State of Charge:

EVs, Batteries and Battery Materials

Adamas Intelligence

8th Biannual, 2022 H2

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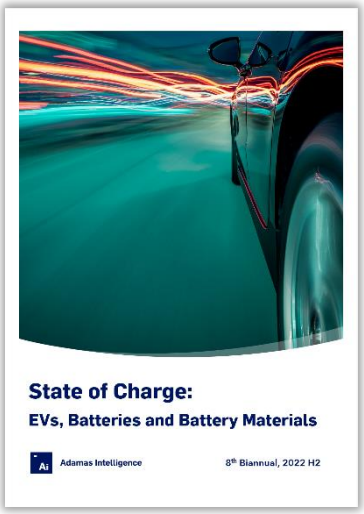

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This report contains "forward-looking statements" – that is, statements related to future events. In this report, forward-looking statements address our expectations of future production, supply, demand, consumption, sales, and pricing within parameters defined by stated scenarios, and often contain words such as "forecast", "project", "expect," "anticipate," "intend," "plan," "believe," "seek," "see," or "will." Forward-looking statements by their nature address matters that are, to different degrees, uncertain.

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CONTENTS

State of Charge in 2022 H2

In this biannual 'State of Charge' report, we provide an informative overview of the global passenger xEV (i.e., HEV, PHEV and BEV) market's performance over the past half-year (in this case "2022 H2") 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.

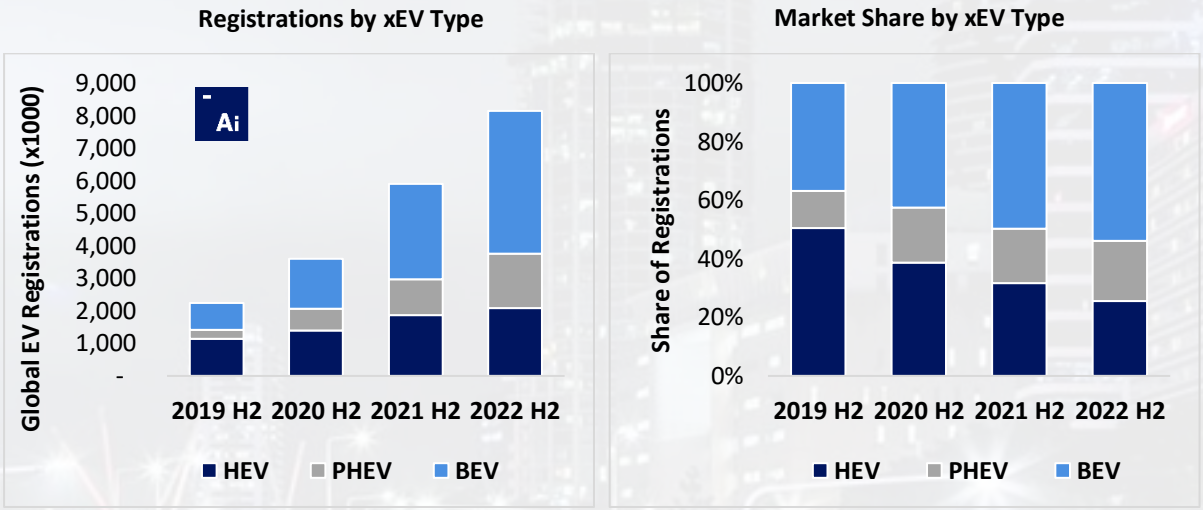
Among the findings of the latest report:

- In 2022 H2 global passenger xEV registrations rose 38% over the same period the year prior, amounting to 8.15 million units, up from 5.9 million units in 2021 H2. This increase was driven by strong sales growth in Asia Pacific (up 53% year-over-year) coupled with modest growth in the Americas (up 21% year-over-year) and Europe (up 19% year-over-year).
- In the Asia Pacific region, a 53% increase in passenger xEV sales year-over-year in 2022 H2 resulted in a booming 77% increase in watt-hours of battery capacity deployed onto roads over the same period, plus a corresponding 74% increase in lithium, 44% increase in nickel and 45% increase in cobalt consumption year-over-year.
- In 2022 H2, total global battery capacity deployed onto roads in all regions combined amounted to a record 291.7 GWh, 64% more than was deployed globally in 2021 H2.
- In 2022 H2, Tesla and BYD installed nearly as many watt-hours into newly sold passenger xEVs as their fifteen closest competitors combined.
- In 2022 H2, just seven cell suppliers globally (CATL, LG Energy Solution, BYD, Panasonic, Samsung SDI, SK On and CALB) were collectively responsible for more than 80% of all battery capacity and battery metals deployed onto roads globally in newly sold passenger xEVs.
- In 2022 H2, deployment of LFP cells (in watt-hours) jumped 129% over the same period the year prior, slowing the rise of nickel, cobalt and manganese use per vehicle, on average.
- In 2022 H2, 173,790 tonnes of lithium carbonate equivalent ("LCE") were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, 62% more than were deployed globally in 2021 H2. In 2022 H2, 59% of all LCE units were deployed as carbonate, 41% as hydroxide.
- Similarly, in 2022 H2, 121,170 tonnes of nickel were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, 44% more than in 2021 H2.
- Additionally, in 2022 H2, 24,870 tonnes of cobalt were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, 37% more than in 2021 H2.
- Moreover, in 2022 H2, 32,700 tonnes of manganese were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, 39% more than in 2021 H2.
- Lastly, in 2022 H2, 267,800 tonnes of graphite were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, 68% more than in 2021 H2.

Passenger xEV Registrations

In 2022 H2, global passenger xEV registrations rose 38% over the same period the year prior, amounting to 8.15 million units versus 5.90 million units in 2021 H2. This increase was driven by strong sales growth in Asia Pacific (up 53% year-over-year), despite persistent lockdowns in China, coupled with a modest rise in the Americas (up 21% year-over-year) and Europe (up 19% year-over-year).

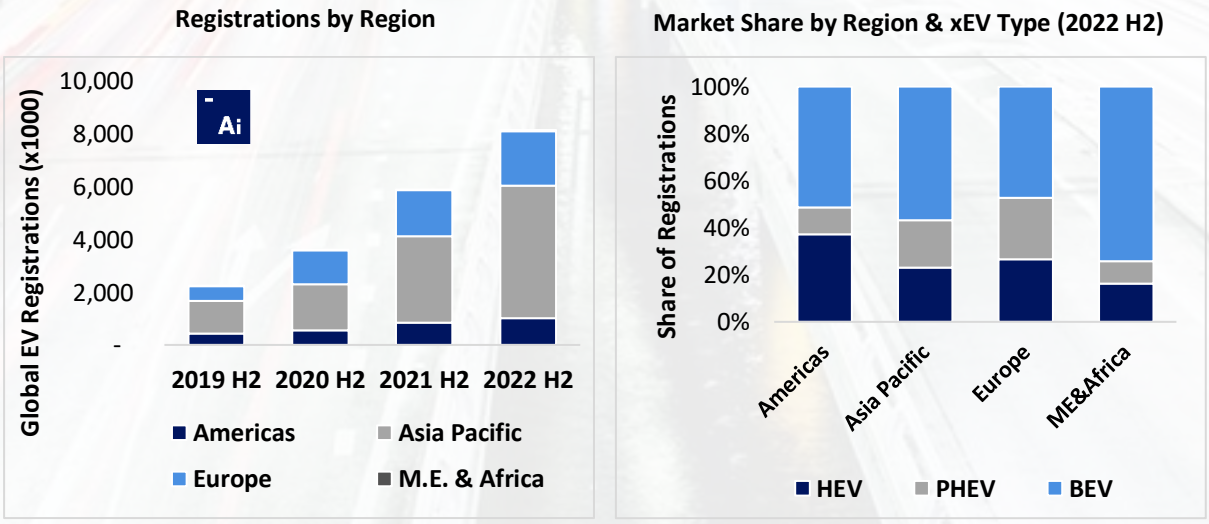
Overall, BEVs made up 54% of total global passenger xEV registrations in 2022 H2, up from 50% in 2021 H2 and 43% in 2020 H2. PHEVs made up 21% of total global passenger xEV registrations in 2022 H2, up from 19% the year prior, while HEVs made up 26% in 2022 H2, down from 32% the year prior.



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

In 2022 H2, Asia Pacific recorded year-over-year xEV sales growth of 53% owing to especially strong BEV and PHEV sales in the region. Sales of Chinese BEVs and PHEVs from the likes of BYD, SGMW and GAC continue to drive the majority of the region's volume.

Although combined BMW and VW Group sales grew nearly 40% in Asia Pacific, Tesla remains the only foreign automaker with major EV production volume in the region.



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

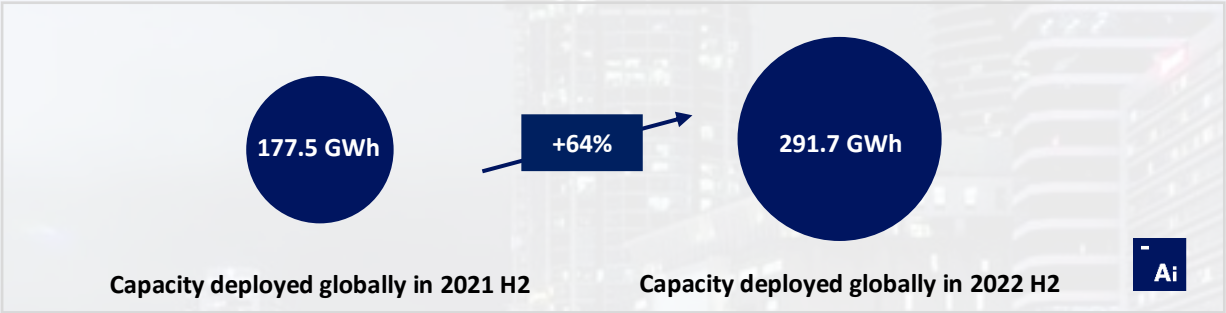
Battery Capacity Deployed

OVERVIEW

In 2022 H2, a record 291.7 GWh of battery capacity were deployed onto roads in the packs of all newly sold passenger xEVs combined, up 64% over 2021 H2. This rise is attributed to a surge in B/PHEV sales growth over the same period, and a consequential rise in average pack capacity.

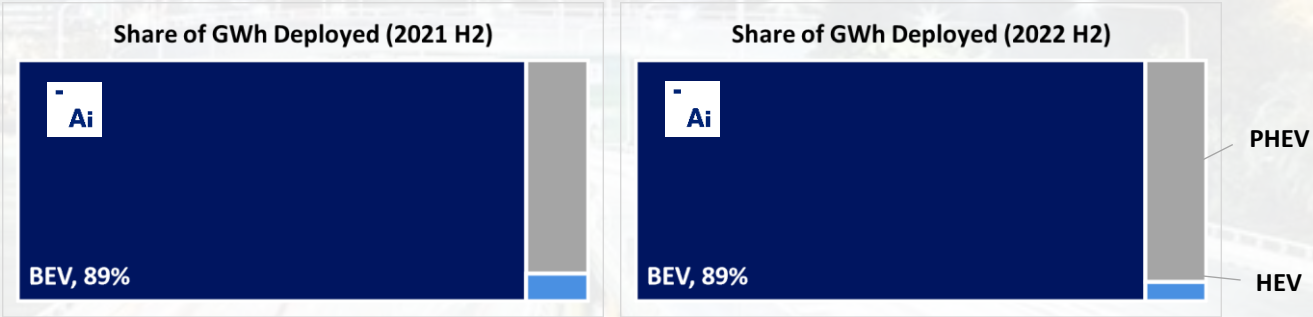
Tesla and BYD were together responsible for more than 30% of all battery capacity deployed on the roads in 2022 H2, nearly as much as their next 15 competitors combined.

By cell supplier, CATL continued to lead globally by battery capacity (GWh) deployed in 2022 H2 stemming from strong global sales of LFP-powered Tesla Model 3s and Ys, along with a growing list of over 200 other EV model-versions globally that CATL currently supplies cells for.



BY EV TYPE

BEVs were responsible for 89% of all battery capacity deployed globally in 2022 H2, PHEVs were responsible for 10% and HEVs were responsible for 1% (all unchanged from 2021 H2).

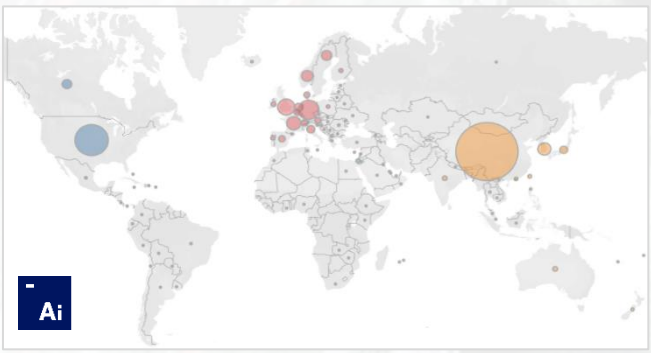


BY REGION

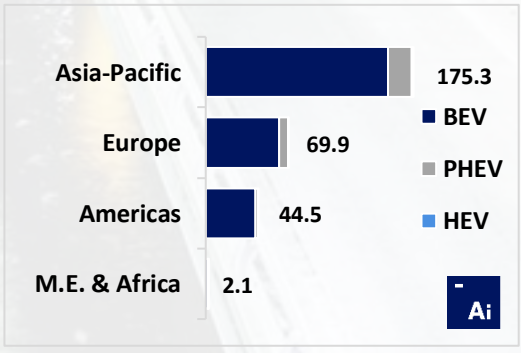
Asia Pacific continues to dominate the global market as its share of global battery capacity (in GWh) deployed onto roads rose to 60% in 2022 H2 from 56% in 2021 H2.

Over the same period, Europe's share fell from 29% in 2021 H2 to 24% in 2022 H2 and that of the Americas remained unchanged at 15%.

GWh Deployed by Country (2022 H2)



GWh Deployed by Region & xEV Type (2022 H2)



BY EV MAKE

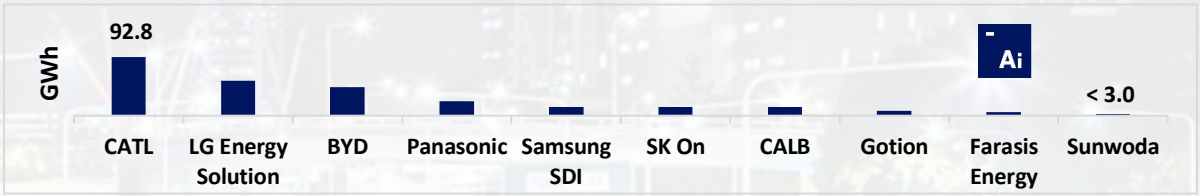
Tesla and BYD deployed combined 98.3 GWh of battery capacity onto roads globally in 2022 H2, nearly as much as their fifteen closest competitors combined (including GAC, BMW, VW, etc.).

BYD continues to close the gap on Tesla's leadership with an impressive 166% increase in battery capacity deployed onto roads in 2022 H2 versus the same period the year prior, driven higher by a 164% increase in EV sales worldwide.

BY CELL SUPPLIER

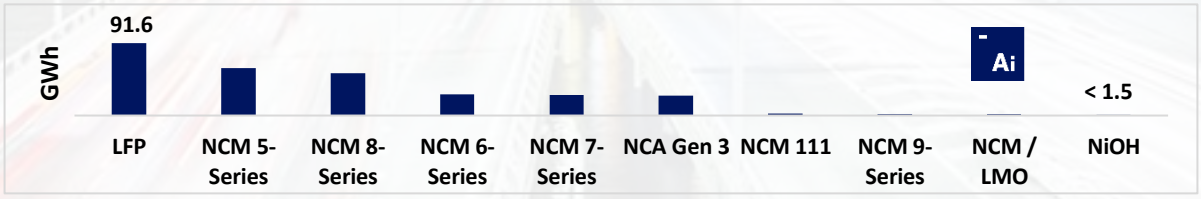
As a key supplier to Tesla in China, as well as a host of other automakers around the globe, cell supplier CATL led with 92.8 GWh deployed globally in 2022 H2, commanding a 32% market share, unchanged from the same period the year prior.

LG Energy Solution held onto second place in 2022 H2, deploying 55.7 GWh globally through the second half of the year versus 35.7 GWh during the second half of the year prior. BYD rounded off the top 3 with 44.6 GWh deployed in 2022 H2, up 163% from 16.9 GWh in 2021 H2.



BY CHEMISTRY

Deployment of LFP cells amounted to 91.6 GWh (31% of total) in 2022 H2, followed by NCM 5-Series and NCM 8-Series with 59.8 GWh (21%) and 53.3 GWh (18%), respectively. NCM 6-Series cells claimed fourth place (9%) and NCM 7-Series rounded off the top five (9% of total).



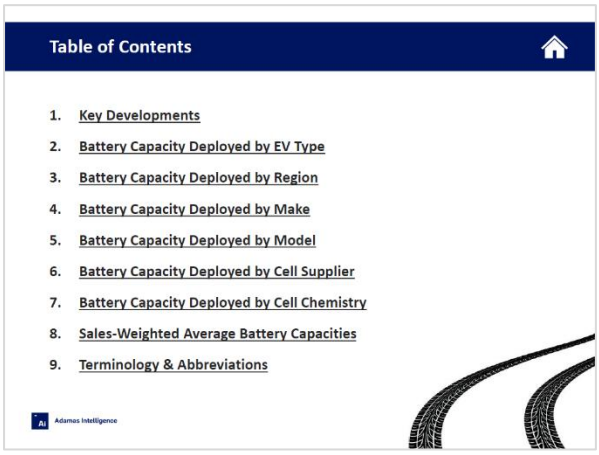
AVERAGE

In 2022 H2, the global sales-weighted average battery pack capacity of all newly sold passenger xEVs combined increased by 19% year-over-year, from 30.1 kWh to 35.8 kWh, as BEV and PHEV sales growth continues to outpace that of HEVs.

“EV Battery Capacity Monthly” subscription-based report and data service

Our ‘EV Battery Capacity Monthly’ is a subscription-based report and data service for tracking global monthly deployment of passenger EV battery capacity (in watt-hours) by EV type, region, country, make, model, cell supplier and cell chemistry on an ongoing basis.

The 65-page monthly report (and accompanying Excel data) is a must-have resource for automakers, cell suppliers, battery materials manufacturers, miners, explorers, investors, and other stakeholders with a professional interest in the EV, battery or battery materials industries.



Every report contains a detailed snapshot of the latest monthly market data plus an additional 12 months of historical data for context and comparison.

All reported monthly data is available to subscribers in Excel format.

Latest Monthly Data & Monthly Report + **12 Months of Historical Data** + **Data Available in Excel Format**

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EV Battery Capacity Monthly

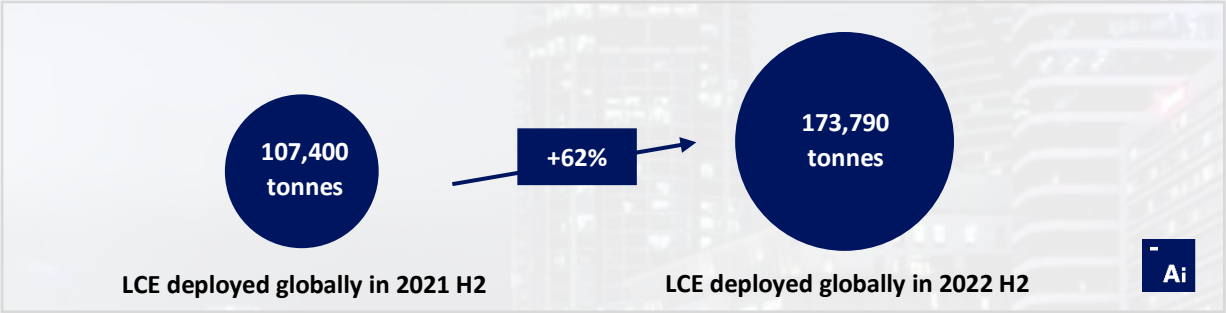
Lithium Deployed

OVERVIEW

In 2022 H2, 173,790 tonnes of lithium carbonate equivalent ("LCE") were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, up 62% year-over-year.

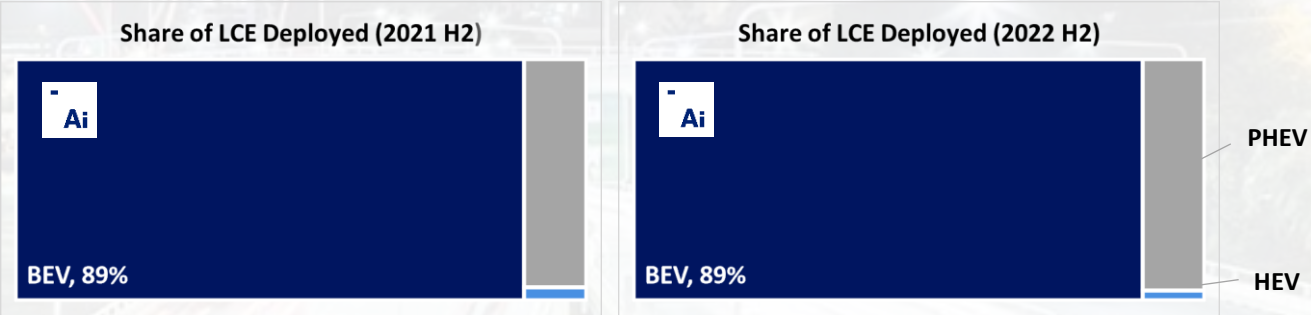
This increase comes on the back of a 38% rise in global xEV sales and a 19% increase in the average xEV's pack capacity, coupled with pervasive use of medium-nickel cell chemistries, like NCM 5- and 6-Series, which use more LCE per kWh than LFP, NCA or NCM 8- and 9-Series cells.

Tesla was responsible for 17% of global LCE deployment in 2022 H2 (down from 19% in 2021 H2) and the Tesla Model Y alone was responsible for 11% of all LCE deployed worldwide.



BY EV TYPE

BEVs were responsible for 89% of all LCE deployed globally (unchanged from 2021 H2), whereas PHEVs and HEVs were responsible for a combined 11% (also unchanged from the same period the year prior).

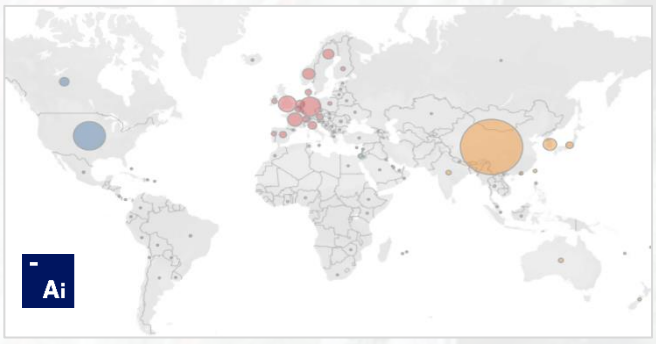


BY REGION

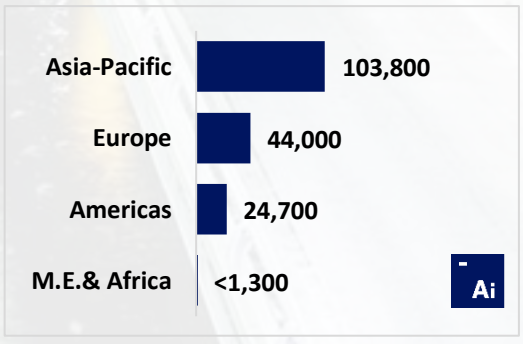
As the largest xEV market globally and the largest producer and consumer of xEV battery cells, the Asia Pacific region was responsible for 60% of all LCE deployed onto roads globally in 2022 H2, up from 56% in 2021 H2.

Europe's share of global LCE deployment amounted to 25% in 2022 H2, down from 30% in 2021 H2, while that of the Americas rose from 13% in 2021 H2 to 14% in 2022 H2.

LCE Deployed by Country (2022 H2)



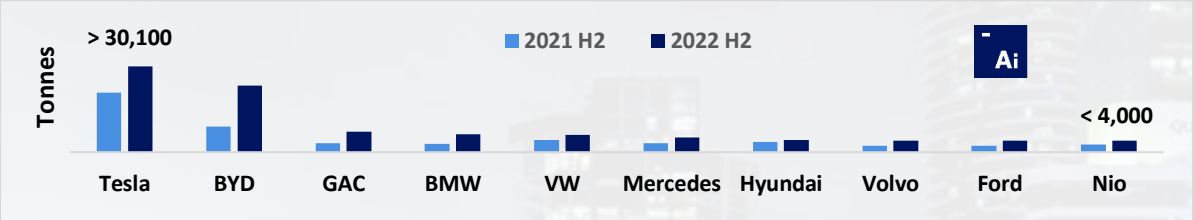
Tonnes of LCE Deployed by Region (2022 H2)



BY EV MAKE

In 2022 H2 Tesla deployed over 30,100 tonnes of LCE onto roads globally, 45% more than it deployed in 2021 H2, remaining the largest lithium consumer among its peers, although BYD is steadily closing the gap.

BYD deployed over 23,300 tonnes of LCE onto roads globally in 2022 H2, an increase of 160% over 2021 H2, while GAC deployed almost 7,100 tonnes, an increase of 122% over 2021 H2.

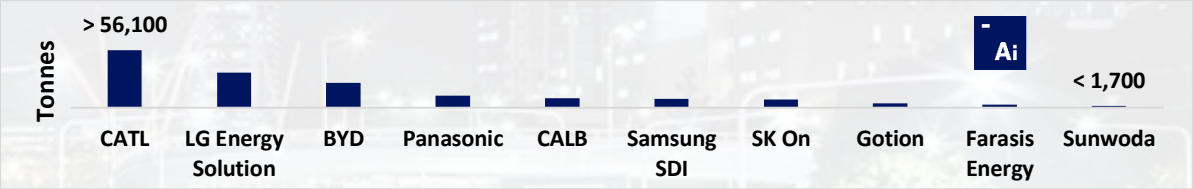


BY CELL SUPPLIER

CATL's LCE deployment increased 61% in 2022 H2 versus 2021 H2, while its share of global LCE consumption remained unchanged at 32% versus the same period the year prior.

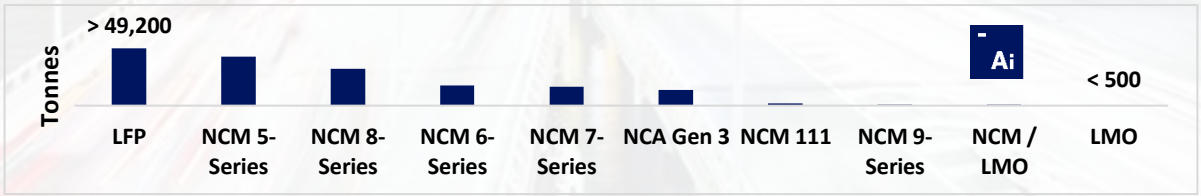
Moreover, in 2022 H2, LG Energy Solution's LCE deployment increased by 54% over the same period the year prior while that of BYD increased by 157%.

Notably, the top seven cell suppliers worldwide were collectively responsible for 87% of all LCE deployed onto roads globally in passenger xEV batteries in 2022 H2.



BY CHEMISTRY

LCE deployment in LFP cells amounted to over 49,200 tonnes in 2022 H2 (up by 130% from 2021 H2), followed by NCM 5-Series (up 52%), and NCM 8-Series (up 70%). LCE deployment in NCM 6-Series and NCM 7-Series cells rose by 11% and 49%, respectively, over the same period.



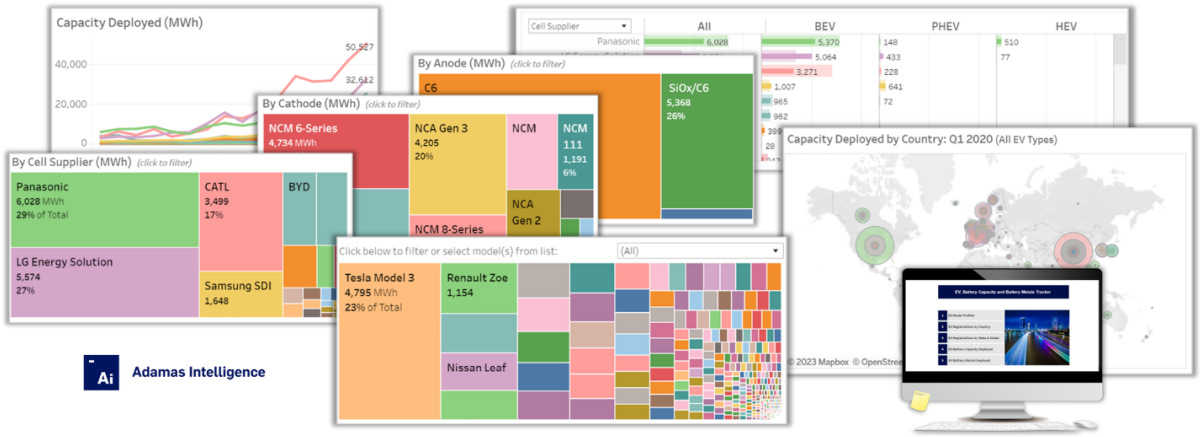
AVERAGE

With strong BEV and PHEV sales growth globally in 2022 H2, coupled with a rise in sales-weighted average battery pack capacity, the average amount of LCE deployed onto roads globally per xEV (HEV, PHEV and BEV) sold in 2022 H2 was 21.3 kilograms, 17% higher than the same period the year prior.

Lithium: EV and Battery Supply Chain Coverage

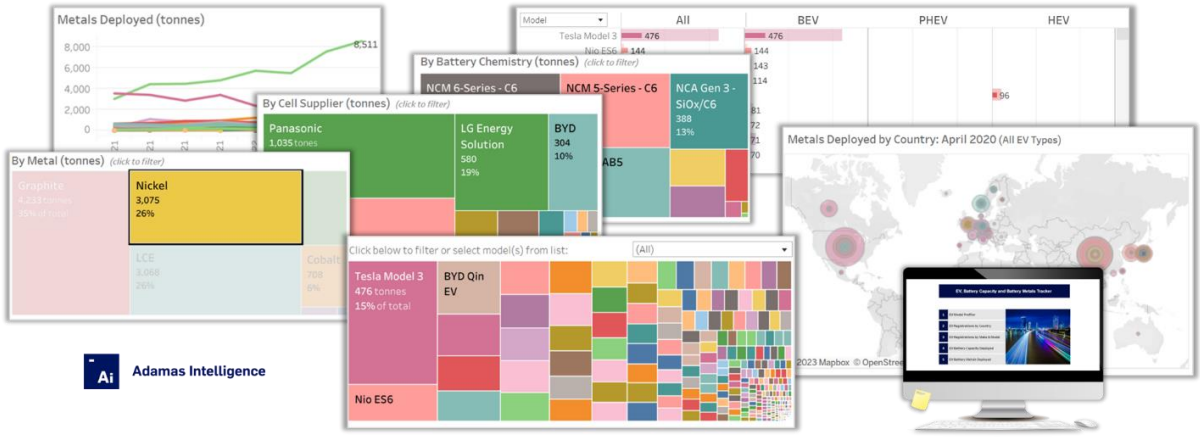
Adamas' EV Battery Capacity and Battery Metals Tracker intelligence platform tracks and reports the cell suppliers, chemistries and other key specifications of every EV model produced globally to-date.

- Granular **cell chemistry** breakdown (e.g., LFP, NCM 5-, 6-, 7-, 8-Series, etc.)
- Platform **updated monthly**, complete with historical monthly data back to January 2004



The platform also tracks and reports the total mass of lithium used in the battery of every unique EV model produced globally to-date, along with total lithium consumption per make, vehicle segment, EV segment, cell supplier, cell chemistry, country, region and more.

- Battery specs and **lithium consumption per vehicle** for every EV produced globally to-date
- Platform **updated monthly**, complete with historical monthly data back to January 2004



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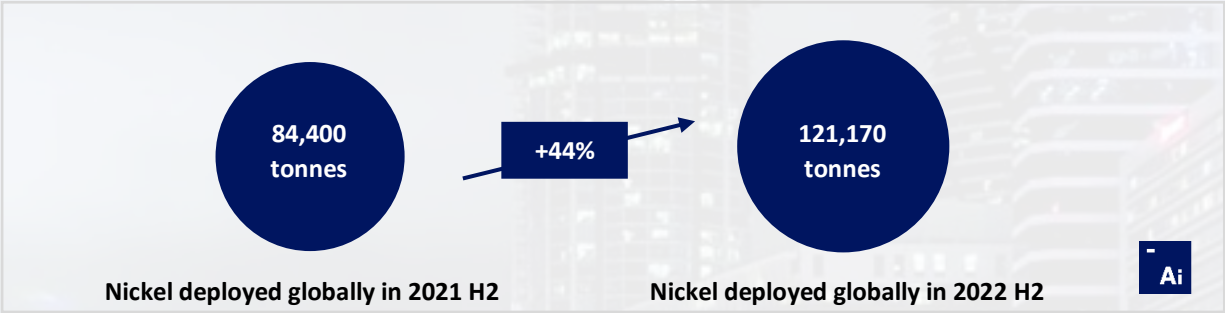
Nickel Deployed

OVERVIEW

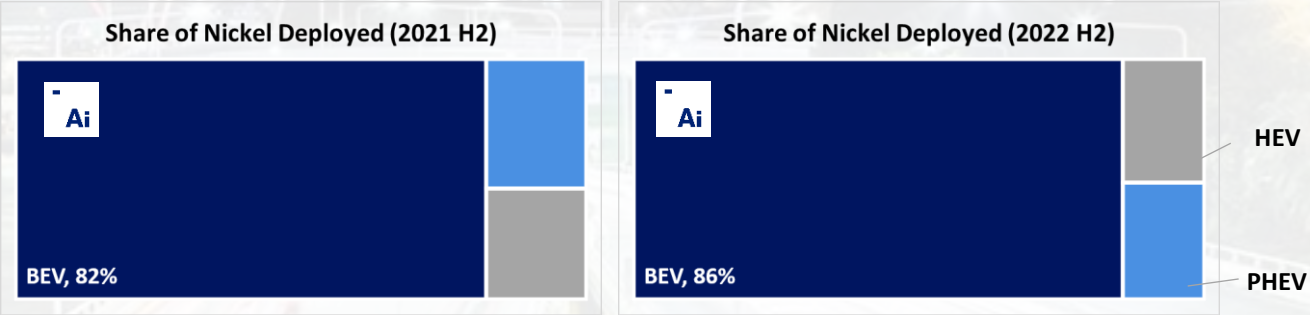
In 2022 H2, 121,170 tonnes of nickel were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, an increase of 44% over the same period the year prior. This increase is attributed to a rise in global xEV sales, pervasive use of medium- and high-nickel cathode chemistries, and a simultaneous increase in global sales-weighted average pack capacity.

Despite Tesla switching to LFP for entry level models, Tesla led by nickel deployed onto roads in 2022 H2 with a 20% share of the market, unchanged year-over-year. Notably, the Tesla Model Y alone was responsible for 13% of all nickel deployed onto roads globally in 2022 H2.



BY EV TYPE

BEVs were responsible for 86% of all nickel deployed onto roads globally in passenger xEV batteries in 2022 H2 (up from 82% in 2021 H2) while PHEVs and HEVs were responsible for a combined 14% in 2022 H2 (down from 17% in 2021 H2).

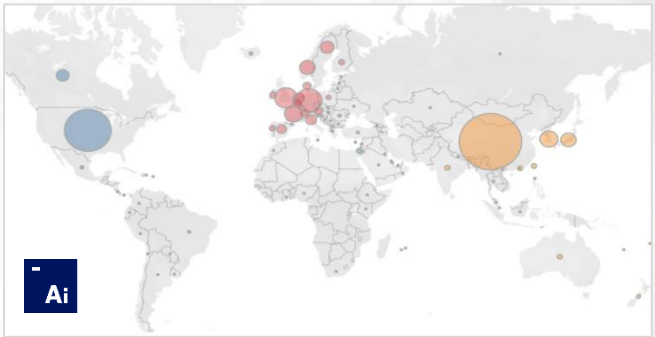


BY REGION

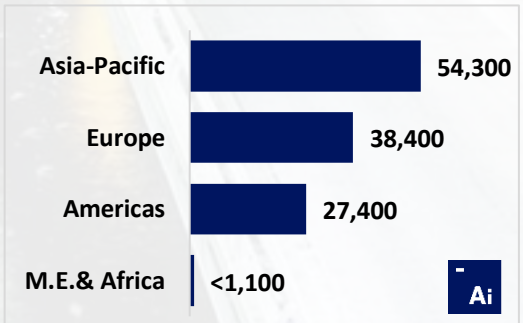
As the largest xEV market globally and the largest producer and consumer of passenger xEV battery cells, the Asia Pacific region was responsible for 45% of all battery nickel deployed globally in 2022 H2, unchanged from 2021 H2.

Over the same period, Europe's share of global battery nickel deployment fell from 33% to 32% and that of the Americas, which is a major market for NCA and NiMH, increased from 22% to 23%.

Nickel Deployed by Country (2022 H2)



Tonnes of Nickel Deployed by Region (2022 H2)

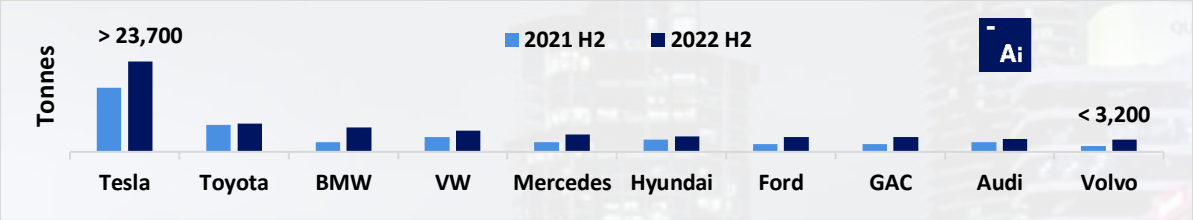


BY EV MAKE

In 2022 H2, Tesla deployed over 23,700 tonnes of nickel onto roads globally in passenger xEV batteries, more than its three closest competitors (Toyota, BMW and VW) combined.

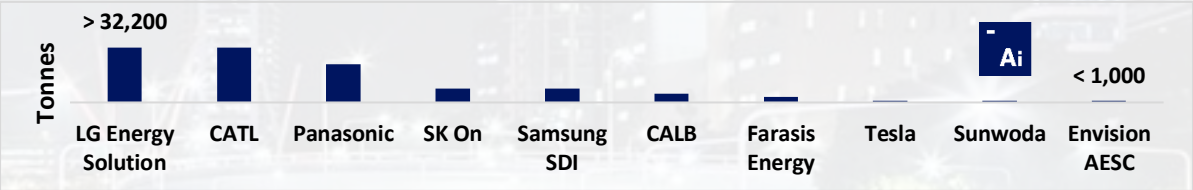
Tesla's Model Y alone was responsible for over 68% of the automaker's total nickel consumption in 2022 H2.

In second spot, Toyota deployed over 7,000 tonnes of nickel onto roads globally (up 7% year-over-year), followed closely by BMW and VW, which saw their nickel deployments increase by 152% and 47%, respectively, in 2022 H2 versus 2021 H2.



BY CELL SUPPLIER

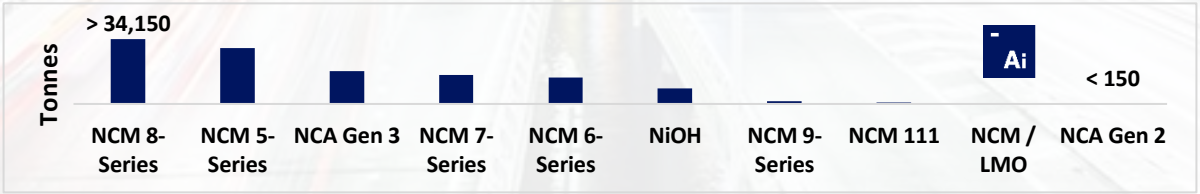
As the top two cell suppliers globally by GWh deployed, LG Energy Solution and CATL also led by battery nickel deployed onto roads globally in 2022 H2, commanding a 53% combined market share (up from 50% in 2021 H2). Conversely, Panasonic's share dropped from 25% to 19% over the same period.



BY CHEMISTRY

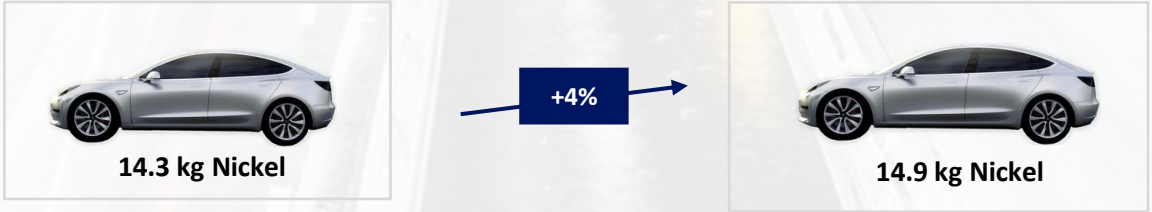
In 2022 H2, NCM 8-Series cells drove 28% of total global nickel deployment onto roads in passenger xEV batteries while NCM 5-Series and nickel-rich NCA Gen 3 cells were responsible for 24% and 14%, respectively.

Moreover, in 2022 H2, NCM 7-Series cells were responsible for 13% of total global nickel deployment and NCM 6-Series cells were responsible for 12%.



AVERAGE

Finally, the average amount of nickel deployed onto roads globally per xEV (HEV, PHEV and BEV) sold in 2022 H2 was 14.9 kg, 4% higher than the same period the year prior.



Nickel: EV and Battery Supply Chain Coverage

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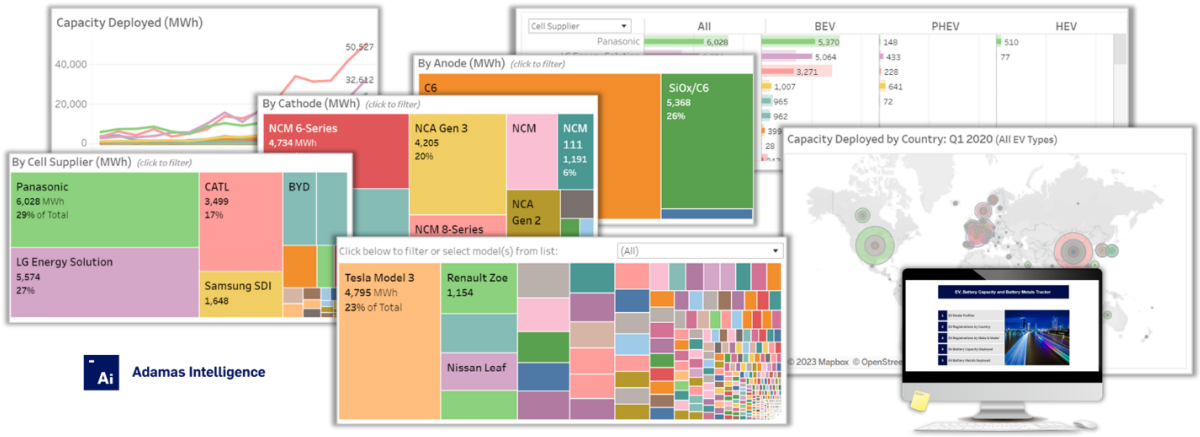
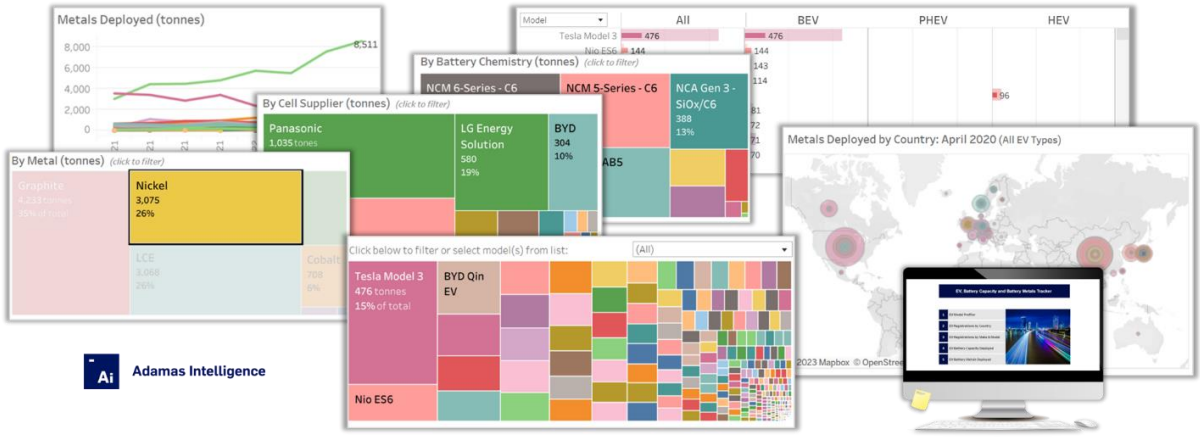


The platform also tracks and reports the total mass of nickel used in the battery of every unique EV model produced globally to-date, along with total nickel consumption per make, vehicle segment, EV segment, cell supplier, cell chemistry, country, region and more.

- Battery specs and **nickel consumption** per vehicle for every EV produced globally to-date
- Platform **updated monthly**, complete with historical monthly data back to January 2004



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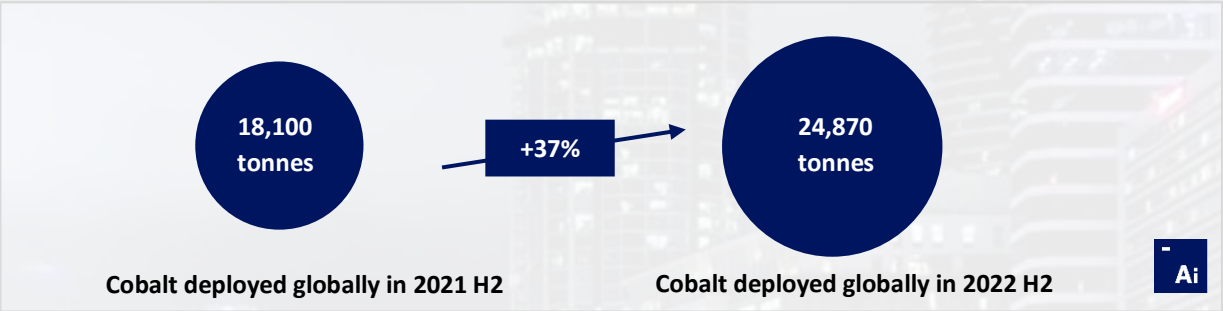
Cobalt Deployed

OVERVIEW

In 2022 H2, 24,870 tonnes of cobalt were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, up 37% over the same period the year prior.

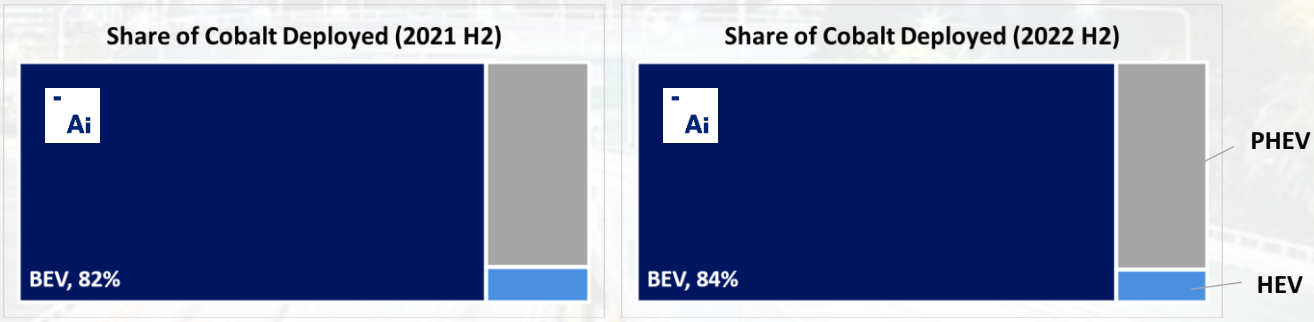
As with nickel, this increase was driven by a rise in global xEV sales, a rise in the average xEV's pack capacity, and pervasive use of medium-nickel cell chemistries, such as NCM 5- and 6-Series, which use inherently more cobalt per kWh than NCA or NCM 8- and 9-Series cells.

Despite LFP driving over 38% of CATL's cell deployments in 2022 H2 (by GWh), the Chinese battery behemoth still led the pack by cobalt deployed with a 30% market share in 2022 H2.



BY EV TYPE

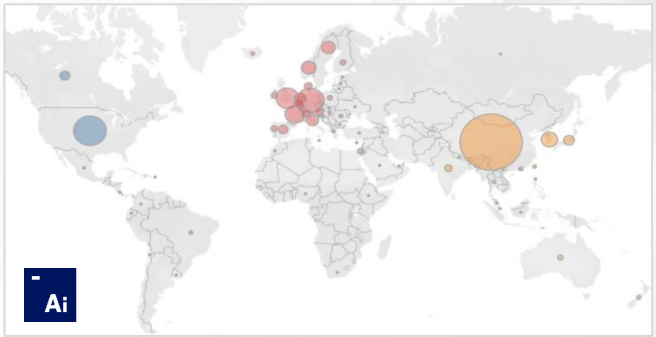
BEVs were responsible for 84% of all cobalt deployed globally in passenger xEV batteries in 2022 H2 (up from 82% in 2021 H2), whereas PHEVs and HEVs were responsible for a combined 16% in 2022 H2 (down from 18% in 2021 H2), as BEV sales growth outpaced that of P/HEVs over the same period.



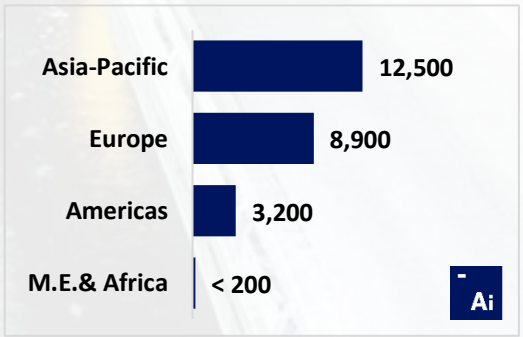
BY REGION

On the back of strong xEV sales growth (especially in China), Asia Pacific led by cobalt deployed onto roads in 2022 H2, boosting its share of global deployment to 50% from 48% the same period the year prior. Conversely, Europe was responsible for a lower 36% of all cobalt deployed onto roads globally in 2022 H2, down from 39% the year prior, owing to a regional slowdown in xEV sales growth. Over the same period, the Americas share of cobalt deployment rose from 12% at 13%.

Cobalt Deployed by Country (2022 H2)

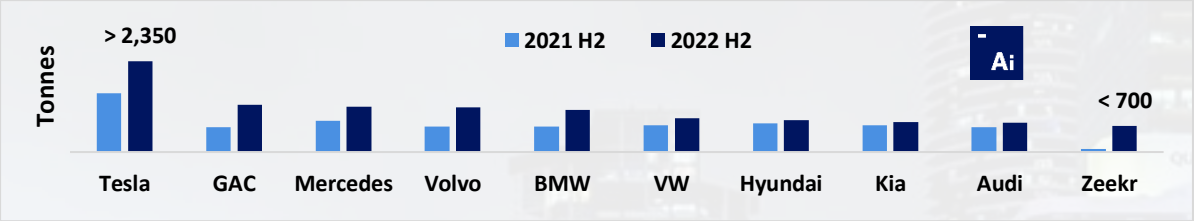


Tonnes of Cobalt Deployed by Region (2022 H2)



BY EV MAKE

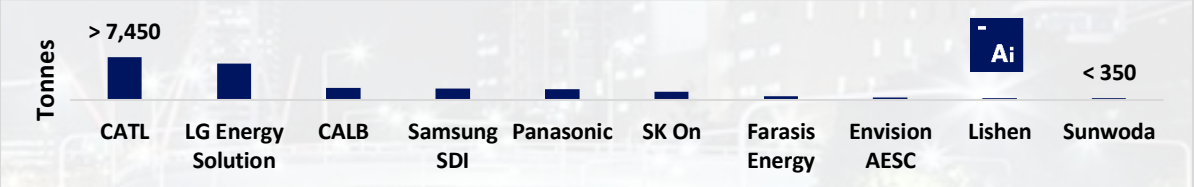
In 2022 H2, Tesla deployed more than 2,350 tonnes of cobalt onto roads globally, 54% more than it deployed in xEV batteries in 2021 H2, pushing Tesla well ahead of GAC and Mercedes as the largest cobalt consumer globally, despite its articulated preference for cobalt-lean and cobalt-free cell chemistries. GAC and Mercedes deployed an estimated 1,240 tonnes and 1,190 tonnes of cobalt onto roads globally in 2022 H2, respectively, up 88% and 46% over 2021 H2.



BY CELL SUPPLIER

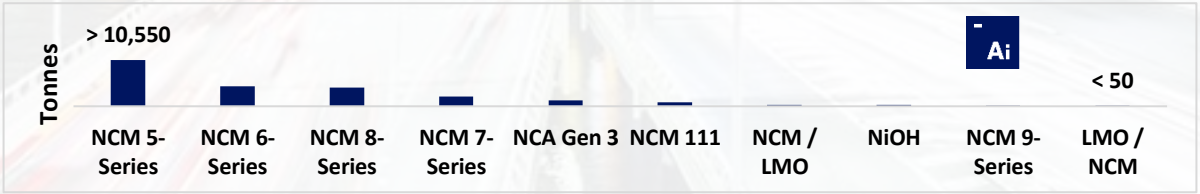
By cell supplier, CATL maintained its lead in 2022 H2 with a 30% share of global cobalt deployment on the back of a 47% increase in cobalt consumption year-over-year. In second, LG Energy Solution deployed nearly 6,300 tonnes of cobalt (up 44% year-over-year), followed at a distance by CALB, which saw its deployment nearly double over the same period.

Notably, the top seven cell suppliers globally by cobalt deployed onto roads (CATL, LG Energy Solution, CALB, Samsung SDI, Panasonic, SK On and Farasis) were collectively responsible for 87% of all cobalt deployment into passenger xEV batteries in 2022 H2.



BY CHEMISTRY

Cobalt deployment onto roads in NCM 5-Series cells topped 10,550 tonnes in 2022 H2, followed by NCM 6-Series cells (4,670 tonnes), NCM 8-Series cells (4,260 tonnes) and NCM 7-Series cells (1,360 tonnes).



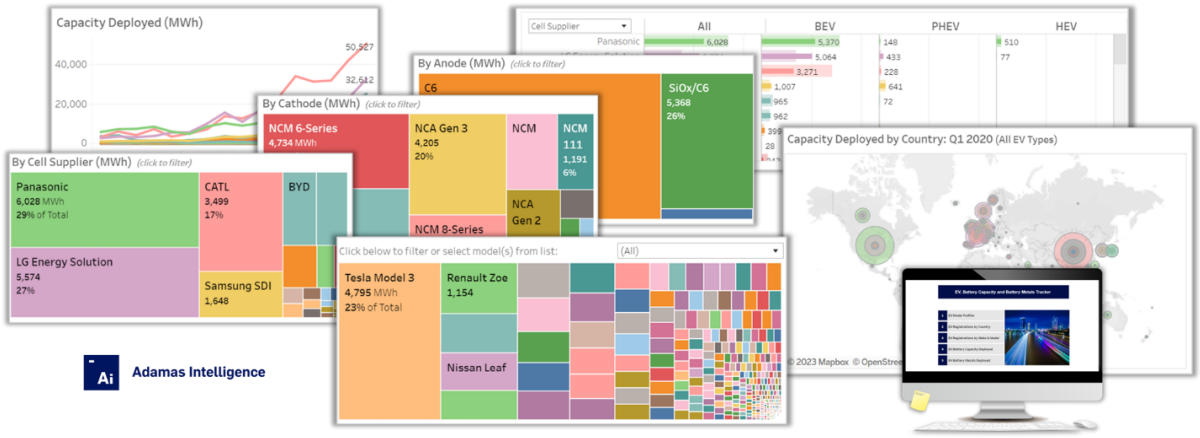
AVERAGE

Notably, the average amount of cobalt deployed onto roads globally per xEV sold in 2022 H2 was 3.1 kg, unchanged year-over-year (as with manganese) as consumption per unit has been suppressed by rising adoption of cobalt-free LFP cells, particularly in China.

Cobalt: EV and Battery Supply Chain Coverage

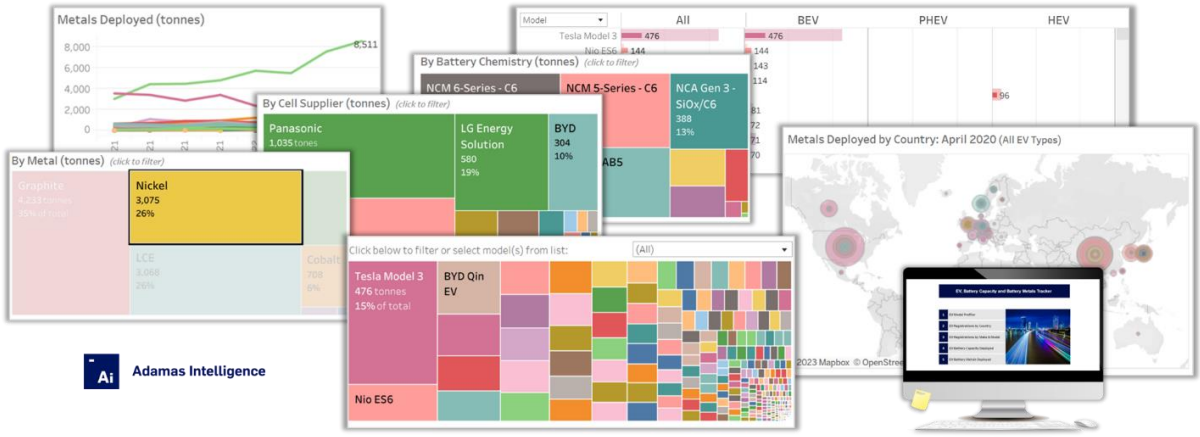
Adamas' EV Battery Capacity and Battery Metals Tracker intelligence platform tracks and reports the cell suppliers, chemistries and other key specifications of every EV model produced globally to-date.

- Granular **cell chemistry** breakdown (e.g., LFP, NCM 5-, 6-, 7-, 8-Series, etc.)
- Platform **updated monthly**, complete with historical monthly data back to January 2004



The platform also tracks and reports the total mass of cobalt used in the battery of every unique EV model produced globally to-date, along with total cobalt consumption per make, vehicle segment, EV segment, cell supplier, cell chemistry, country, region and more.

- Battery specs and **cobalt consumption** per vehicle for every EV produced globally to-date
- Platform **updated monthly**, complete with historical monthly data back to January 2004



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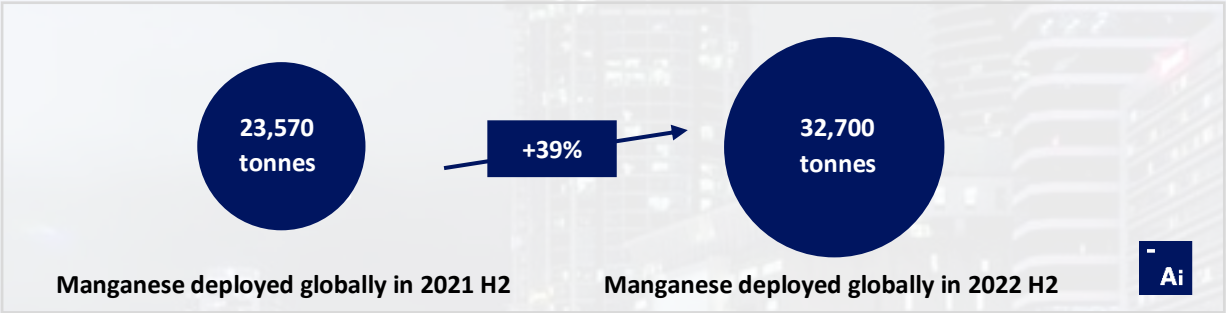
Manganese Deployed

OVERVIEW

In 2022 H2, 32,700 tonnes of manganese were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, up 39% over the same period the year prior.

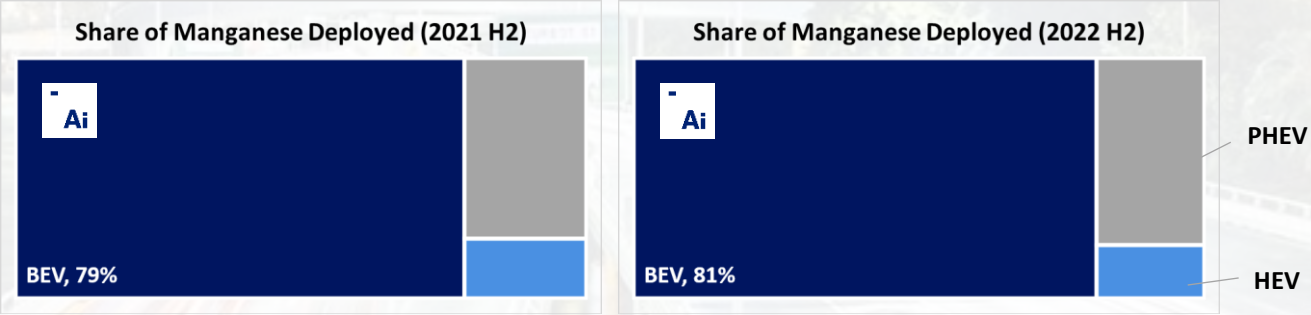
As with nickel and cobalt, this increase was driven by a rise in global xEV sales, a rise in the average xEV's pack capacity, and pervasive use of medium-nickel cell chemistries, such as NCM 5- and 6-Series, which use inherently more manganese per kWh than NCM 8- and 9-Series cells.

The top seven cell suppliers by manganese deployed onto roads in 2022 H2 (CATL, LG Energy Solution, CALB, Samsung SDI, SK On, GS Yuasa and Panasonic) were collectively responsible for 83% of the market's consumption.



BY EV TYPE

BEVs were responsible for 81% of all manganese deployed globally in passenger xEV batteries in 2022 H2 (up from 79% in 2021 H2), whereas PHEVs and HEVs were responsible for 19% in 2022 H2 (down from 21% in 2021 H2), as BEV sales growth outpaced that of P/HEVs over the same period.



AVERAGE

The average amount of manganese deployed onto roads globally per xEV sold in 2022 H2 was 4.0 kg, unchanged year-over-year (as with cobalt) as consumption per unit has been suppressed by rising adoption of manganese-free LFP cells, particularly in China.

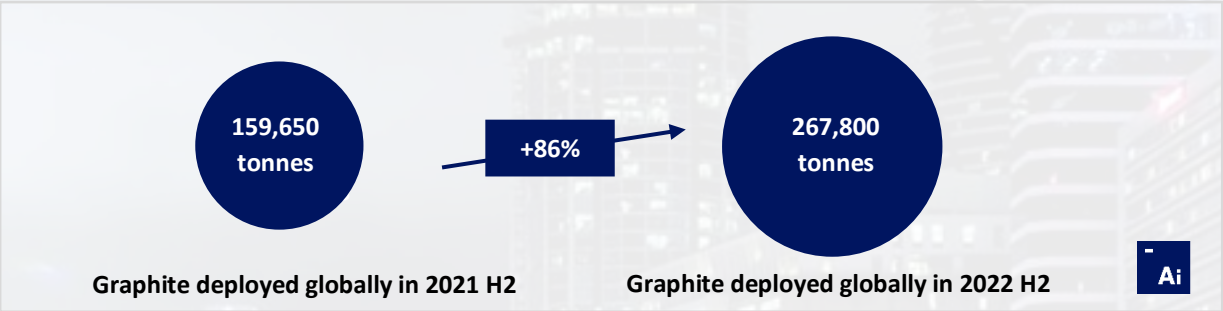
Graphite Deployed

OVERVIEW

In 2022 H2, 267,800 tonnes of graphite were deployed onto roads globally in the batteries of all newly sold passenger xEVs combined, up 68% over the same period the year prior.

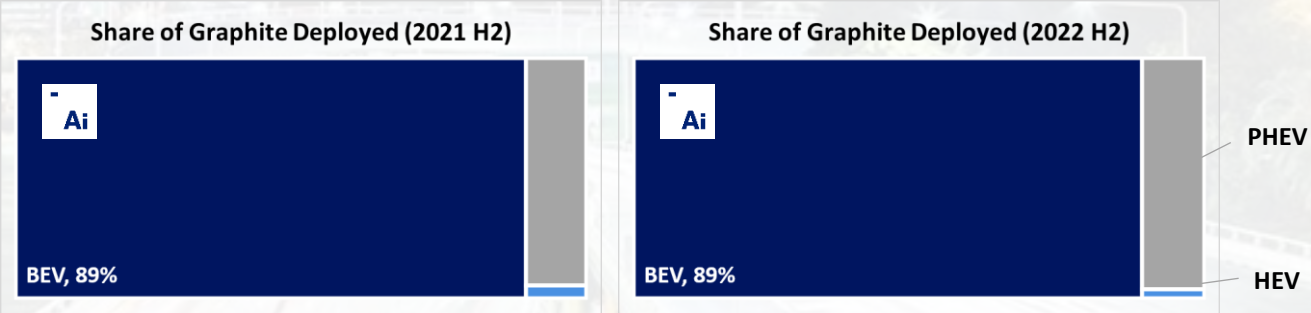
As with lithium, this increase was driven mainly by a rise in global xEV sales (up 38% year-over-year) coupled with a rise in the average xEV's pack capacity (up 19% year-over-year) over the same period.

The top seven cell suppliers by graphite deployed onto roads in 2022 H2 (CATL, LG Energy Solution, BYD, Panasonic, CALB, SK On and Samsung SDI) were collectively responsible for 88% of the market's consumption.



BY EV TYPE

BEVs were responsible for 89% of all graphite deployed onto roads globally in passenger xEV batteries in 2022 H2 (unchanged from 2021 H2), whereas P/HEVs were responsible for 11% in 2022 H2 (also unchanged from 2021 H2).



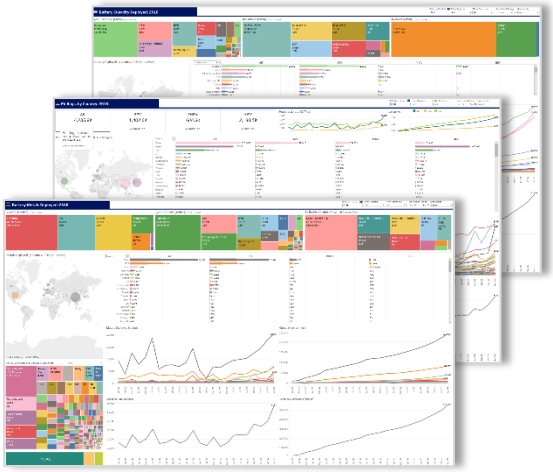
AVERAGE

The average amount of graphite deployed onto roads globally per xEV sold in 2022 H2 was 32.9 kg, up 21% year-over-year on the back of a rise in xEV sales and a rise in the average xEV's pack capacity.

Adamas Data Platform: "EV Battery Capacity and Battery Metals Tracker"

Building on ongoing EV registrations in over 110 countries, our web-based EV Battery Capacity and Battery Metals Tracker intelligence platform helps users track monthly consumption of battery metals and materials (in tonnes), battery capacity (in GWh), and the ever-evolving competitive landscapes of battery chemistries and cell suppliers.

The platform's intuitive user interface and interactive charts and filters let users quickly zoom in on specific regions, countries, automakers, EV models, segments, cell suppliers, battery chemistries, battery materials and more.



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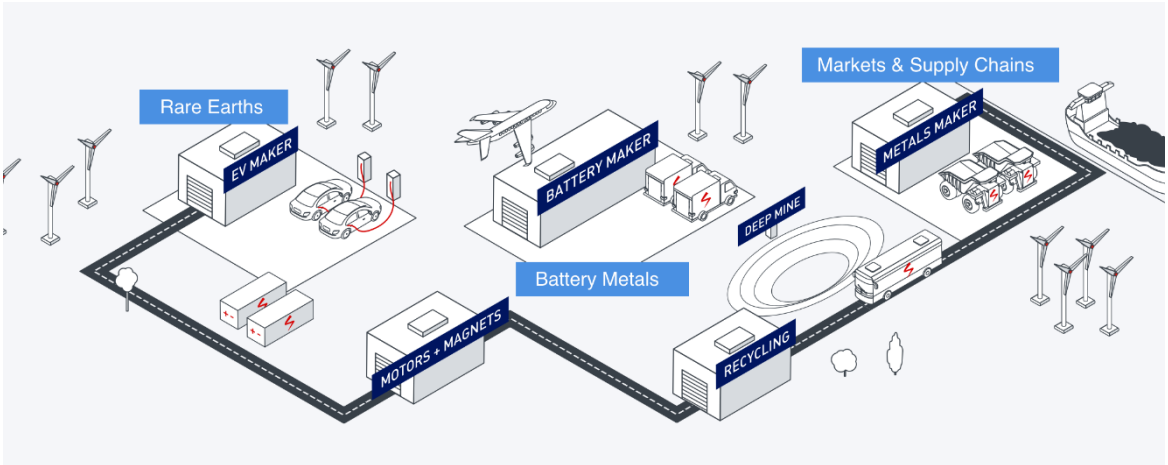

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