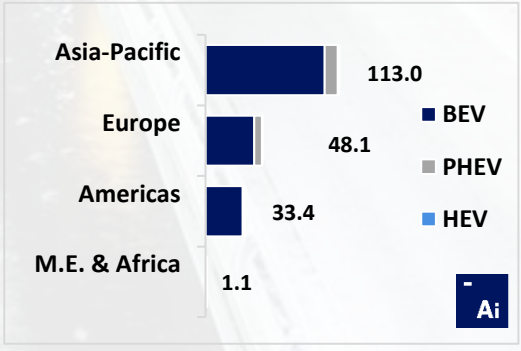
Asia Pacific continues to dominate the global market as its share of global battery capacity (GWh) deployed onto roads rose to 58% in 2022 H1 from 48% in 2021 H1.

Over the same period, Europe's share of global battery capacity deployed fell from 33% in 2021 H1 to 25% in 2022 H1 and that of the Americas fell from 18% to 17%.

GWh Deployed by Country (2022 H1)



GWh Deployed by Region & EV Type (2022 H1)



BY EV MAKE

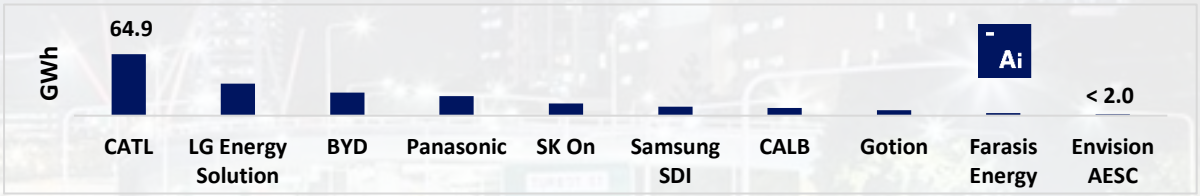
Tesla deployed 41.7 GWh of battery capacity onto roads globally in 2022 H1, nearly as much as its four closest competitors combined (BYD, GAC, Hyundai and Kia).

Despite Tesla's hefty lead, BYD continues to close the gap with a massive 243% increase in battery capacity deployment in 2022 H1 versus the same period the year prior on the back of a 320% increase in EV sales growth in China.

BY CELL SUPPLIER

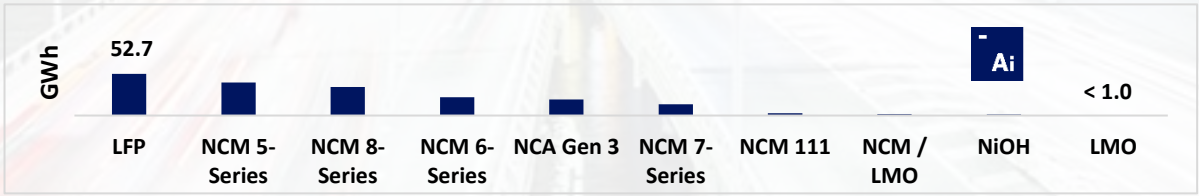
As a key supplier to Tesla in China, as well as a host of other automakers around the globe, cell supplier CATL led by cell capacity (GWh) deployed globally in 2022 H1 with a 33% market share, up from 27% during the same period the year prior.

LG Energy Solution held onto second place in 2022 H1, deploying 33.8 GWh globally through the first half of this year versus 27.9 GWh during the first half of 2021. BYD rounded off the top 3 with 24.4 GWh deployed in 2022 H1, up more than three-times from 7.1 GWh in 2021 H1.



BY CHEMISTRY

Deployment of LFP cells amounted to 52.7 GWh (27% of total) in 2022 H1, followed by NCM 5-Series and NCM 8-Series with 41.6 GWh (21%) and 36.2 GWh (19%), respectively. NCM 6-Series cells claimed fourth place (12%) and NCA Gen 3 rounded off the top five (10% of total).



AVERAGE

In 2022 H1, the global sales-weighted average battery pack capacity of all newly sold passenger EVs combined increased by 27% year-over-year, from 24.8 kWh to 31.4 kWh, as BEV and PHEV sales growth outpaced that of HEVs.

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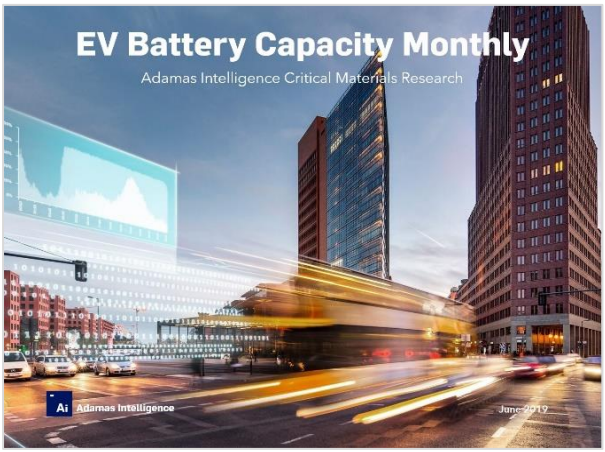

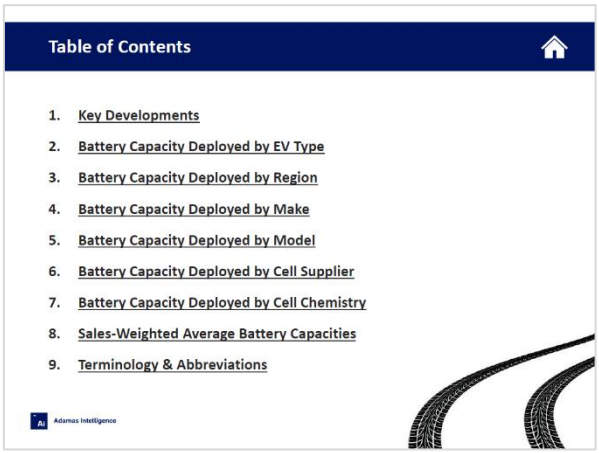

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EV Battery Capacity Monthly

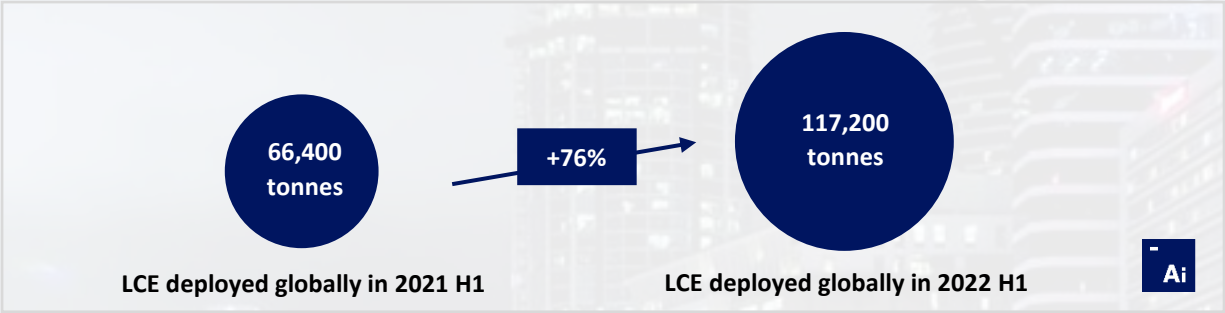
Lithium Deployed

OVERVIEW

In 2022 H1, 117,200 tonnes of lithium carbonate equivalent ("LCE") were deployed onto roads globally in the batteries of all newly sold passenger EVs combined, an increase of 76% year-over-year.

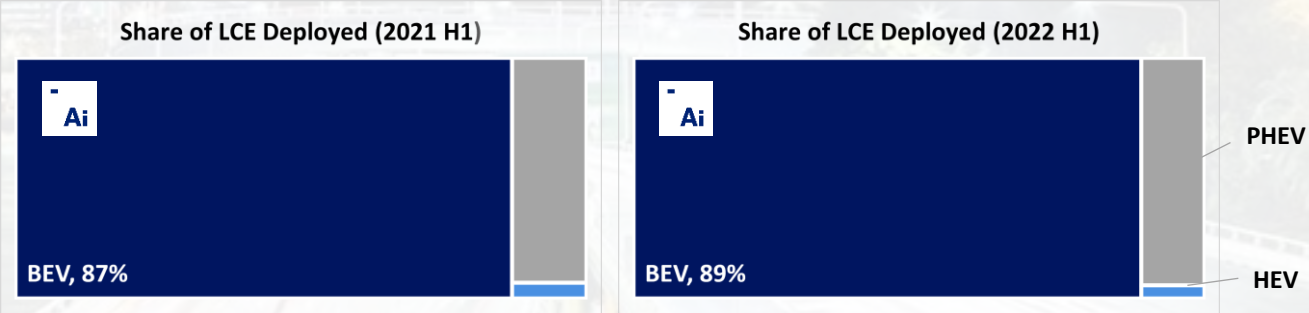
This increase comes on the back of a 42% rise in global EV sales, and a 27% increase in the global sales-weighted average pack capacity, coupled with pervasive use of LFP and medium- and high-nickel cell chemistries, like NCM 5-, 6- and 8-Series.

Tesla was responsible for 19% of global LCE deployment in 2022 H1 (down from 22% in 2021 H1) with the Tesla Model Y alone responsible for 11% of global LCE deployment.



BY EV TYPE

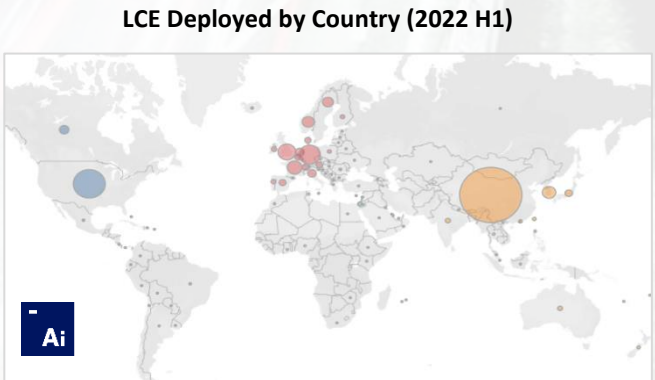
BEVs were responsible for 89% of all LCE deployed globally in 2022 H1 versus 87% in 2021 H1, whereas PHEVs and HEVs were responsible for a combined 11% in 2022 H1 versus a higher 13% during the same period the year prior.

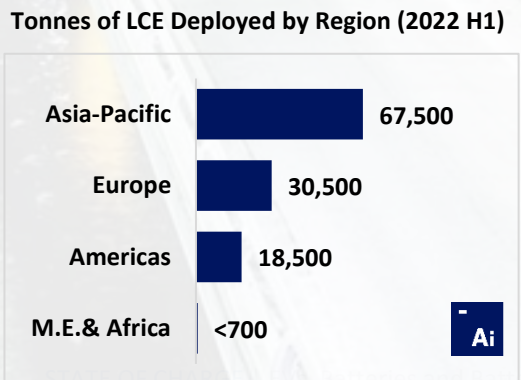


BY REGION

As the largest EV market globally and the largest producer and consumer of EV battery cells, the Asia Pacific region was responsible for 58% of all LCE deployed onto roads globally in 2022 H1, up from 48% in 2021 H1.

Europe's share of global LCE deployment amounted to 26% in 2022 H1, down from 35% in 2021 H1, while that of the Americas fell from 17% in 2021 H1 to 16% in 2022 H1.

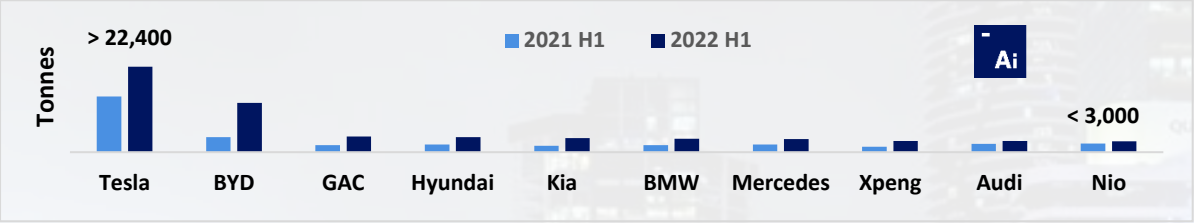




BY EV MAKE

In 2022 H1 Tesla deployed over 22,400 tonnes of LCE onto roads globally, 53% more than it deployed in 2021 H1, remaining the largest lithium consumer among its peers by a long shot.

BYD deployed approximately 13,000 tonnes of LCE onto roads globally in 2022 H1, an increase of 231% over 2021 H1, while GAC deployed almost 4,200 tonnes, an increase of 122% over 2021 H1.

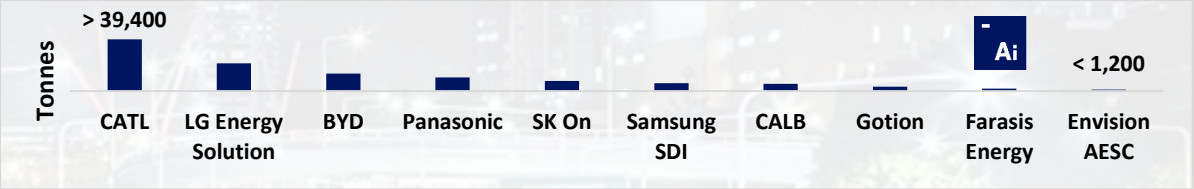


BY CELL SUPPLIER

CATL's LCE deployment jumped 116% in 2022 H1 versus 2021 H1, leading its share of global LCE consumption to rise to 34% from 28% the same period the year prior.

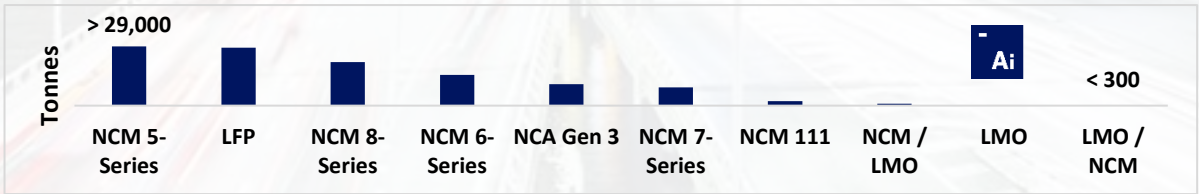
Similarly, in 2022 H1, LG Energy Solution's LCE deployment increased by 20% over the same period the year prior while that of BYD increased by 234%.

Notably, the top seven cell suppliers worldwide were collectively responsible for 88% of all LCE deployed onto roads globally in passenger EV batteries in 2022 H1.



BY CHEMISTRY

LCE deployment in NCM 5-Series cells amounted to over 29,000 tonnes in 2022 H1 (up by 70% from 2021 H1), followed by LFP (up 237%), and NCM 8-Series (up 163%). LCE deployment in NCM 6-Series cells and NCA Gen 3 cells in 2022 H1 rose by just 23% and 22%, respectively.



AVERAGE

With a surge in BEV and PHEV sales globally in 2022 H1, coupled with a jump in sales-weighted average battery pack capacity, the average amount of LCE deployed onto roads globally per EV sold in 2022 H1 was 18.8 kilograms, 24% higher than the same period the year prior.

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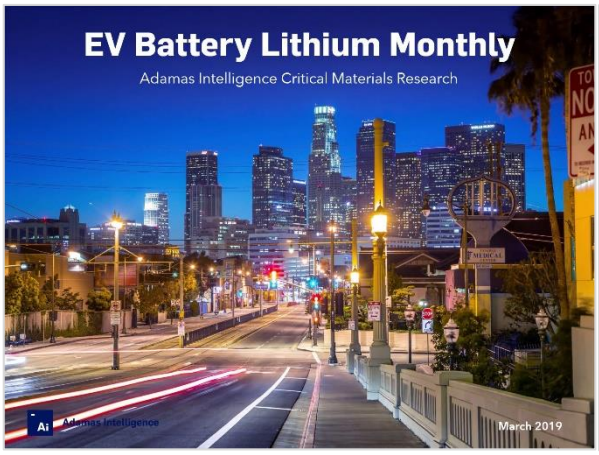

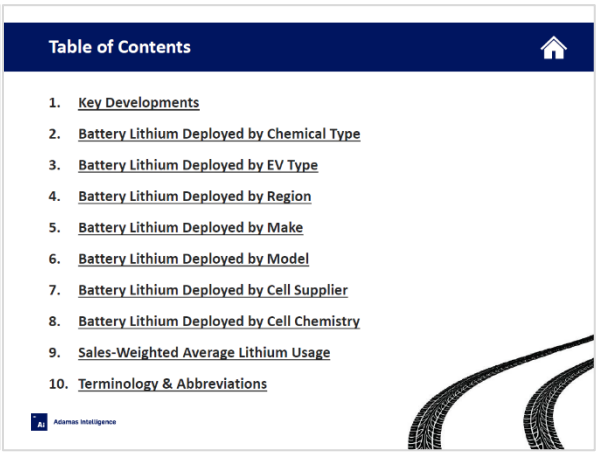

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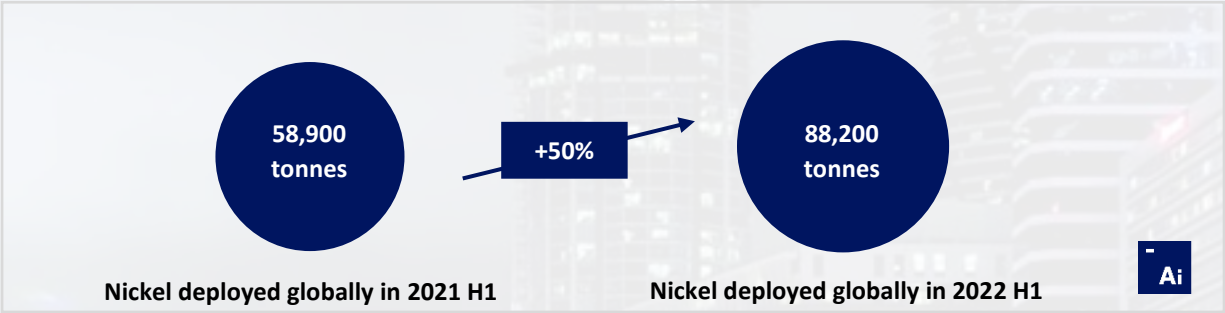
EV Battery Lithium Monthly

Nickel Deployed

OVERVIEW

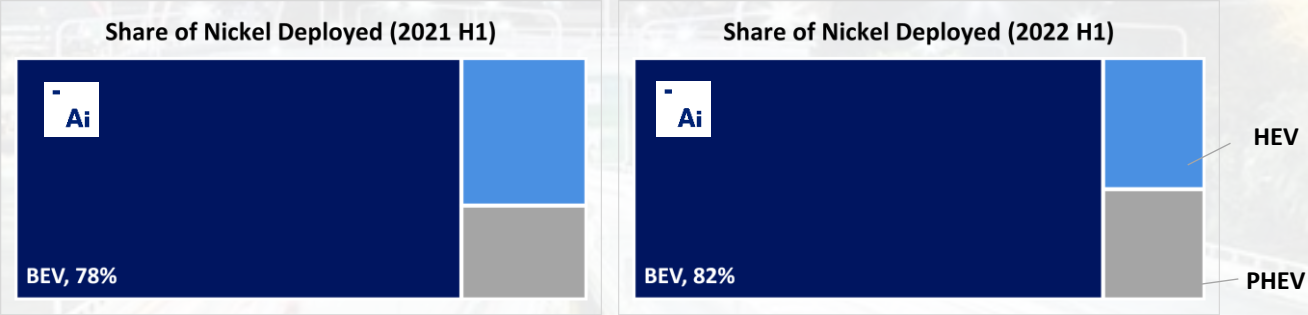
In 2022 H1, 88,200 tonnes of nickel were deployed onto roads globally in the batteries of all newly sold passenger EVs combined, an increase of 50% over the same period the year prior. This increase is attributed mainly to a jump in global EV sales, coupled with pervasive use of medium- and high-nickel cathode chemistries, plus an increase in global sales-weighted average pack capacity.

That said, however, with Tesla's global adoption of LFP cells for entry level versions, its share of total global nickel deployment fell from 25% in 2021 H1 to 20% in 2022 H1. Notably, the Tesla Model Y alone was responsible for 13% of global nickel deployment onto roads in 2022 H1.



BY EV TYPE

BEVs were responsible for 82% of all nickel deployed onto roads globally in passenger EV batteries in 2022 H1 (up from 78% in 2021 H1) while PHEVs and HEVs were responsible for a combined 18% in 2022 H1 (up from 22% in 2021 H1).

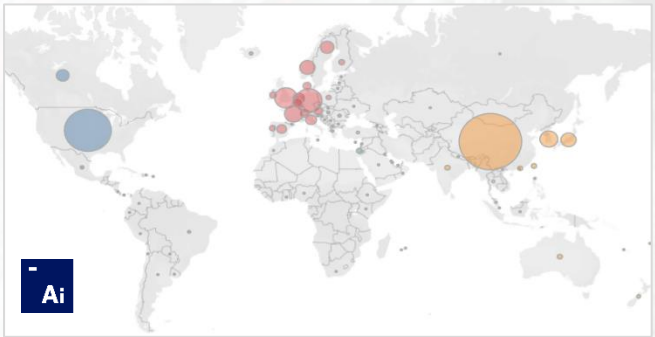


BY REGION

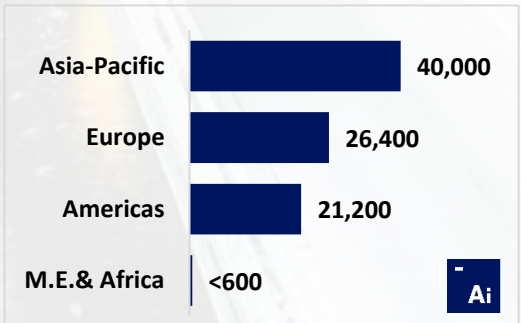
As the largest EV market globally and the largest producer and consumer of passenger EV battery cells, the Asia Pacific region was responsible for 45% of all battery nickel deployed globally in 2022 H1, up from 40% in 2021 H1.

Over the same period, Europe's share of global battery nickel deployment decreased from 35% to 30% while that of the Americas, which is a major market for NCA and NiMH, fell from 25% to 24%.

Nickel Deployed by Country (2022 H1)



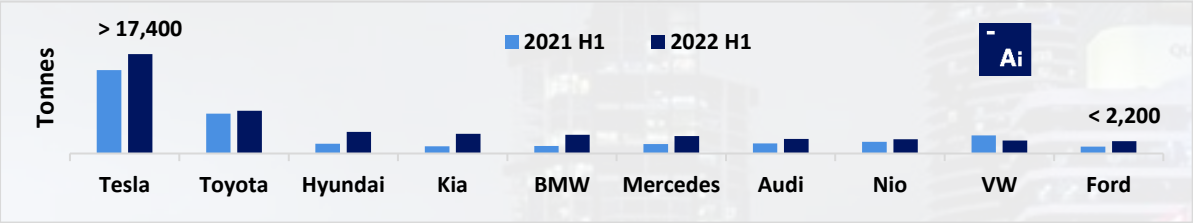
Tonnes of Nickel Deployed by Region (2022 H1)



BY EV MAKE

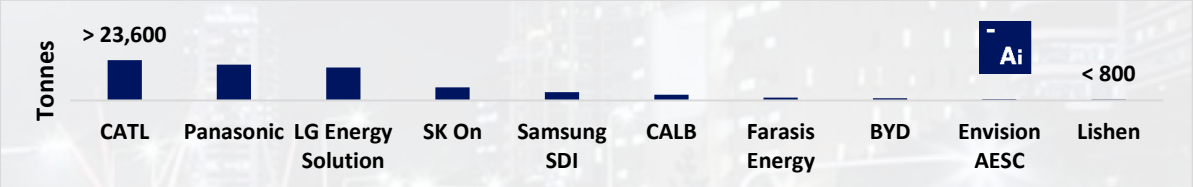
In 2022 H1, Tesla deployed over 17,400 tonnes of nickel onto roads globally in passenger EV batteries, more than its three closest competitors (Toyota, Hyundai and Kia) combined. Tesla's Model Y alone was responsible for over 64% of the automaker's total nickel consumption in 2022 H1.

In second spot, Toyota posted an 8% increase in nickel deployment onto roads year-over-year, while Hyundai and Kia saw their respective nickel deployments increase by 123% and 166%, respectively, in 2022 H1 versus 2021 H1.



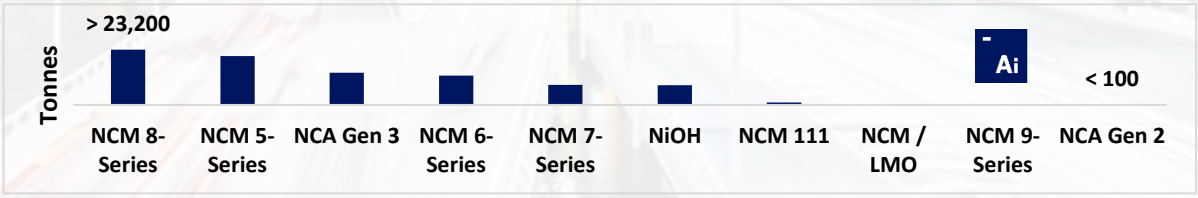
BY CELL SUPPLIER

As the top cell supplier globally, CATL also led by battery nickel deployed onto roads globally in 2022 H1, commanding a 27% market share overall, up from 20% in 2021 H1. Conversely, Panasonic's share dropped from 33% to 24% while that of LG Energy Solution decreased from 27% to 22% in 2022 H1.



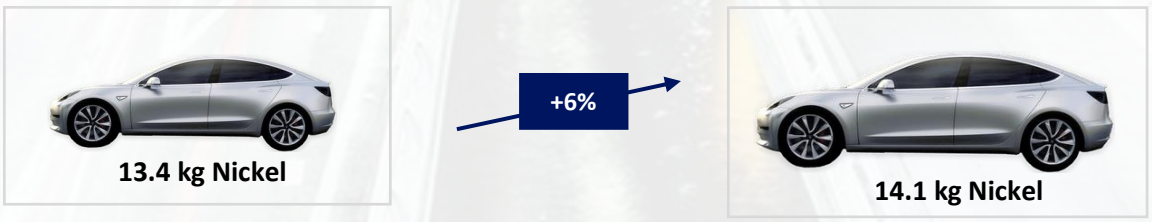
BY CHEMISTRY

In 2022 H1, NCM 8-Series cells were responsible for 26% of total global nickel deployment in passenger EV batteries while NCM 5-Series and nickel-rich NCA Gen 3 cells were responsible for 23% and 15%, respectively. Moreover, in 2022 H1, NCM 6-Series cells were responsible for 14% of total global nickel deployment and NCM 7-Series cells were responsible for 10%.



AVERAGE

Finally, the average amount of nickel deployed onto roads globally per EV sold in 2022 H1 increased by 6% year-over-year, from 13.4 kg in 2021 H1 to 14.1 kg.



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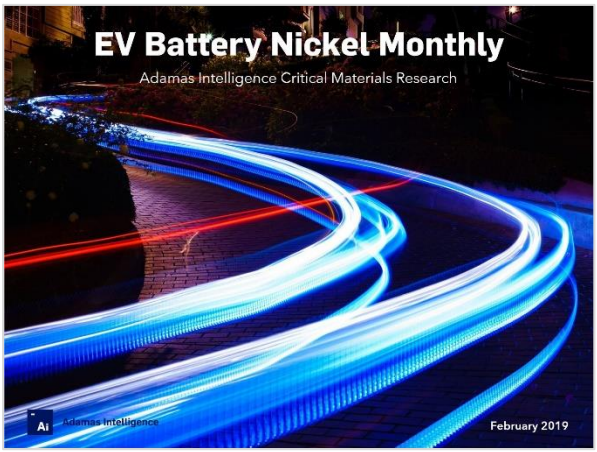

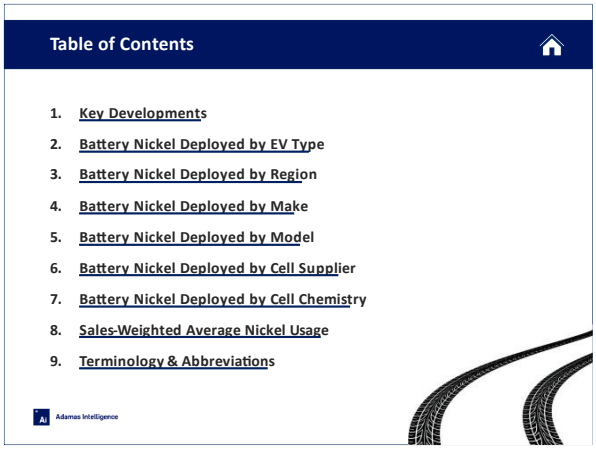

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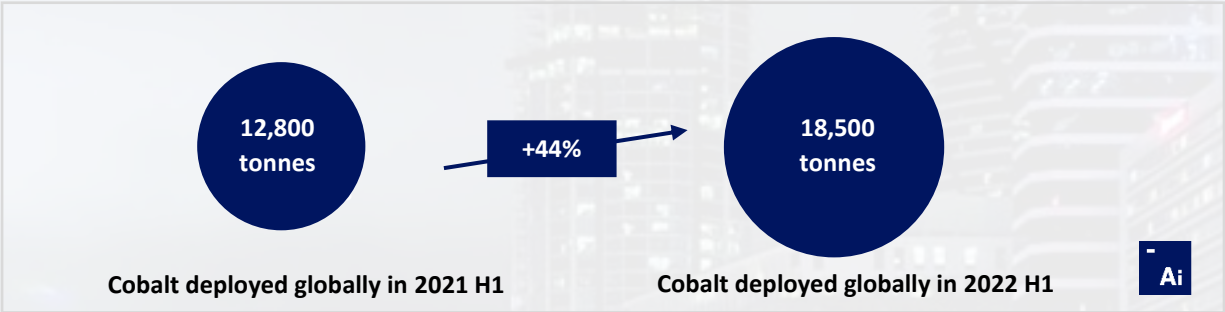
Cobalt Deployed

OVERVIEW

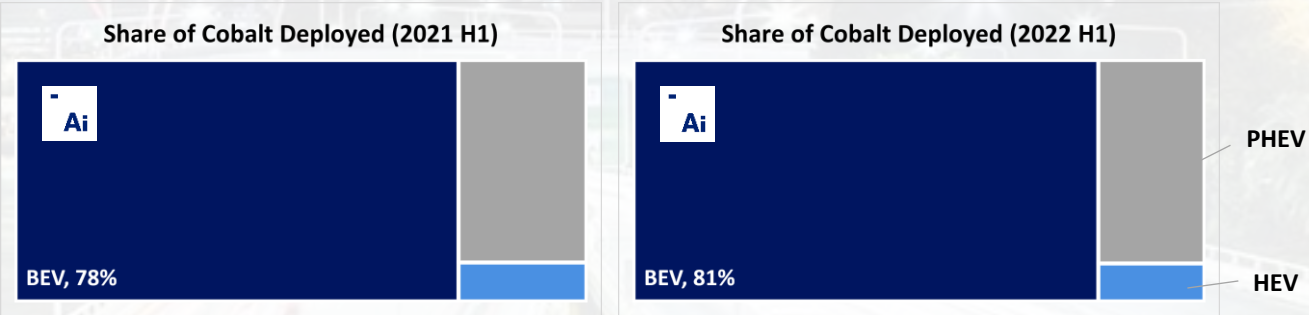
In 2022 H1, 18,500 tonnes of cobalt were deployed onto roads globally in batteries of all newly sold passenger EVs combined, an appreciable 44% increase over the amount deployed the same period the year prior. As with nickel, this increase is attributed mainly to surge in global EV sales coupled with widespread use of medium-nickel cell chemistries, such as NCM 5- and 6-Series, plus an increase in global sales-weighted average pack capacity, from 24.8 kWh to 31.4 kWh.

The top seven cell suppliers by cobalt deployed onto roads (CATL, LG Energy Solution, Samsung SDI, Panasonic, SK On, CALB and BYD) were collectively responsible for 88% of the market's consumption.



BY EV TYPE

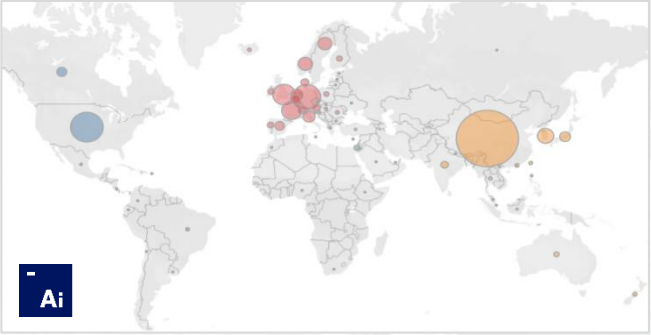
BEVs were responsible for 81% of all cobalt deployed globally in passenger EV batteries in 2022 H1 (up from 78% in 2021 H1), whereas PHEVs and HEVs were responsible for a combined 19% in 2022 H1 (down from 22% in 2021 H1), as BEV sales growth outpaced that of P/HEVs over the same period.



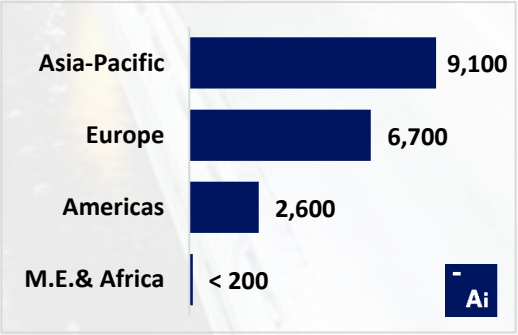
BY REGION

On the back of strong EV sales (especially in China), Asia Pacific led by cobalt deployed onto roads in 2022 H1, boosting its share of global deployment to 49% from 41% in 2021 H1. Conversely, Europe was responsible for a lower 36% of all cobalt deployed onto roads globally in 2022 H1, down from 44% the year prior owing to a slowdown in EV sales growth and the rising popularity of cobalt-free LFP-powered BEVs. Americas share of cobalt deployment went unchanged at 14%.

Cobalt Deployed by Country (2022 H1)

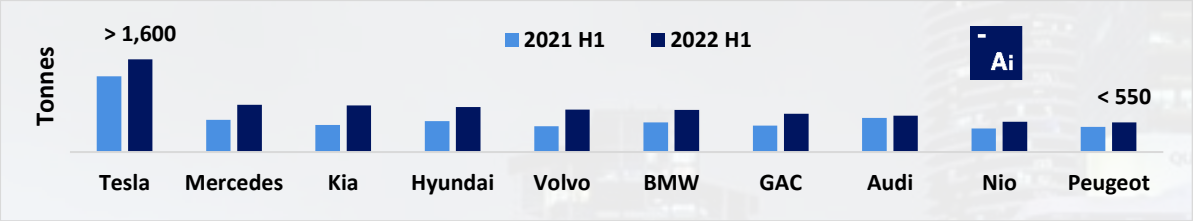


Tonnes of Cobalt Deployed by Region (2022 H1)



BY EV MAKE

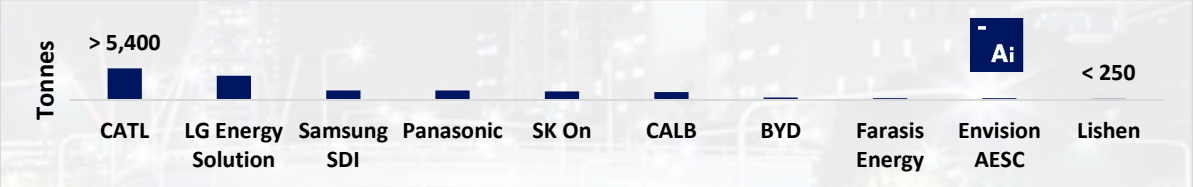
In 2022 H1, Tesla deployed more than 1,600 tonnes of cobalt onto roads globally, 22% more than it deployed in EV batteries in 2021 H1, pushing Tesla ahead of Mercedes and Kia as the largest consumer globally, despite its demonstrated preference for cobalt-lean and cobalt-free cell chemistries. Mercedes and Kia deployed 826 and 815 tonnes of cobalt onto roads globally in 2022 H1, up 47% and 72% over 2021 H1, respectively.



BY CELL SUPPLIER

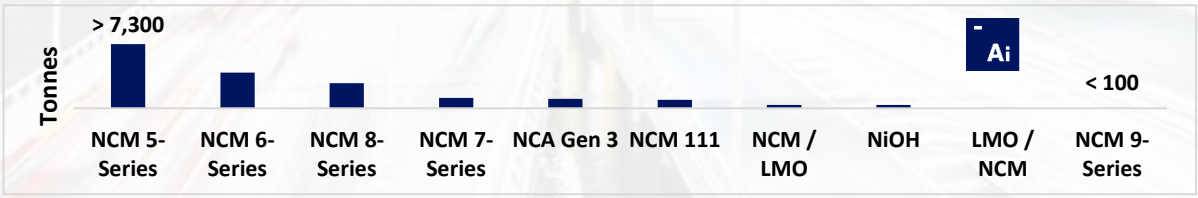
By cell supplier, CATL remained in the lead in 2022 H1 with a 29% share of global cobalt deployment following a 77% increase in its consumption year-over-year. Moreover, LG Energy Solution's cobalt deployment increased by 17% year-over-year in 2022 H1, and Samsung SDI's deployment rose by just 4% over the same period.

Notably, the top seven cell suppliers globally by cobalt deployed onto roads (CATL, LG Energy Solution, Samsung SDI, Panasonic, SK On, CALB and BYD) were collectively responsible for 88% of all cobalt deployment into passenger EV batteries in 2022 H1.



BY CHEMISTRY

Cobalt deployment onto roads in NCM 5-Series cells topped 7,300 tonnes in 2022 H1, followed by NCM 6-Series cells (4,100 tonnes), NCM 8-Series cells (2,900 tonnes) and NCM 7-Series cells (1,200 tonnes).



AVERAGE

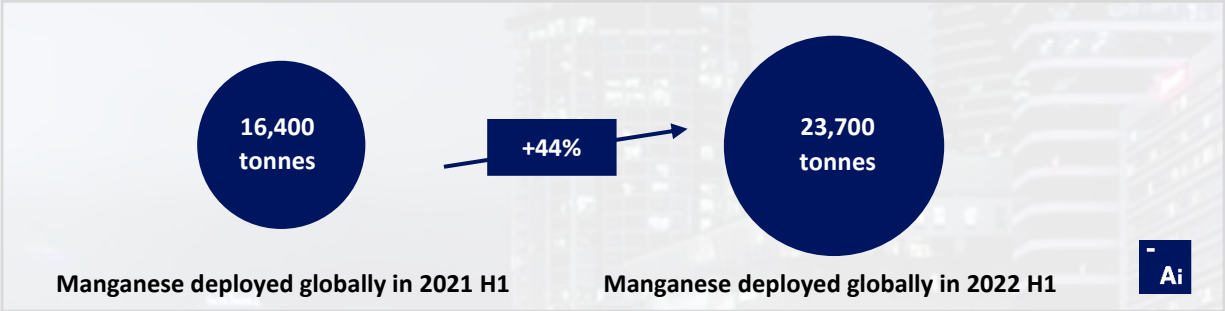
Lastly, as with nickel, the average amount of cobalt deployed onto roads globally per EV sold in 2022 H1 increased by just 2% year-over-year, from 2.9 kg in 2021 H1 to 3.0 kg in 2022 H1, suppressed by ongoing adoption of cobalt devoid LFP cells for entry level BEV and PHEV models, particularly in China.

Manganese Deployed

OVERVIEW

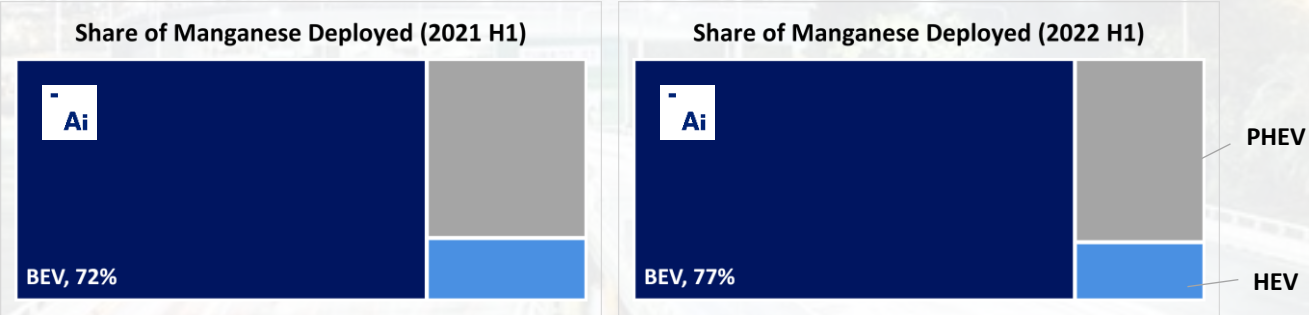
In 2022 H1, 23,700 tonnes of manganese were deployed onto roads globally in batteries of all newly sold passenger EVs combined, a remarkable 44% increase over the amount deployed during the same period the year prior. As with nickel and cobalt, this increase is attributed mainly to surge in global EV sales in 2022 H1, coupled with widespread use of medium-nickel cell chemistries, such as NCM 5- and 6-Series, plus an increase in global sales-weighted average pack capacity.

The top seven cell suppliers by manganese deployed onto roads (CATL, LG Energy Solution, CALB, Samsung SDI, SK On, GS Yuasa and Panasonic) in 2022 H1 were collectively responsible for 85% of the market's consumption.



BY EV TYPE

BEVs were responsible for 77% of all manganese deployed globally in passenger EV batteries in 2022 H1 (up from 72% in 2021 H1), whereas PHEVs and HEVs were responsible for 23% in 2022 H1 (down from 28% in 2021 H1), as BEV sales growth outpaced that of P/HEVs over the same period.



AVERAGE

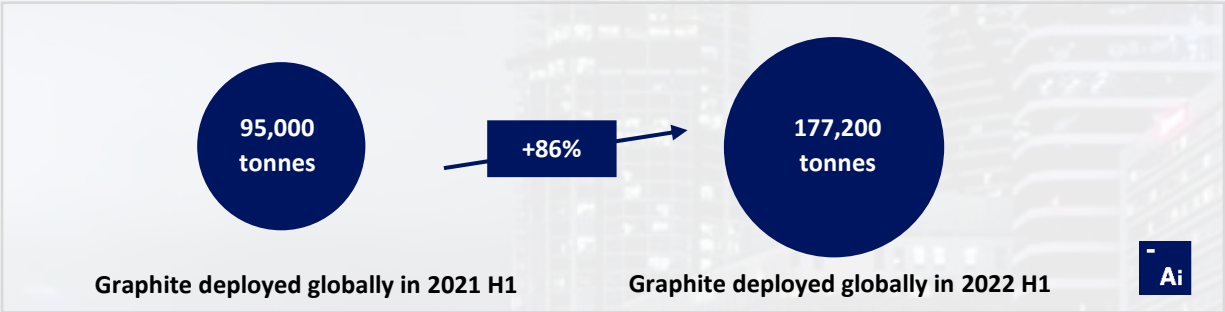
Lastly, the average amount of manganese deployed onto roads globally per EV sold in 2022 H1 was 3.8 kg, up just 2% year-over-year as manganese use in medium- and high-nickel cell chemistries (including the newly introduced NCMA) weas partially negated by rising adoption of manganese-free LFP cells for entry level BEV and PHEV models.

Graphite Deployed

OVERVIEW

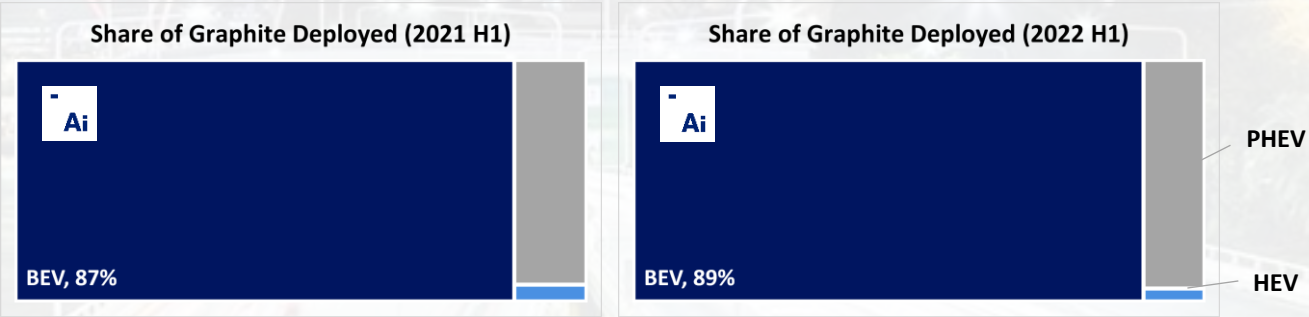
In 2022 H1, 177,200 tonnes of graphite were deployed onto roads globally in batteries of all newly sold passenger EVs combined, a lofty 86% increase over the amount deployed during the same period the year prior. As with LCE, this increase mainly comes on the back of a 42% jump in global EV sales coupled with a 27% jump in the global sales-weighted average pack capacity.

The top seven cell suppliers by graphite deployed onto roads (CATL, LG Energy Solution, BYD, Panasonic, SK On, Samsung SDI and CALB) in 2022 H1 were collectively responsible for 89% of the market's consumption.



BY EV TYPE

BEVs were responsible for 89% of all graphite deployed onto roads globally in passenger EV batteries in 2022 H1 (up from 87% in 2021 H1), whereas P/HEVs were responsible for 11% in 2022 H1 (down from 13% in 2021 H1), as BEV sales growth outpaced that of P/HEVs over the same period.



AVERAGE

On the back of modest global EV sales growth and increasing average pack capacity, the average amount of graphite deployed onto roads globally per EV sold in 2022 H1 increased by 32% year-over-year, from 21.6 kg in 2021 H1 to 28.4 kg in 2022 H1.

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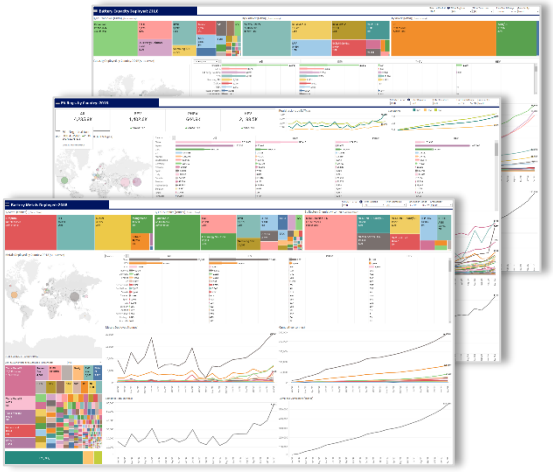

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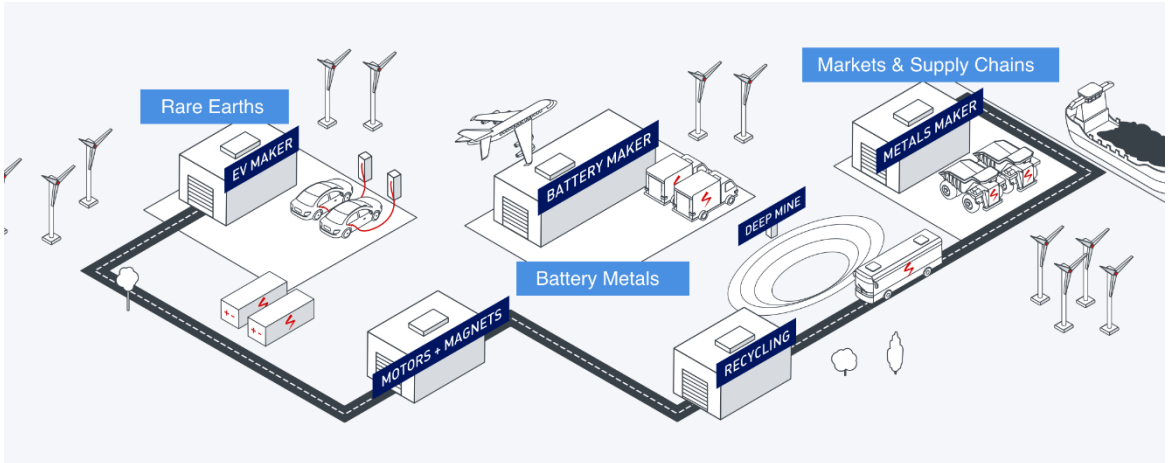

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