Rhodium Group

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Global Clean Investment Monitor: Electric Vehicles and Batteries

Energy & Climate

Authors

Michael Delgado, Jessica Chan, Kate Larsen, Anne Luo, Charlotte McClintock, Mahmoud Mobir, Shweta Movalia, Abbie Olson, Hannah Pitt, Alfredo Rivera, Harold Tavarez, Yvonne Yu, Xinyu Zheng

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Introducing the Global Clean Investment Monitor

Many major economies see domestic manufacturing of clean energy and transportation technology as a powerful driver of economic growth, important to national security objectives, or necessary to sustained political support for related policies. Governments in the US, China, and Europe all provide fiscal or other policy support to spur both the manufacturing of those technologies and the demand needed to sustain domestic industries. This support improves the politics of clean energy and transportation policy domestically, expands clean technology production capacity globally, and accelerates the clean energy transition.

As these industries mature, new international trade and cross-border investment tensions between major economies will emerge. Governments are increasingly concerned about the security and resilience of clean energy supply chains and the need to counter the economic influence of their competitors through trade and overseas investment. Navigating these economic and security concerns while maintaining global climate cooperation and ensuring developing countries receive the support they need to decarbonize affordably will be critical to the success of the global clean energy transition.

For the past two years, the US Clean Investment Monitor (CIM)—a joint project of Rhodium Group and MIT's Center for Energy and Environmental Policy Research (CEEPR)—has provided a comprehensive, real-time source of information on investment in the manufacture and deployment of clean energy technologies in the US. The CIM provides timely insights into the state of the US clean energy transition and the impact of relevant policy on clean energy deployment and local economic development.

Rhodium and MIT-CEEPR are now developing a new **Global Clean Investment Monitor (GCIM)** to track global investment in the manufacturing and deployment of clean energy technologies. The GCIM will provide policymakers and investors with up-to-date information on the manufacturing and deployment of clean energy technologies, including data on manufacturing investments at various stages of completion, estimated annual production capacity by country, current and projected country-level demand, and public subsidies. This report marks the first phase of the GCIM's development. A forthcoming MIT-CEEPR report will build on this report with an in-depth analysis of government incentives and trade policies.

Executive Summary

In this first edition of the Global Clean Investment Monitor series, we explore how—after decades of national policy support, primarily in the US, China, and Europe—electric vehicles (EVs) and batteries have been catapulted into mass commercialization. Demand for EVs and batteries has risen sharply as EVs reach cost competitiveness with combustion vehicles across many regions. In this report, we share insights from our tracking of 1,248 EV and battery manufacturing facilities around the world—including investment levels, project construction status, and EV and battery production capacity—providing real-time data for policymakers, investors, and other decision-makers seeking to understand if EV and battery demand can be met primarily through domestic production in the coming decade, and the extent to which excess capacity by foreign suppliers will compete for market share. We examine four key dynamics that will determine the future of the electric vehicle transition:

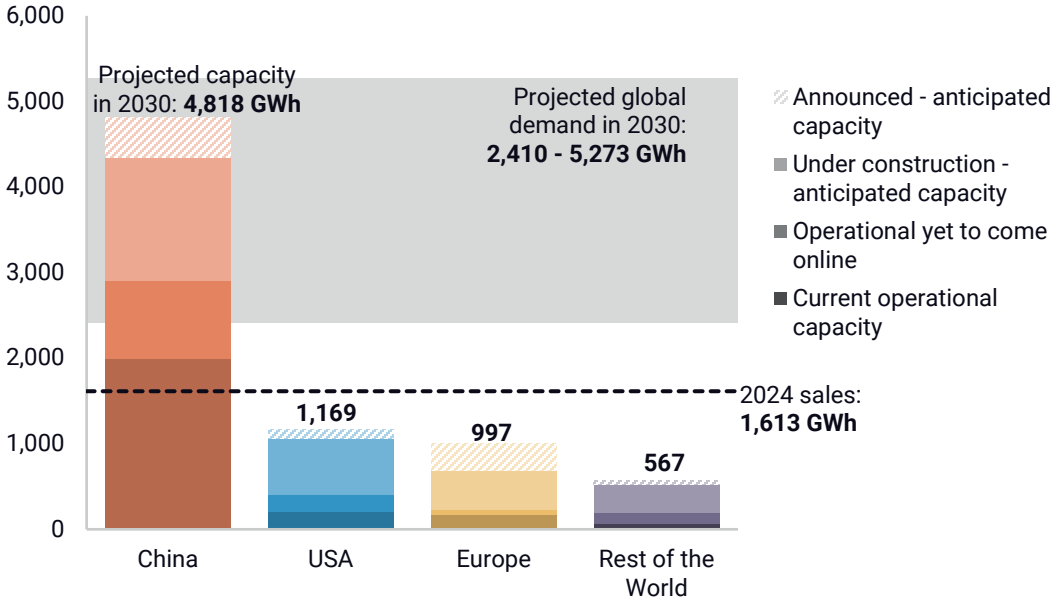
How will China's automakers and the rest of the world react to China's massive overcapacity in batteries—and to a lesser extent EVs—over the coming years?

Thanks to sustained state support for EV and battery manufacturing and deployment, as well as a massive domestic market, China has been home to two-thirds of global growth in EV sales and manufacturing capacity and over 80% of the growth in battery manufacturing capacity over the last 15 years. Fierce competition among EV and battery manufacturers in China for state-based incentives has led to a sharp decline in EV and battery prices, helping scale deployment, but has led to massive overcapacity in batteries. Today, China's battery manufacturing capacity is 2x demand in China and 1.2x global demand.

FIGURE ES1

China's battery overcapacity helps speed global EV transition but could undercut new entrants

Projected battery manufacturing capacity in 2030 and expected global demand (GWh of cells)



Source: Global Clean Investment Monitor, Rhodium Group, EV Volumes. Note: Demand includes stationary storage capacity additions and EV sales.

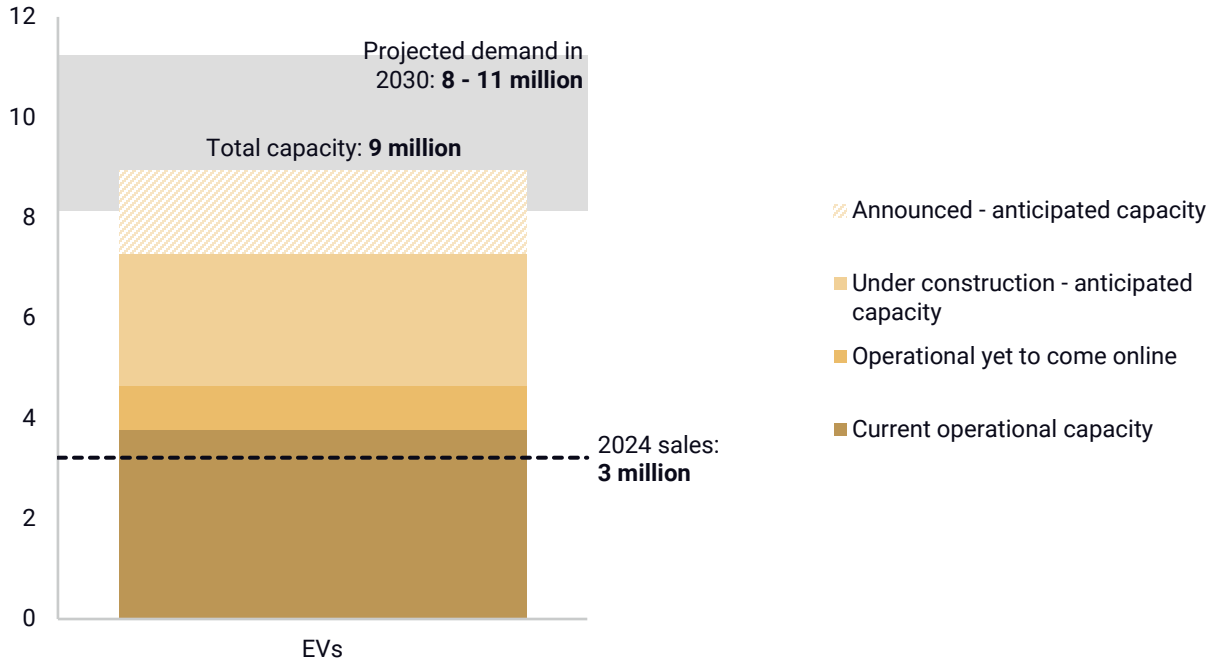
How will Europe's near- and long-term zero-emission vehicle ambitions fare as European OEMs contend with the potential for a wave of cheap EV imports from China?

After China, Europe is the world's second-largest EV market, and current and planned policies put the region on track to achieve 100% zero-emission vehicles in the coming decades. Unlike China where nearly all EV sales are produced domestically, almost a third of Europe's EVs are imported. In 2024, 15% of EVs sold in Europe were Chinese brands, most of which offer a significant cost advantage compared to European brands. Cost parity with ICE vehicles will be critical to achieving Europe's zero-emission vehicle ambitions, making cheap imports from China a boon to scaling EV deployment. Looking ahead, the big question for Europe is to what extent it will continue to open its doors to EV imports from China? What will cheap imports from China mean for the competitiveness of European OEMs and their willingness to go along with stringent zero-emission vehicle policy? How will policymakers balance the dual goals of maintaining domestic political support for the EV transition with the need to ensure access to cost-competitive EVs?

FIGURE ES2

Europe's planned EV production capacity may fall short of rapidly growing demand

Europe's operating EV manufacturing capacity vs. European EV sales today (million vehicles)



Source: Bruegel European Clean Tech Tracker, Global Clean Investment Monitor, 2024 Rhodium Climate Outlook, EV Volumes.

What is the outlook for the EV transition in the United States? Unlike China and Europe, where EVs have reached escape velocity, the potential for the US to follow suit is at risk as the Trump administration threatens to repeal policies that support EV sales and domestic manufacturing.

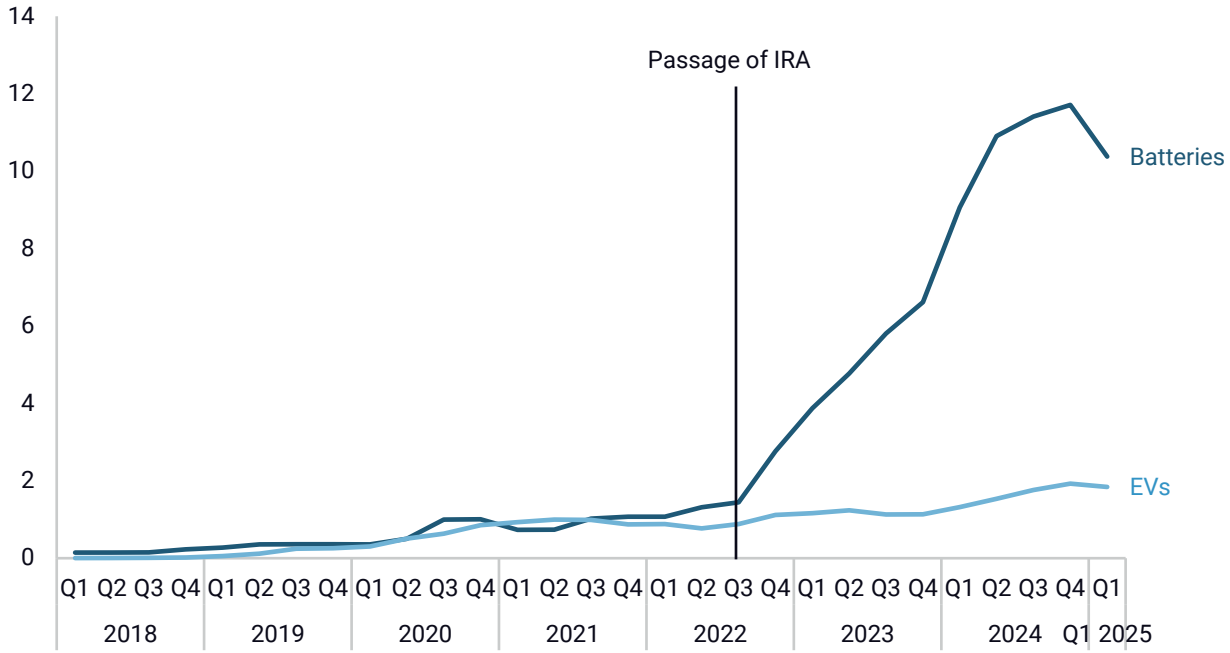
The passage of the Inflation Reduction Act (IRA) in the US in 2022 kicked off unprecedented investments in domestic EV supply chains by providing direct subsidies for domestic manufacturing of battery cells and EVs. These supply-side policies, coupled with

consumer EV tax credits tied to domestic content requirements and stricter tailpipe regulations, have spurred a wave of investment in domestic EV supply chains over the past few years.

FIGURE ES3

IRA supercharges US battery manufacturing investment, but US EV future now in doubt

Investment in EV supply chains in the US (billion 2023 USD)



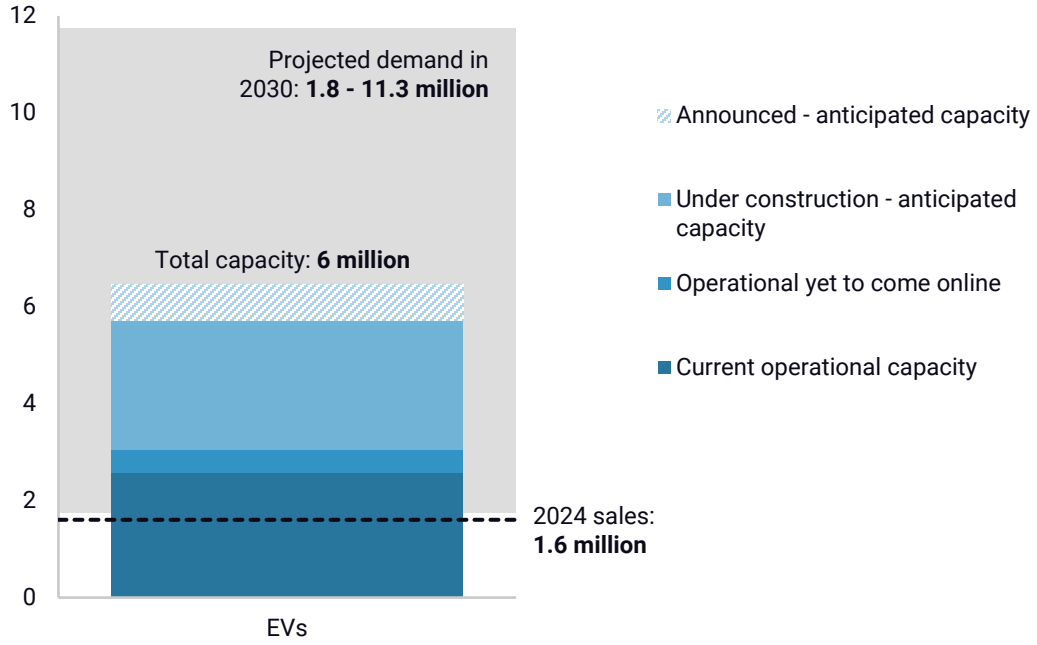
Source: Clean Investment Monitor

In contrast with Europe, the US has been on track to establish a competitive EV industry based on a largely domestic EV supply chain, but just as the EV transition is gaining steam, the EV and battery manufacturing sectors are now at risk of having core policy support revoked. President Trump's trade policy and signs of slowing demand cast further doubt on the outlook for EVs in the US. Going forward, key questions about the future of an electric vehicle transition in the US include: What happens to domestic production and sales if key policies, including the IRA tax credits and federal and state EV and GHG standards, are rolled back? How might trade policy, especially an escalation with China, reshape domestic manufacturing? If market conditions weaken, do planned manufacturing investments become redundant? In the absence of policy to encourage innovation, will US companies be able to compete in a world moving increasingly toward EVs? If not, what does that mean for the prospects of electrifying US transportation if major domestic automakers aren't producing the EVs of the future?

FIGURE ES4

US policy uncertainty makes it difficult to plan for future EV demand

Current and planned EV manufacturing capacity relative to current and 2030 demand (million vehicles)



Source: Global Clean Investment Monitor, Rhodium Group, EV Volumes.

How will the rest of the world respond to these dynamics emerging among China, Europe, and the US?

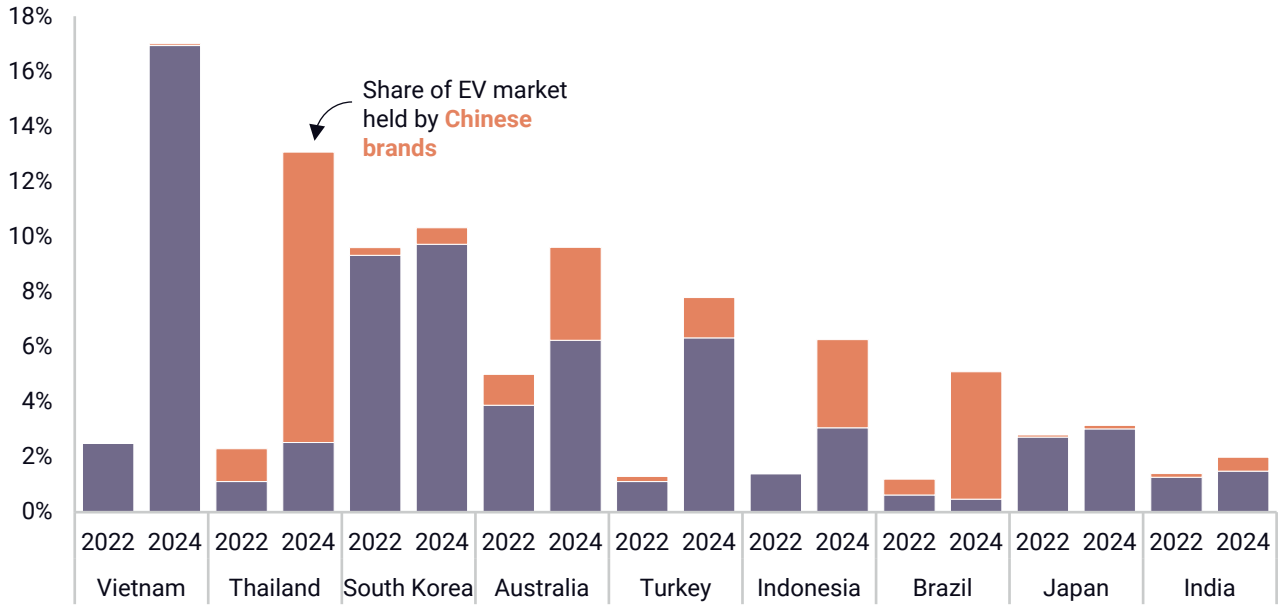
While China, Europe, and the US dominate EV markets today, sales in the rest of the world are rising rapidly. We project that by 2050, EV sales outside of China, Europe, and the US will grow from 10% to 30-40% of global EV sales. Just in the last few years, sales have surged in Turkey, Brazil, and many Southeast Asian countries, driven in large part by low-cost Chinese models. For consumers in emerging economies, EVs must be affordable to gain market share. Low-cost imports from China and foreign investment present opportunities for widespread adoption and local manufacturing, but risk crowding out domestic manufacturers (Figure ES5).

Investments in EV and battery manufacturing outside of China, Europe, and the US are ramping up rapidly (Figure ES6). As the rest of the world seeks to participate in and benefit from the EV transition, they will need to understand how they can position themselves in the global EV supply chain. How do EVs compete with traditional vehicles outside of China, Europe, and the US? Where are EV sales beginning to take off? Which countries are investing in domestic manufacturing? To what extent are both sales and manufacturing driven by Chinese imports and investment, versus domestic brands? What pressures do policymakers face to carve out market share for domestic manufacturers, versus allowing access to low-cost Chinese EVs?

FIGURE ES5

EV market share has surged with Chinese brands playing a major role in many markets

EV sales share and fraction from Chinese brands

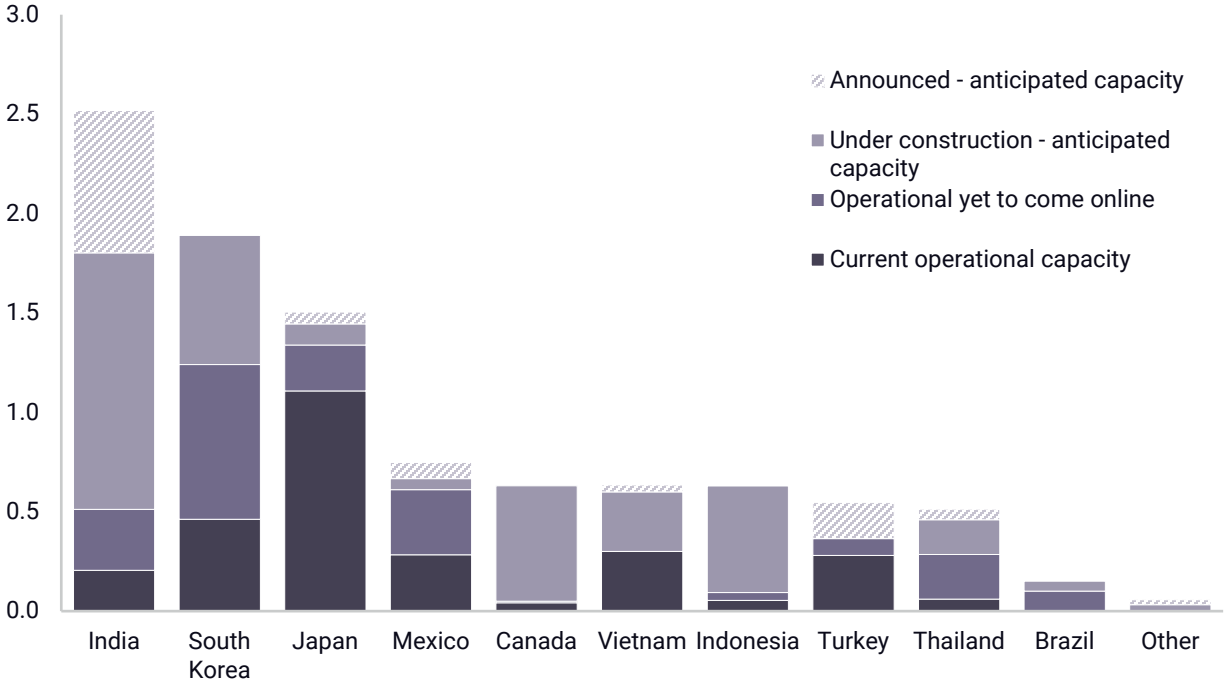


Source: EV Volumes

FIGURE ES6

The pipeline of EV manufacturing shows a shifting landscape for capacity

EV current and planned capacity in 2030 (million vehicles)



Source: Global Clean Investment Monitor

The world is at a critical inflection point when it comes to global auto manufacturing. The global transition to electric mobility has finally achieved escape velocity as EVs reach cost

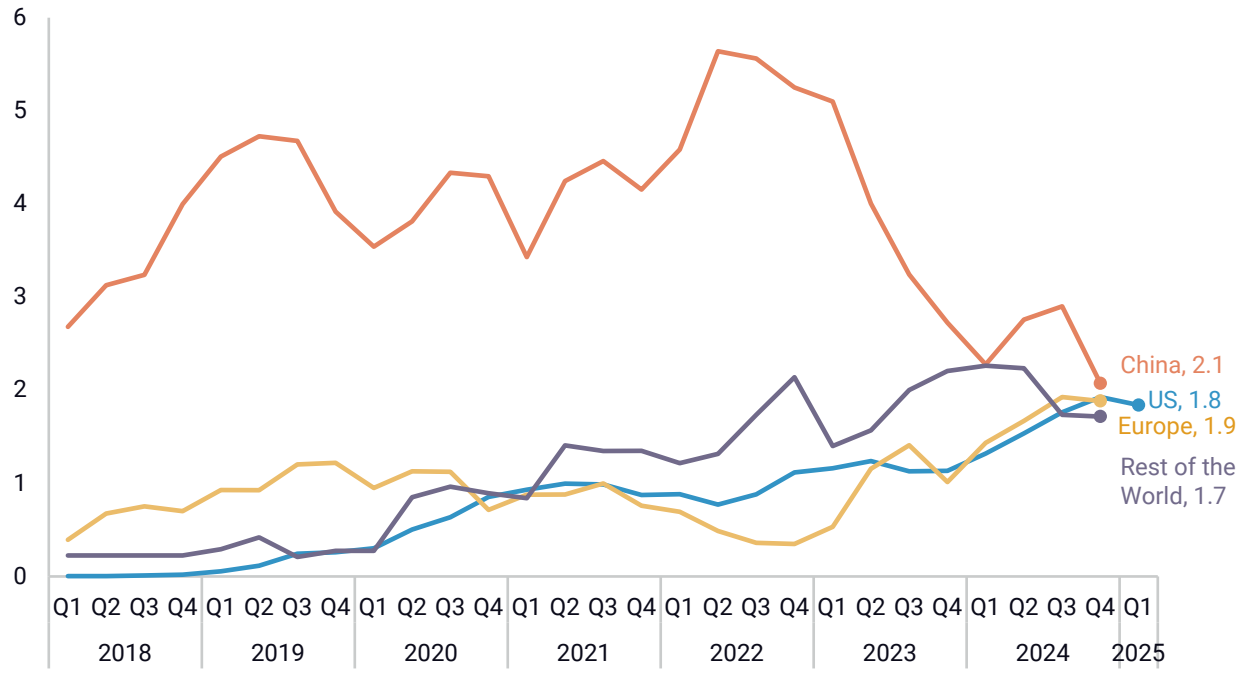
parity with internal combustion engine vehicles. In fact, even absent an acceleration in clean transportation policy, the Rhodium Climate Outlook projects that passenger EVs will *very likely* (greater than 95% probability) make up at least half and as much as 80% of global sales by mid-century. While the Big Three—China, the US, and Europe—will represent the majority of sales for the next decade or so, demand growth in the rest of the world is set to accelerate sharply.

Who will produce the vehicles driving the future of mobility? China's head start and massive domestic market have given it a leg up, but policy-driven upticks in US and European investment in recent years have tightened the race (Figure ES7), and the rest of the world is investing rapidly to serve the Big Three and their own growing domestic markets.

FIGURE ES7

China's lead on EV manufacturing investments has narrowed as the US and Europe ramp up

Quarterly EV manufacturing investment by region (billion 2023 USD)



Source: Global Clean Investment Monitor

The auto sector's outsized role in economic, political, and, increasingly, national security dynamics will create significant trade-offs for policymakers in the coming decades. To what extent will countries look to secure largely domestic or friend-shored supply chains, and what will that mean for EV affordability and the ultimate pace of EV adoption? To arm these policymakers with real-time information to inform them as they navigate this critical inflection point, in the coming months and years the Global Clean Investment Monitor will track quarterly investments in EV and battery manufacturing, capacity additions by project status, EV sales, and trade flows to provide a real-time window into how these dynamics are at play across the world.

CHAPTER 1

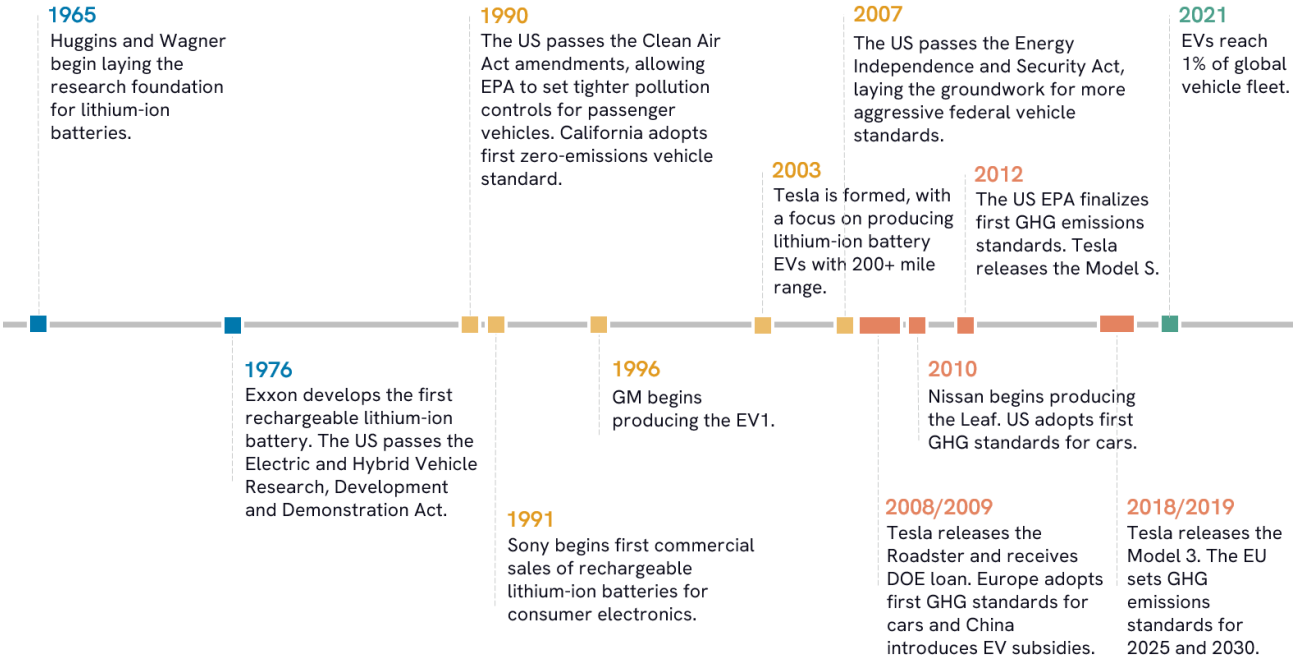
Driving the Global Electric Vehicle Transition

In recent years, electric vehicles have finally reached escape velocity. Global sales in 2024 exceeded 18 million vehicles, up from only 2 million just five years ago. Today, one in five of every vehicle sold worldwide is an electric vehicle (EV), defined here to include battery electric and plug-in hybrids. In China, over half of the vehicles sold last year were electric. This exponential rise was not a foregone conclusion, however. EVs and the batteries that power them have benefited from six decades of research & development (R&D) investments and policy support (Figure 1).

FIGURE 1

56 years to get from the lab, demonstration, early adoption, all the way to scaled deployment

Electric vehicle commercialization timeline



The initial phases of policy support were a response to the 1970s oil crisis, but this did little to advance lithium-ion battery EV deployment in the lab stage. It wasn't until the 1990s when the most important technology advancements came from the consumer electronics sector, where Japanese manufacturers achieved scaled cost reductions for rechargeable lithium-ion batteries (Figure 2). California's Zero-Emission Vehicle (ZEV) standards set the stage for automakers to focus on innovation in electric mobility. In 2003, a new vehicle startup—Tesla—began to focus on a lithium-ion battery EV to serve the budding California ZEV market.

The 2000s saw a wave of new vehicle standards that incentivized the electrification of passenger vehicles. In Europe, Norway led the way with early tax credits and incentives for EV adoption in the early 2000s, followed by EU-wide vehicle CO_2 standards in 2009, and a broadening of EV support policies across the UK, Germany, France, and other EU member states throughout the 2010s. In the US, early adoption of EVs was fueled by fuel

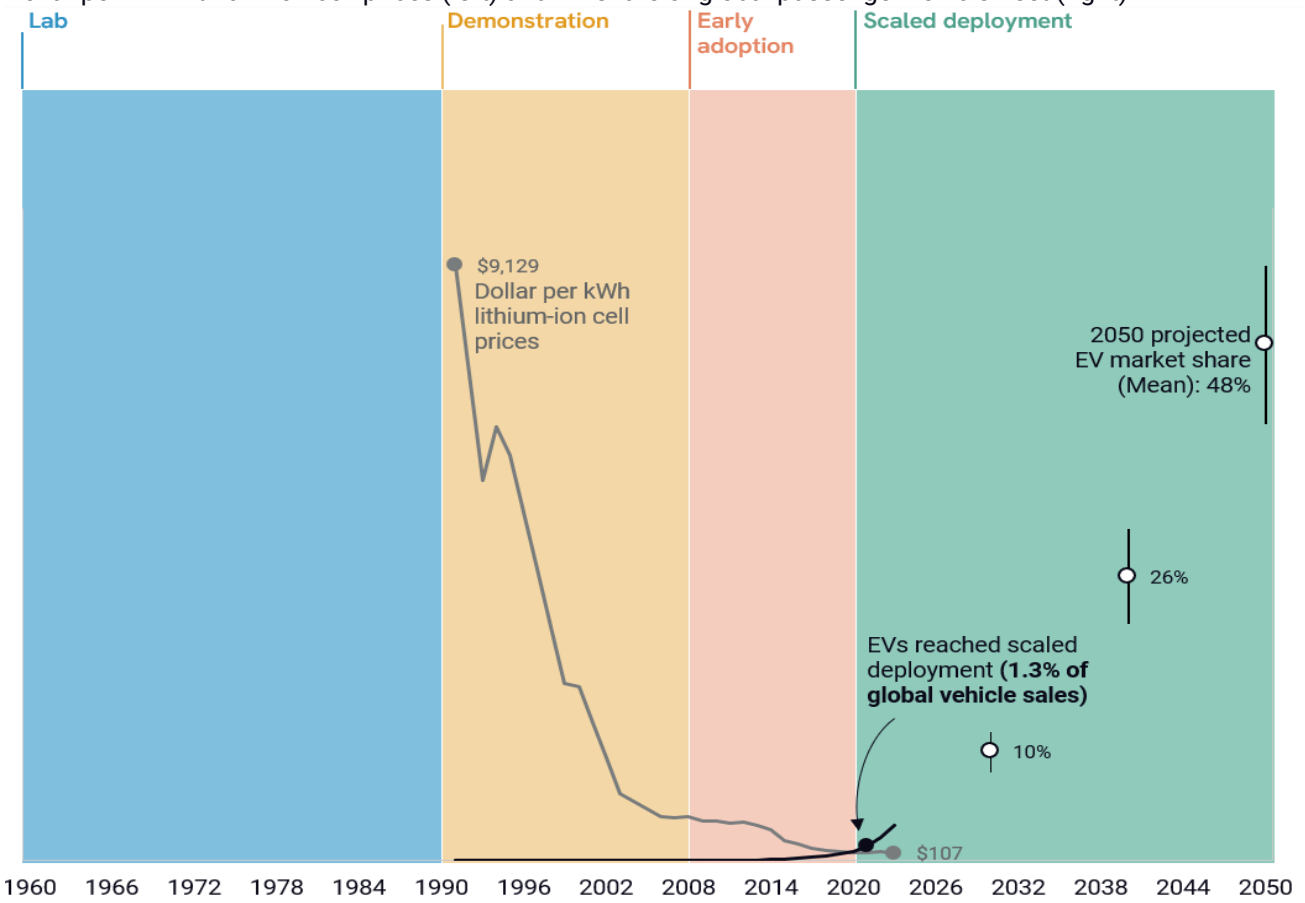
economy standards and GHG standards (2010) and tax credits that boosted national demand. Consumer EV subsidies and tax credits spurred the EV market in China starting in 2009. Policy support for EVs accelerated again in the early 2020s with the extension of consumer subsidies and tax credits paired with EV/GHG standards in key markets like the US, China, and Europe.

It is on the back of multiple decades of R&D and policy support that EVs have only recently entered scaled deployment globally, reaching a major milestone of 1% of global sales in 2021. This was possible only because of the dramatic decline in battery costs that resulted from economies of scale, with battery cell costs declining 90% over the past 20 years (Figure 2).

FIGURE 2

Critical inflection points in the electric vehicle commercialization process

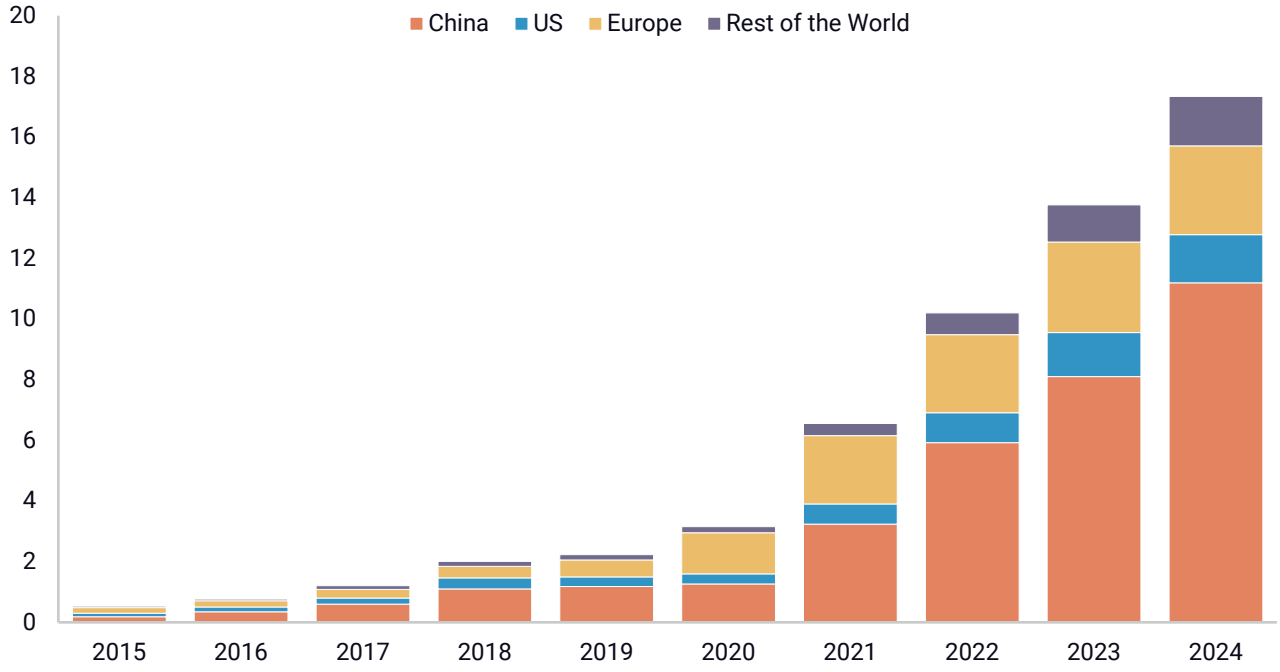
Dollar per kWh lithium-ion cell prices (left) and EV share of global passenger vehicle fleet (right)



Source: Ziegler and Trancik, BNEF, IEA, Rhodium Climate Outlook. Includes projected market share from the Rhodium Climate Outlook 2023 likely range and mean projection.

As a result of increasing cost competitiveness of EVs, demand has surged across the globe. Policy support has remained a critical factor in driving demand in the Big Three markets—Europe, China, and the US—all of which have sustained some combination of CO_2/EV standards, tax credits, and consumer subsidies through the early 2020s to spur demand (Figure 3).

FIGURE 3
EV adoption has surged in recent years thanks to policy support and falling costs
Global EV passenger vehicle sales by region (million vehicles)

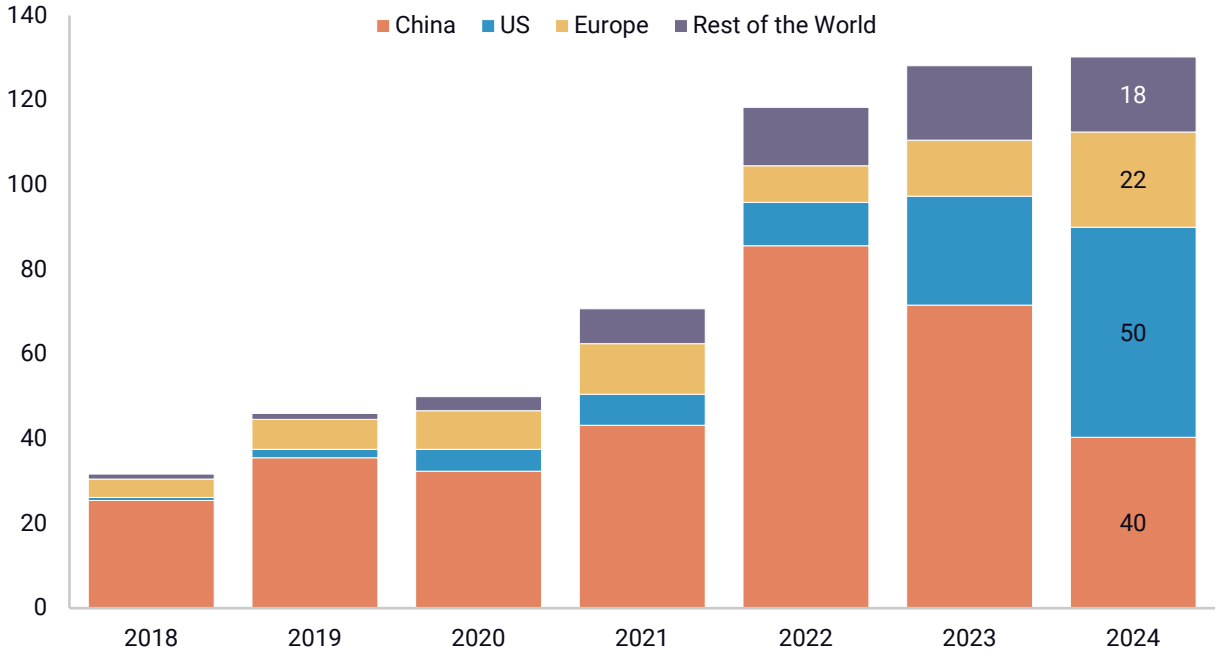


Source: EV Volumes

To keep pace with this demand, investment in global EV and battery manufacturing also ramped up sharply in the late 2010s and early 2020s (Figure 4). These investments surged first in countries with large domestic markets where policy support signaled a solid and growing source of EV demand (or in adjacent countries producing for export to those large markets). Public incentives for EV and battery manufacturing were critical to scaling investment, driving investment dollars to regions with large domestic markets and with subsidies that encouraged domestic production.

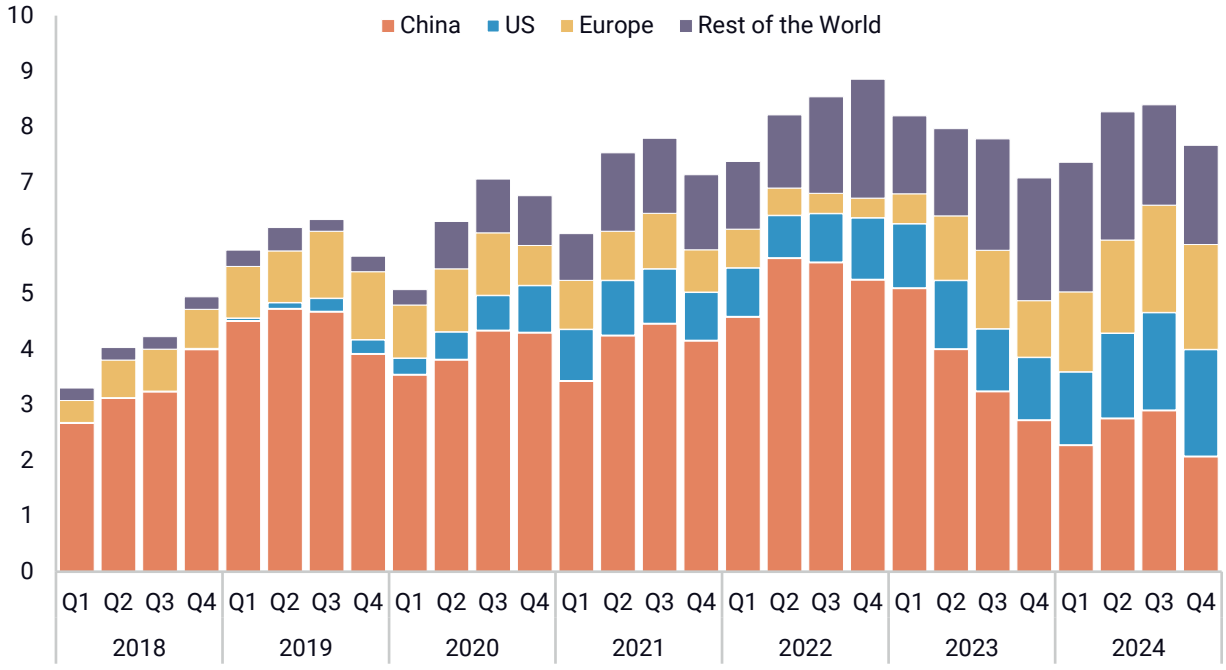
From 2018 through 2021, China was home to the majority of global EV manufacturing investments (Figure 5). By 2023, quarterly investments began to slow, declining steadily through last year. In Q4 2024, China's domestic EV manufacturing investments represented only 27% of the global total—a far cry from the 81% of global investment it represented in Q1 2018. China's investment decline led to an overall global decline in EV manufacturing investment throughout 2023. By 2024, a surge in investment from other regions began to pick up the slack, bringing overall global investment levels back up, but not quite reaching the Q4 2022 peak.

FIGURE 4
EV supply chain investment grew rapidly in the early 2020s
Global EV and battery manufacturing investments by region (billion 2023 USD)



Source: Global Clean Investment Monitor

FIGURE 5
China's dominance in EV manufacturing has slowed as other regions fill the gap
Global EV manufacturing investments by region (billion 2023 USD)



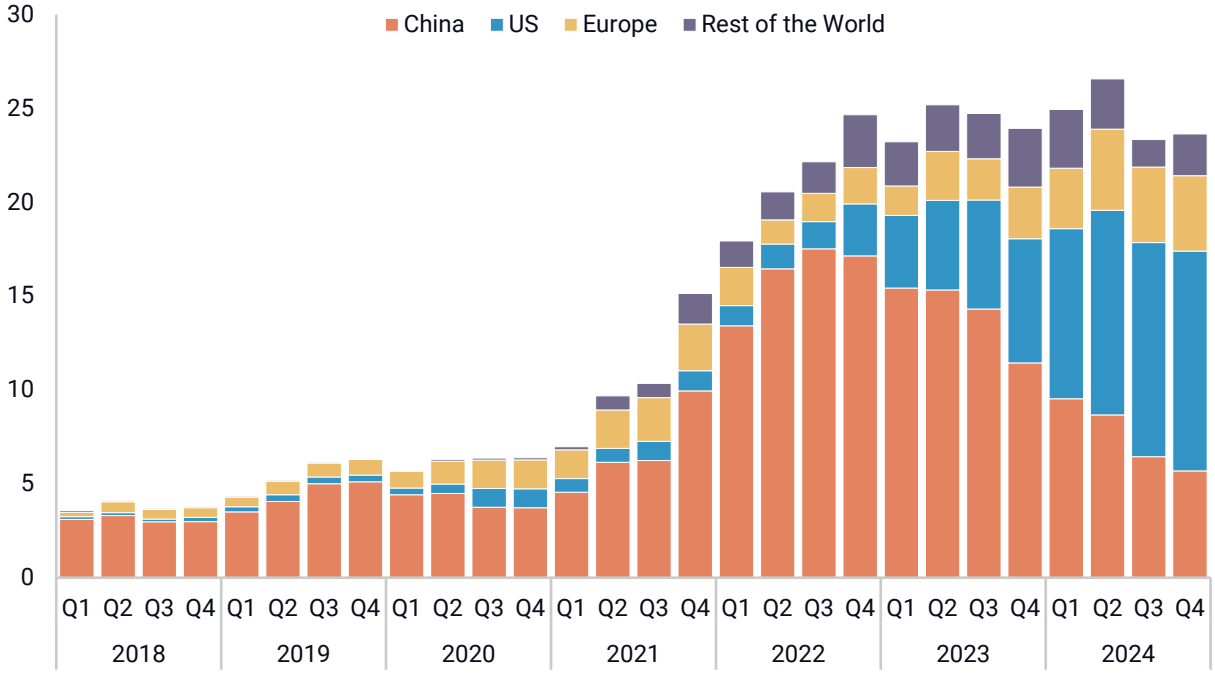
Source: Global Clean Investment Monitor

Global battery manufacturing investment took a bit longer to take off, remaining relatively flat from 2018 to 2020, but ramping up through 2021 as China's battery investment soared (Figure 6). It wasn't until investment in China began to cool due in part to domestic overcapacity in early 2023 that other regions began to expand their own domestic battery investments, led by the US with the passage of the Inflation Reduction Act (IRA).

FIGURE 6

China's battery manufacturing investment surged, then the US took the lead

Global battery manufacturing investments by region (billion 2023 USD)



Source: Global Clean Investment Monitor

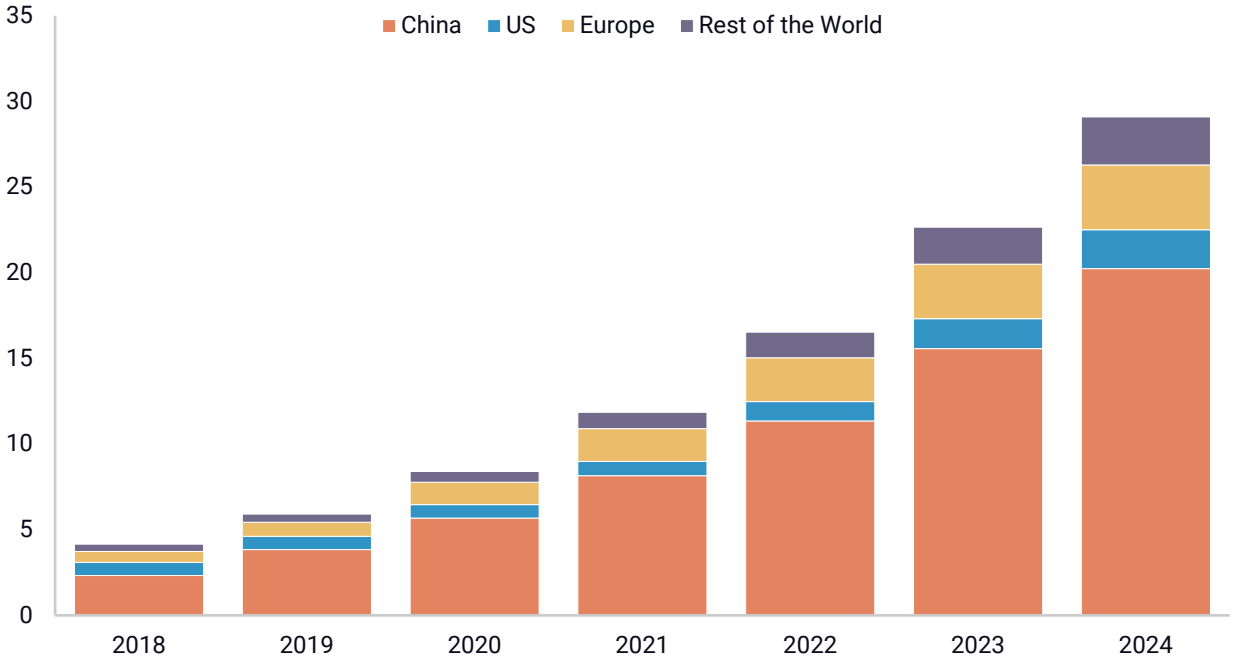
All that investment has led to significant growth in global EV and battery manufacturing capacity. Since 2018, global EV manufacturing capacity has grown from just over 4 million to nearly 29 million EVs, nearly 7x growth over only six years (Figure 7). Much of this growth has happened in China, Europe, and the US, as well as Japan and Korea, but capacity has been expanding worldwide, including big new facilities in Turkey, India, Mexico, and Vietnam (Figure 8).

Battery cell and module manufacturing capacity has followed a similar trend, though with much faster growth, with capacity increasing 14x between 2018 and 2024. The bulk of new facilities are located within China, the US, and Europe, as well as Japan, Korea, Turkey, India, Malaysia, Indonesia, and Thailand (Figure 9).

FIGURE 7

The world's capacity to build EVs has grown seven-fold since 2018

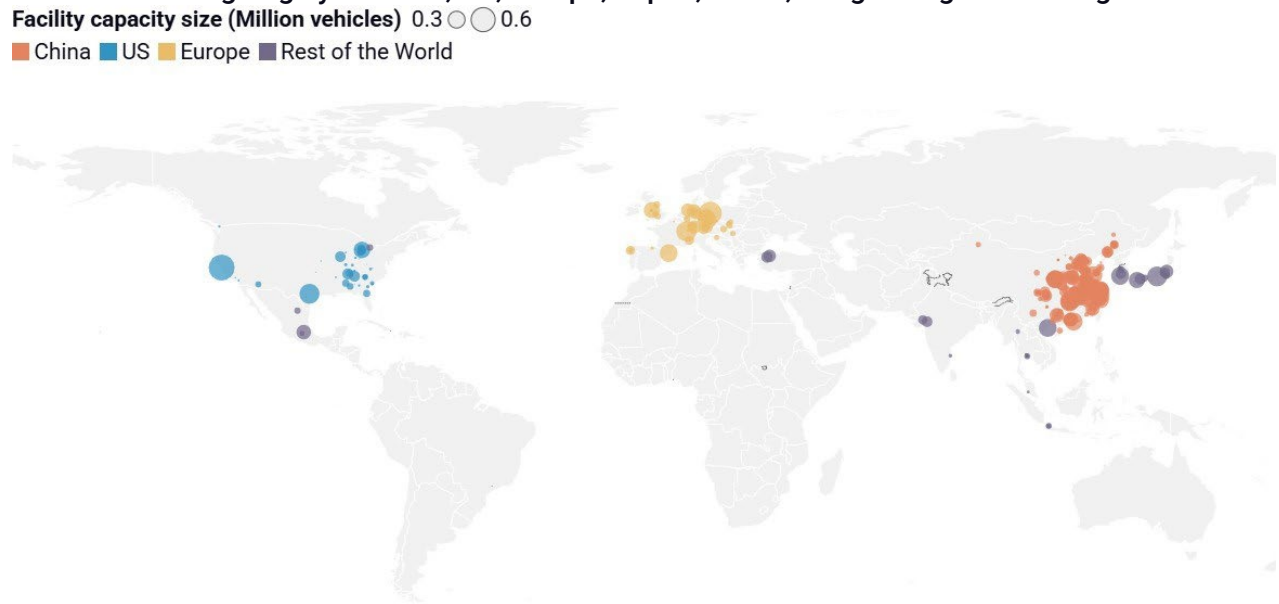
Global EV manufacturing capacity by region (million vehicles)



Source: Global Clean Investment Monitor

FIGURE 8

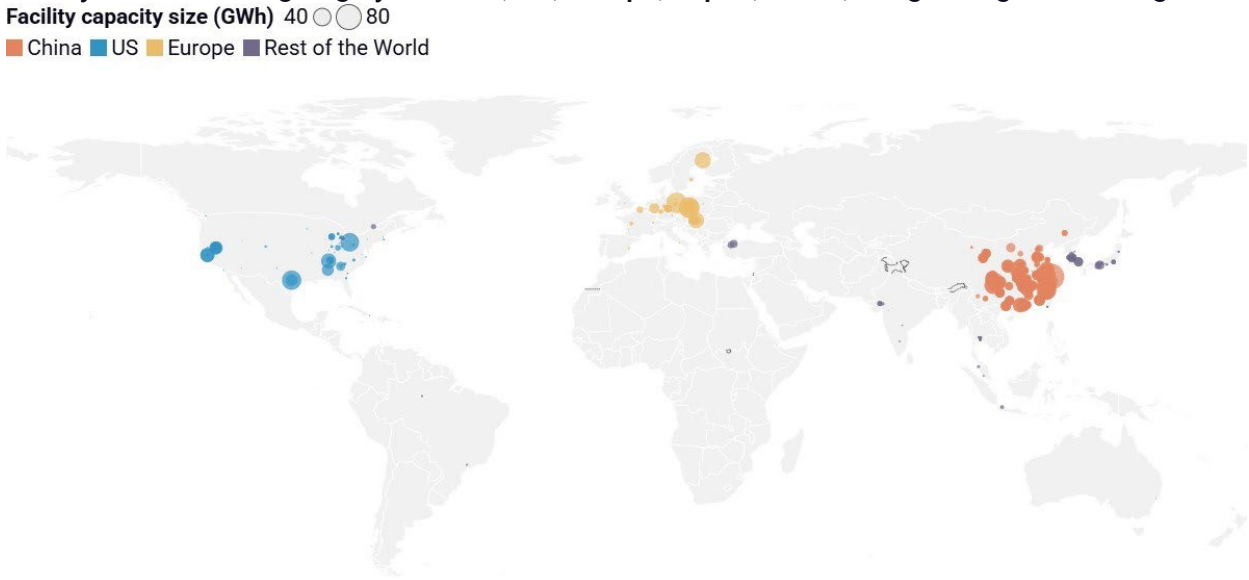
EV manufacturing largely in China, US, Europe, Japan, Korea, but growing in other regions



Source: Global Clean Investment Monitor

FIGURE 9

Battery manufacturing largely in China, US, Europe, Japan, Korea, but growing in other regions

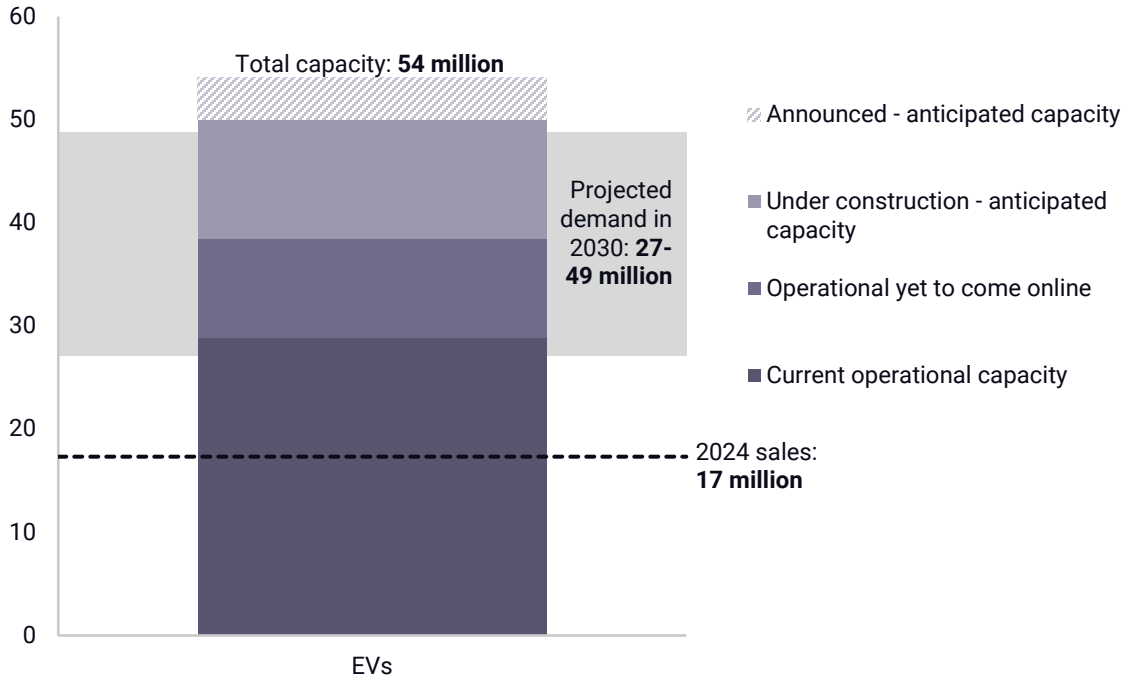


Source: Global Clean Investment Monitor

With all this new capacity expected to be online in the next five years, the world is well-positioned to have more than enough manufacturing capacity to produce sufficient EVs to meet growing demand. Today, global EV manufacturing facilities have the capacity to produce 29 million EVs each year. By 2030, facilities that are currently operational but still ramping up to meet planned operation levels will add an additional 9.6 million in global capacity. New projects that are currently under construction or announced but yet to commence construction are expected to add an additional 11.6 million and 4.1 million to overall EV manufacturing capacity, respectively, by 2030. That brings the total expected capacity in 2030 to 54 million EVs—that's roughly 3x the number of vehicles sold in 2024 (Figure 10).

That may seem like good news for the global EV transition, with plenty of excess vehicle stock to meet growing demand. However, overcapacity presents its own challenges. Based on our current policy projections from the 2024 Rhodium Climate Outlook—as well as Rhodium's latest analysis of the potential for US EV policy rollbacks —global EV sales in 2030 likely range from 27 to 49 million vehicles. This wide range of potential EV sales is due to several highly uncertain factors—including the pace of overall economic growth, policies driving EV adoption and charging infrastructure, battery costs, and oil prices—which we treat probabilistically to provide a likely range of outcomes. If all facilities that are currently announced and under construction come online as planned, the world is on track to have excess capacity of only about 3.2 million EVs if global EV sales are at the higher end of the projected range. But if global EV sales are at the lower end of the projected range in 2030—due to lower economic growth and sluggish EV policy—the world could see overcapacity of as much as 27 million vehicles by 2030 (Figure 10).

FIGURE 10
Global EV manufacturing capacity on track to exceed global demand in 2030
2030 global EV manufacturing capacity and demand (million vehicles)

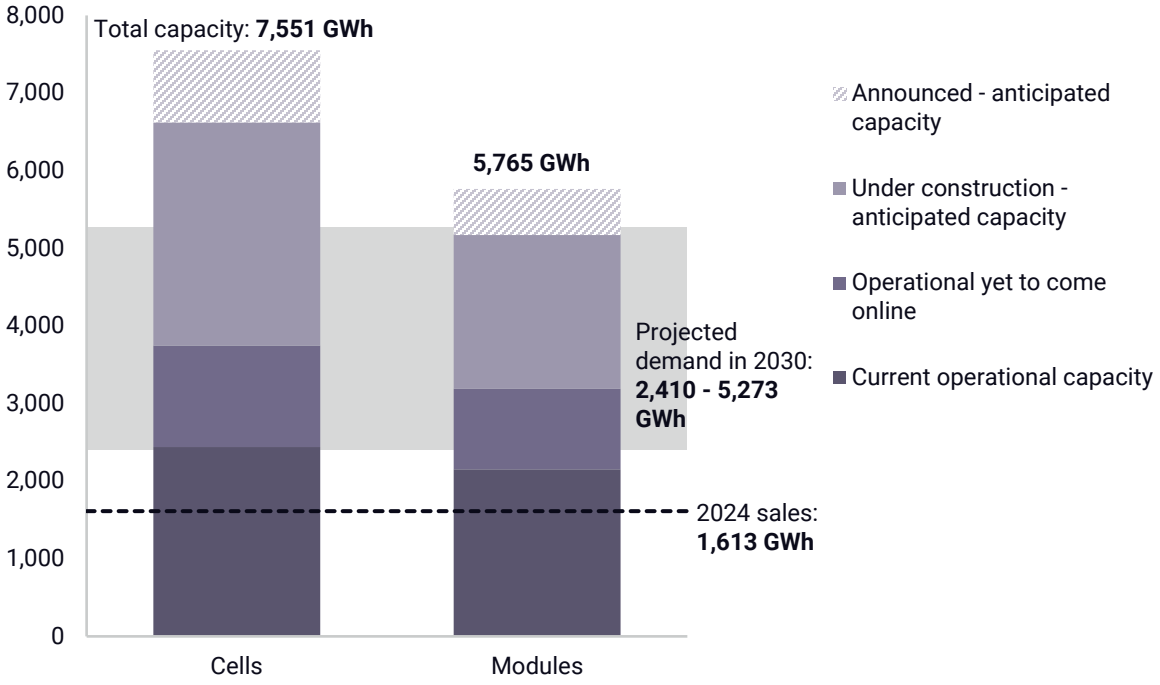


Source: Global Clean Investment Monitor, Rhodium Group, EV Volumes.

When it comes to batteries—both modules and cells—we see a much starker picture of overcapacity—a continuation of today's trend only amplified five years from now unless there is a correction. Today, we estimate global battery manufacturing capacity of 2,438 GWh of battery cells and 2,153 GWh of modules, including batteries for both vehicles and stationary storage. This is more than enough to meet current battery demand (1,613 GWh in 2024), creating a global glut of batteries.

That does not look likely to ease anytime soon. By 2030, another 1,307 GWh of cell and 1,037 GWh of module capacity that is operational today but yet to come fully online is expected to be fully operational. A vast quantity—nearly as much as total operating capacity in 2024—of new battery capacity is currently under construction and expected to be online by 2030 (2,876 GWh of cells and 1,981 GWh of modules). On top of that, an additional 595 GWh of module and 929 GWh of cell capacity projects have been announced and are anticipated to be online within the next five years. If all of that announced and under-construction battery capacity comes online by 2030, total global battery cell capacity will reach 7,551 GWh, and battery module capacity will reach 5,765 GWh (Figure 11).

FIGURE 11
Planned global battery manufacturing expansion could worsen overcapacity by 2030
GWh



Source: Global Clean Investment Monitor, Rhodium Group, EV Volumes. Note: Demand includes stationary storage capacity additions and EV sales.

To put that in perspective, battery manufacturing capacity in 2030—just five short years from now—is expected to reach 3.5-4.5x battery demand today. Will there be sufficient demand to warrant such investments? In the Rhodium Climate Outlook, we project that under current policy, battery demand in 2030 will likely be anywhere from 2,410 GWh to 5,273 GWh (depending on overall economic growth, EV and clean energy policy, and battery costs). Global battery overcapacity could reach anywhere from 2,278 to 5,141 GWh in cells and 492 to 3,355 GWh in modules.

While this paints a picture of the overall global outlook for supply and demand of EVs and batteries, regional dynamics and trade measures constrict the free flow of goods across borders. The political economy of auto manufacturing and industrial policy, restrictions on imports and local content requirements, and geopolitics and security concerns all impact the regional dynamics of where EVs and batteries are produced and sold. Looking ahead, the true global outlook for EV and battery production and sales will depend on several rapidly evolving questions, including: Where will the largest markets be in the coming decades? Who will emerge as the dominant suppliers? How open will countries be to cheap imported vehicles and batteries? In the chapters that follow, we dive into the policy and market dynamics driving EV investments in the three main EV markets—China, Europe, and the US—and provide a comparative look across these regions. Finally, we look at the emerging EV dynamics in the rest of the world to explore how they may respond in the coming decades as they seek to find their place in the global electric vehicle supply chain.

CHAPTER 2

China

In the past decade, China emerged as a dominant player in the electric vehicle market and supply chain. China was extremely well-positioned to expand its EV industry quickly, taking advantage of its massive domestic vehicle market, its decades of experience in scaled production of consumer electronics, and a raft of state subsidies to incentivize domestic manufacturing. As a result, today China is the world's largest producer and consumer of EVs and batteries—producing 90% of the world's EVs and three-quarters of its batteries—the vast majority of which are destined for the Chinese market. The past decade of investment in domestic EV and battery manufacturing has created significant overcapacity in China—operating EV manufacturing facilities in China today have the capacity to produce 165% of its domestic EV demand and 190% of its domestic battery demand. In fact, in 2024, China's EV manufacturing capacity exceeded total global demand for EVs and batteries, reaching 108% and 124% of global demand, respectively. This overcapacity has underpinned the rise in EV and battery exports from China since 2021.

Looking ahead, the key questions about China's EV ambitions are: How quickly will domestic EV demand grow? If it continues to handily meet all its domestic demand in the coming decade, to what extent will China continue to ramp up EV and battery production to full capacity to take advantage of its cost-competitiveness and export EVs to the rest of the world? Will the rest of the world allow cheap Chinese vehicles and batteries to compete with national brands? Below we dig into the internal dynamics shaping China's rise to dominance of the global EV and battery markets and point to key signals that the Global Clean Investment Monitor will be watching in the years ahead.

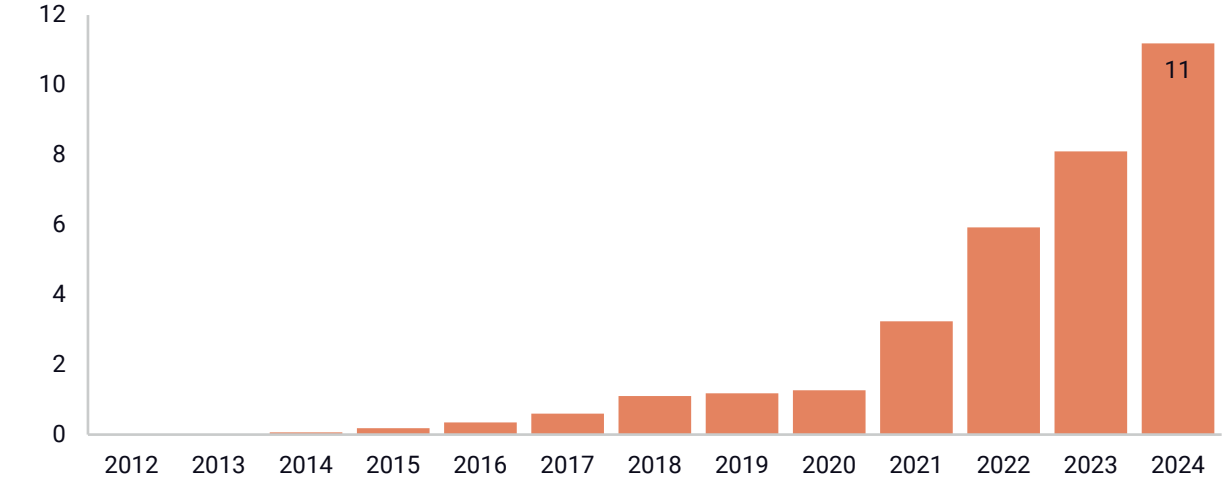
Electric vehicle demand

China has the world's largest passenger vehicle market, with 24 million vehicles sold in 2024. One of every three cars produced globally was sold in China. Electric vehicles made up nearly half of all passenger vehicles sold in China last year, a meteoric rise from only five short years ago when China's EV sales shares were in the single digits (Figure 12).

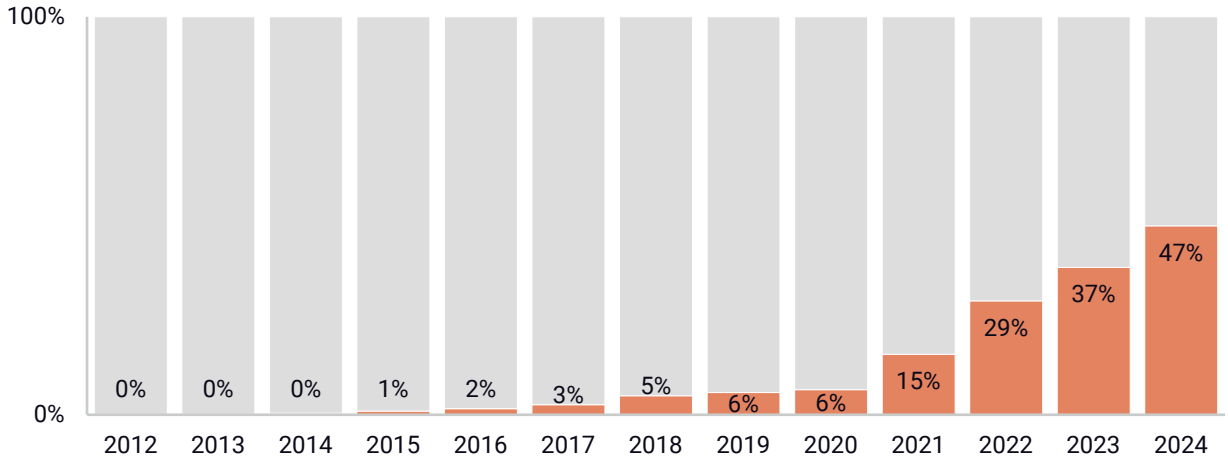
FIGURE 12

EV adoption in China has risen dramatically in the last five years

(a) China EV passenger vehicle sales (million vehicles)



(b) EV sales share of total annual passenger vehicle sales (%)



Source: EV Volumes

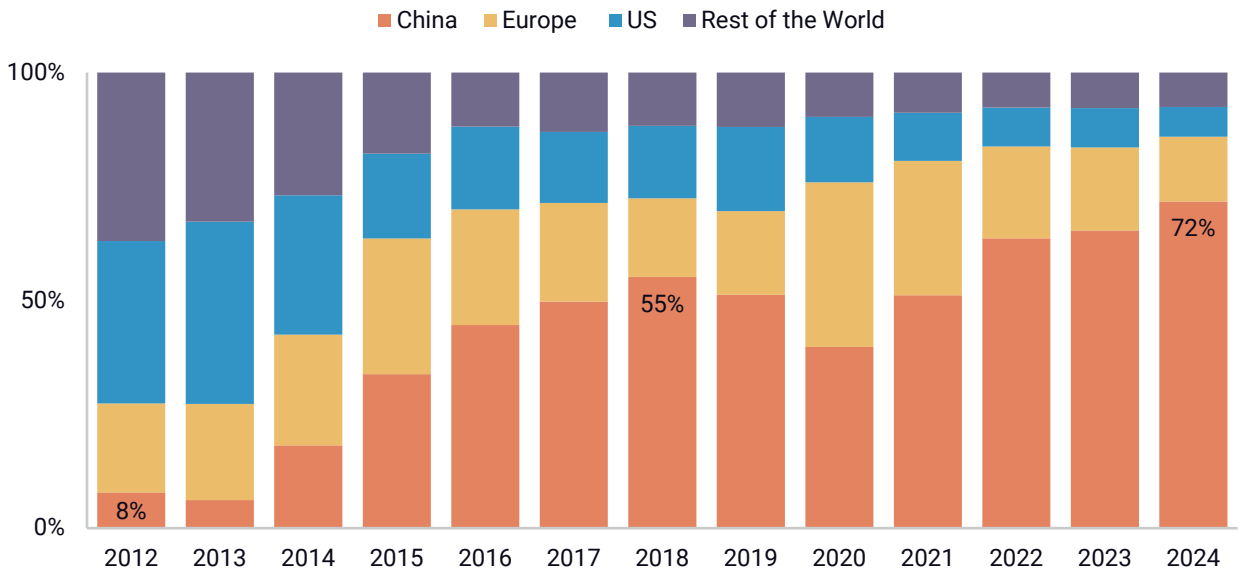
China's advantage in the EV passenger vehicles market didn't materialize until relatively recently, however. In 2012, China's EV sales still lagged dramatically behind the US, with just over 10,000 vehicles sold, compared to almost 55,000 EV sales in the US that year. Early efforts by China's government faced hurdles of weak consumer demand and limited charging infrastructure. It wasn't until China paired these goals with policy support—including consumer and manufacturing subsidies—that sales began to take off in the later part of the 2010s.

As early as 2001, China's government introduced EV technologies as a priority for research and development in its Five-Year Plan, but it wasn't until 2009 that it began to provide financial subsidies, tax breaks, procurement contracts and other support to incentivize production and consumer uptake of New Energy Vehicles (NEVs), with the goal of producing 500,000 NEVs by 2015. NEV purchase subsidies introduced by the central government for the first time in 2013 played a significant role in driving the domestic market for NEVs, as did NEV consumer tax incentives launched in 2014. In 2017, China set

a new goal of producing 2 million NEVs by 2020 and to reach 20% NEV shares of total vehicle production by 2025. A new dual credit system was announced in 2017 and took effect in 2018, which required auto companies and importers to ramp up EV shares over time. These policies were so effective at creating a mature EV market in China, lowering EV costs sufficiently to compete with internal combustion vehicles, that purchase subsidies were scaled back over five phases and ultimately phased out in 2022.

The success of China's domestic EV market has positioned it as a dominant global EV producer. In 2012, China produced only 8% of global EVs, but by 2018 that share jumped to more than half (55%), rising to 72% in 2024 (Figure 13). So while one in every three passenger vehicles sold globally last year were made in China, nearly three-quarters of all EVs sold globally last year were made in China.

FIGURE 13
China dominates global EV production
China EV production as share of global EV production (%)



Source: EV Volumes

China's dominance emerged not from early manufacturing leadership but from its unparalleled position as the world's largest market for downstream products—first in consumer electronics, then in EVs, and now batteries. This scale of demand, coupled with consistent, robust policy support, guaranteed China's firms the consumer base needed to scale up and drive cost competitiveness. Chinese firms could count on consistent and increasing subsidies as they grew in size, allowing them to take greater risks and invest heavily to gain market share. Chinese firms were further advantaged through preferential access to these benefits. Until 2019, regulations mandated that EV manufacturers use batteries listed in a government-approved catalogue—composed exclusively of domestic companies—in order to qualify for subsidies. Guaranteed demand from China's New Energy Vehicle support policies gave Chinese battery firms the confidence to bet on the domestic market and invest heavily in expanding their production capacity.

EV and battery manufacturing investment

Scaled investment in EV and battery manufacturing in China didn't really begin to take off until the dual-credit policy was confirmed in 2017 and implemented in 2018. These announced investments ensured automakers' ability to produce EVs when the NEV credit took effect in 2019. Investment in EV manufacturing eased after the 2019 peak, until a resurgence in 2022, likely driven by relaxed production requirements and revenue from NEV credit trading. Battery investments also spiked in 2019 following the dual-credit policy announcement, but investment volumes would soar again in 2021, increasing nearly 4x between 2020 and 2021, remaining high and peaking in 2022.

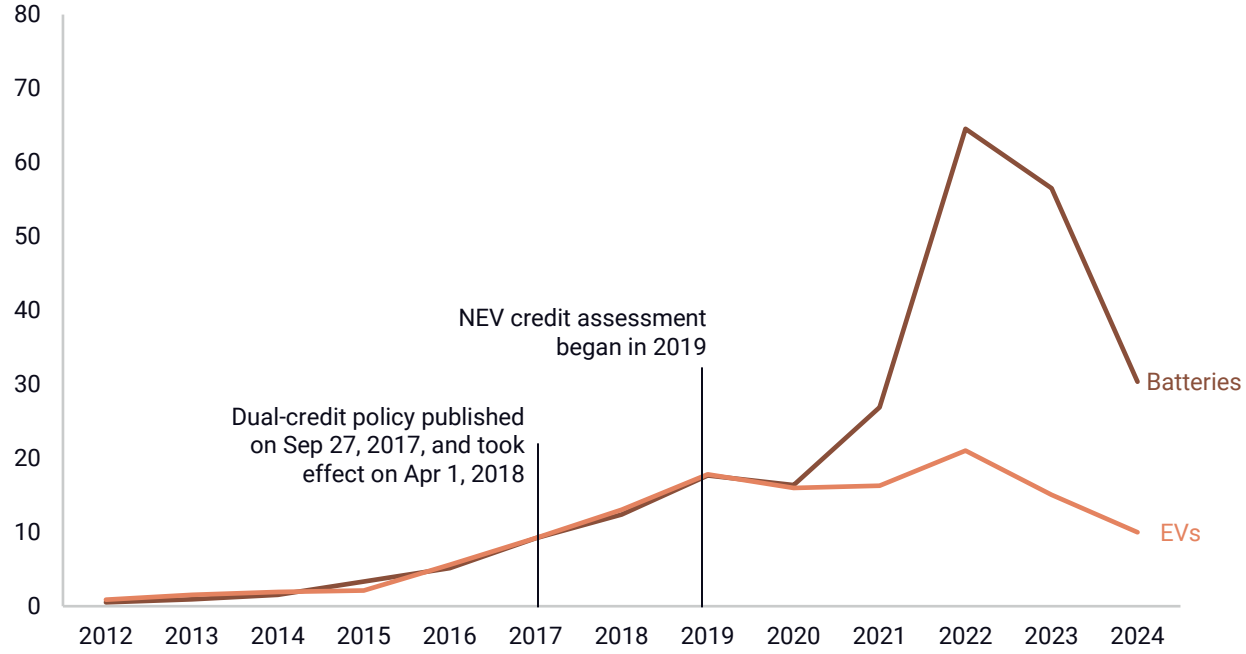
As the sector emerged as one of China's "new three" engines of growth, helping offset the slowdown in traditional growth drivers like real estate and infrastructure after 2021, it drew even more intensive public investment. This rapid expansion of investment was accompanied by an increase in state support for Chinese manufacturers. This support came in multiple forms, including direct subsidies, government-sponsored guidance funds, and the development of dedicated industrial parks.

However, investments in both EV and battery manufacturing dropped precipitously in 2023 and again in 2024, after EV subsidies were phased out in 2022 amid significant overcapacity in batteries.

FIGURE 14

China's EV and battery investments soared through 2022, driven by supportive policy

China's EV and battery manufacturing investments (annual investments, billion 2023 USD)



Source: Global Clean Investment Monitor, Rhodium Group

To understand the underlying dynamics of recent domestic investment in EV and battery manufacturing, the Global Clean Investment Monitor (GCIM) tracked 368 EV manufacturing projects at 260 facilities and 706 battery projects across 370 facilities in China that have been announced (with a specific location and construction timeline), are

under construction, or in operation since the first quarter of 2018. From 2018 to 2024, companies have announced $380 billion in investment in these facilities, with $277 billion in battery manufacturing (including cells, modules, packs, and EAM) and $103 billion in EV manufacturing. Of those announced investments, 96% ($364.6 billion) has translated into actual investments with projects already in operation or under construction. Below we dig deeper into the evolution of announced investments in EV and battery manufacturing in China from 2018-2024.

The year 2018 marked the first major ramp-up of EV manufacturing investment announcements in China. The new dual-credit NEV policy led to a flurry of new announcements in 2017 and 2018, however at least 40% of announcements in 2017 and 16% in 2018 were ultimately cancelled. This likely reflects financial challenges for late entrants to the industry, many of whom were unable to secure follow-up funding and eventually went bankrupt. Others, such as Li Auto, suspended construction and operations on early projects after failing to obtain an EV manufacturing license. Investment announcements spiked again in 2021 with the relaxation of production requirements for domestic subsidies (Figure 15). A relatively large portion of investments announced in 2021 and 2022 remain under construction—with 19% of 2021 investments yet to reach the operational stage and 31% of 2022 investments held up in the construction stage.

Since 2021, there has been a steady decline in new EV manufacturing investment announcements (Figure 15). This is due in part to the suspension of national EV subsidies in 2022, as well as a likely response to overcapacity that had accumulated over the past few years of massive investment, outpacing domestic EV demand. Of all projects announced in 2023, 77% are operational today, with 18% remaining under construction and 5% still in the planning stages. New investments announced in 2024 fell by 50% compared to 2023, totaling $3.4 billion, with 12% in operation and 88% under construction.

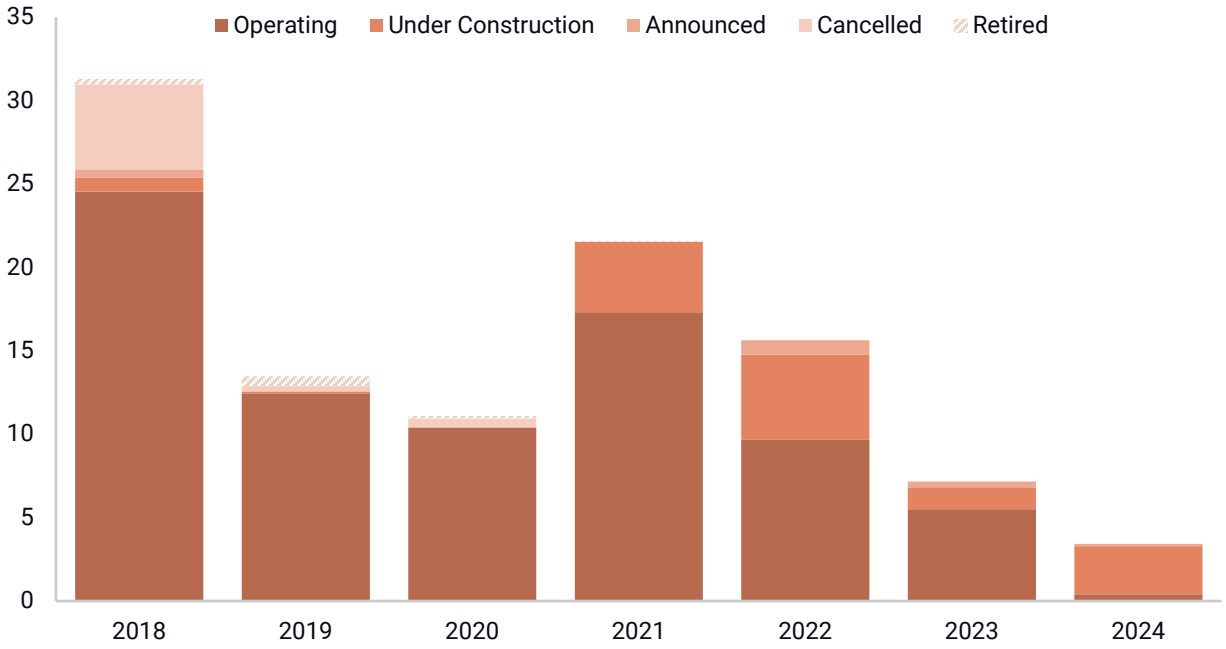
Announcements of battery manufacturing investments began to take off in 2018, but it wasn't until 2021 that battery manufacturing announcements spiked significantly, reaching $78.6 billion (nearly 4x 2020 levels). Announced investments remained relatively flat in 2022, but since then, there has been a sharp decline in new battery manufacturing investment announcements in China (a 57% year-on-year decline in 2023 was followed by a 67% drop from 2023 to 2024) (Figure 16).

Battery investments have been slower to actually materialize after their initial project announcements. Just over half of the projects announced in 2019 are operational today, with nearly a third still under construction and the remainder either cancelled or still awaiting start of construction. Of the battery projects announced in the peak years of 2021 and 2022, only 74% and 54%, respectively, have begun operation. Very few of the investments announced in 2023 (14%) and none announced in 2024 are operational.

FIGURE 15

Policy drove a flurry of announcements of EV manufacturing investments before a recent slowdown

Current status of EV manufacturing investments by year of project announcement (billion 2023 USD)

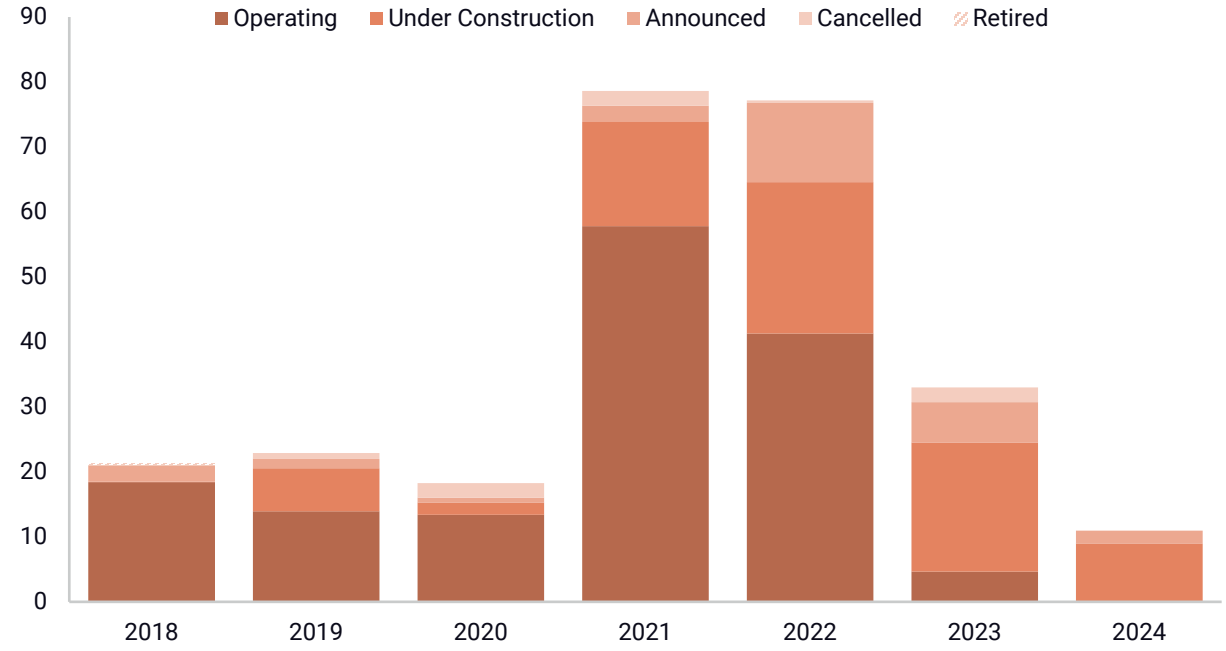


Source: Global Clean Investment Monitor

FIGURE 16

Announced investment in battery manufacturing spiked in 2021, 2022 before cooling off in recent years

Current status of battery manufacturing investments by year of project announcement (billion 2023 USD)



Source: Global Clean Investment Monitor

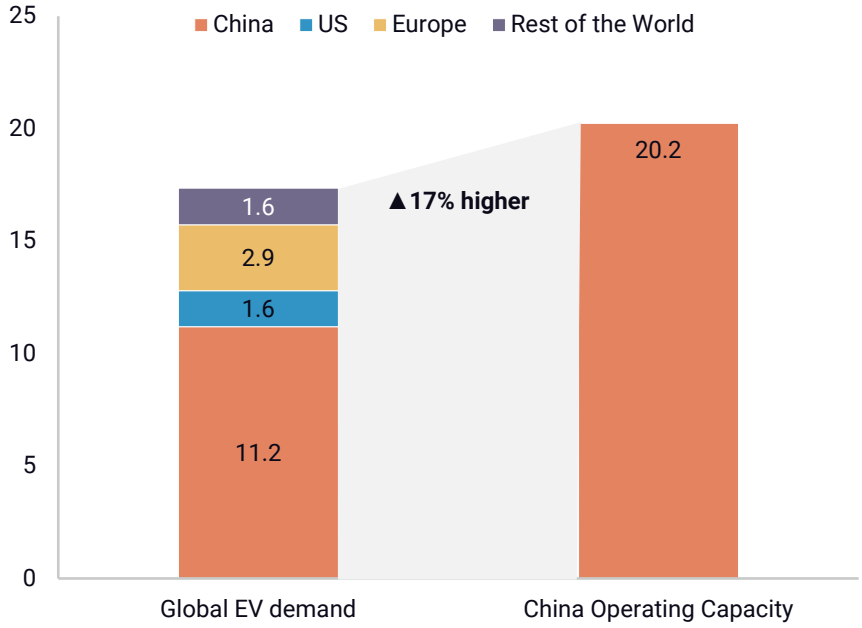
EV and battery manufacturing capacity

As a result of the past decade of accelerated investments in China's domestic battery and EV manufacturing, China's capacity to produce EVs has grown steadily. China's operational EV manufacturing capacity increased nearly 10x between 2018 and 2024—rising from 2.3 million vehicles in 2018 to 20.2 million today. This is enough to supply nearly double China's current domestic demand for passenger EVs. In fact, in 2024 China's operating EV production capacity was 17% higher than total global passenger EV demand (Figure 17).

FIGURE 17

In 2024, China's operating EV production capacity was 17% higher than total global EV demand

China's EV manufacturing capacity compared to global passenger EV sales today (million vehicles)



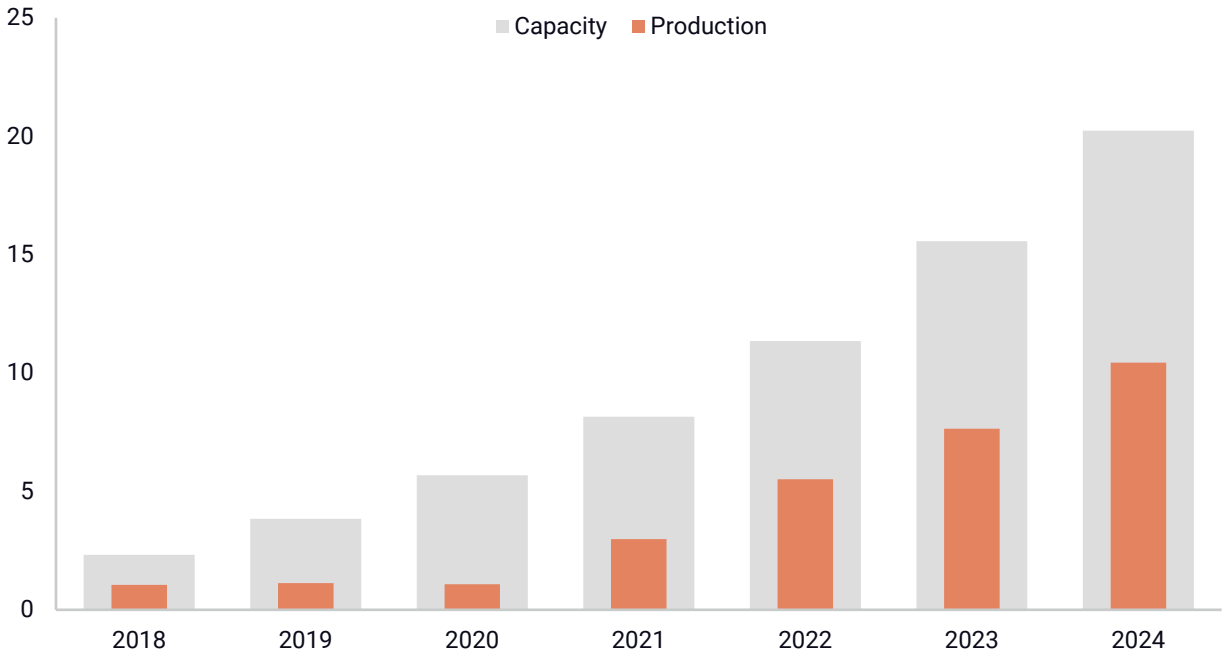
Source: Global Clean Investment Monitor, EV Volumes

China's EV manufacturing sector isn't currently producing at its full capacity. Production has ramped much more slowly than capacity since 2018. Production has risen from a low of about 19% of overall capacity in 2020 to 37% in 2021 and up to 49% in 2022 and 2023 (Figure 18). Today, we estimate China's EV production utilizes only 52% of its overall manufacturing capacity.

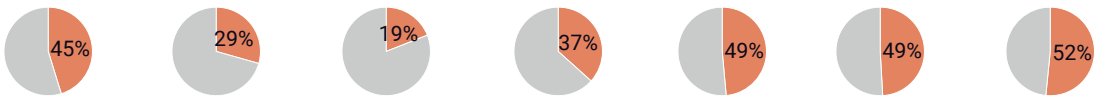
FIGURE 18

China's EV manufacturing sector operates far below full capacity

(a) China's domestic EV manufacturing capacity and actual production (million vehicles)



(b) Utilization rate (%)



Source: Global Clean Investment Monitor, EV Volumes

The sector's low capacity utilization rate (CUR) reflects both macroeconomic challenges and the strategic prioritization of EVs and batteries as engines of China's next phase of growth. Following the onset of the property sector crisis in 2021, Chinese policymakers sought to counteract the economic slowdown by channeling investment into the manufacturing sector, particularly clean technology manufacturing, as an alternative driver of growth. However, while investment surged, domestic demand remained relatively weak, creating a widening gap between production capacity and China's ability to absorb output. Exports helped offset some of this imbalance, but heavy over-investment, fueled by generous subsidies and easy access to credit, ultimately drove China's overall CUR to its lowest point since 2006 during the 2023–2024 period. In a globalized economy, this excess capacity has contributed to mounting pressure on global supply chains, depressing prices and squeezing profits for manufacturers worldwide.

This imbalance has been most pronounced in the battery segment. By 2023, only 36.5% of global battery manufacturing capacity was being utilized, and by 2024, global capacity had swelled to more than 2.5 times actual demand. In contrast, the EV manufacturing landscape is more nuanced. While leading firms like BYD are operating at or near full capacity, many smaller manufacturers are grappling with severe overcapacity. Local protection has shielded these uncompetitive players from market exit, slowing the pace of industry consolidation that would otherwise occur in a more market-driven

environment. The result has been intensified competition and widespread price undercutting. Between 2023 and 2025, price wars became a defining feature of the industry, as firms resorted to deep price cuts and aggressive rebate offers in an effort to protect or expand market share.

Even if production doesn't ramp up to full operational capacity in place today, there's also plenty of additional Chinese capacity in the pipeline yet to come online. Based on our facility-level tracking data, we estimate that if all planned facilities come online, additional manufacturing capacity of 8.6 million vehicles will come online by 2030—including 5.6 million vehicle capacity from facilities that are operational today but still ramping up to full capacity, 2.5 million currently under construction, and 530,000 announced but yet to begin construction. That will bring China's total EV manufacturing capacity to 29 million vehicles annually within the next five years (Figure 19).

Looking ahead

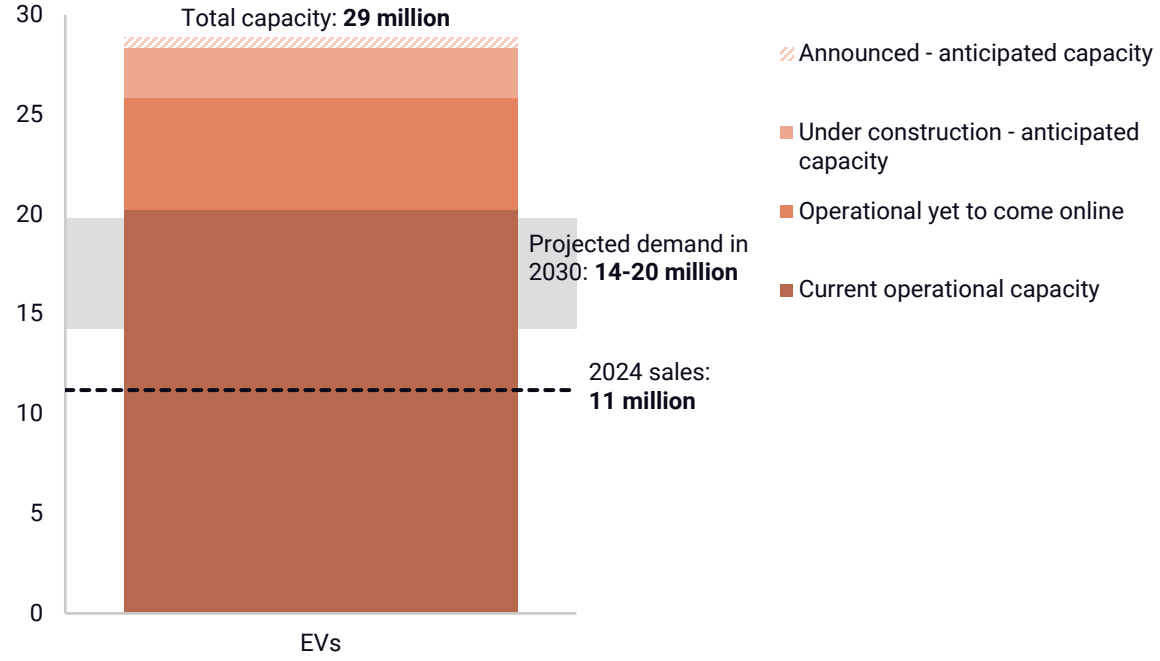
Looking ahead, what is the outlook for China's future in EV manufacturing? Unlike other large auto markets, it appears China will have sufficient domestic EV manufacturing capacity to keep up with expected EV demand over the coming years. With economic uncertainty in China, how much will domestic EV demand grow in the next 5-10 years? How much of its current overcapacity will China need to retain to meet growing EV and battery demand? Will Chinese EV manufacturers aim to rationalize capacity and production with domestic demand? Or will manufacturers be looking to ramp up production beyond expected domestic demand in a bid to take continued advantage of export markets as an outlet for Chinese EVs?

When it comes to batteries—both modules and cells—we see a similar picture when it comes to China's dominance, which we do not expect to abate in the coming five years. China's current operational battery capacity already exceeds global demand today. We expect global battery demand to rise dramatically in the next five years, rising anywhere from 49 to 227%. Yet China's *current* battery capacity—including facilities online and ramping up—is nearly sufficient to meet the low end of expected global demand in 2030, even if all announced projects or those under construction today are cancelled. And if all anticipated Chinese capacity comes online in the coming five years, China could produce enough battery cells and modules to meet projected global demand in 2030.

FIGURE 19

China's planned EV production capacity is on track to far exceed domestic demand in 2030

Current and planned EV manufacturing capacity in China in 2030 relative to domestic demand (million vehicles)



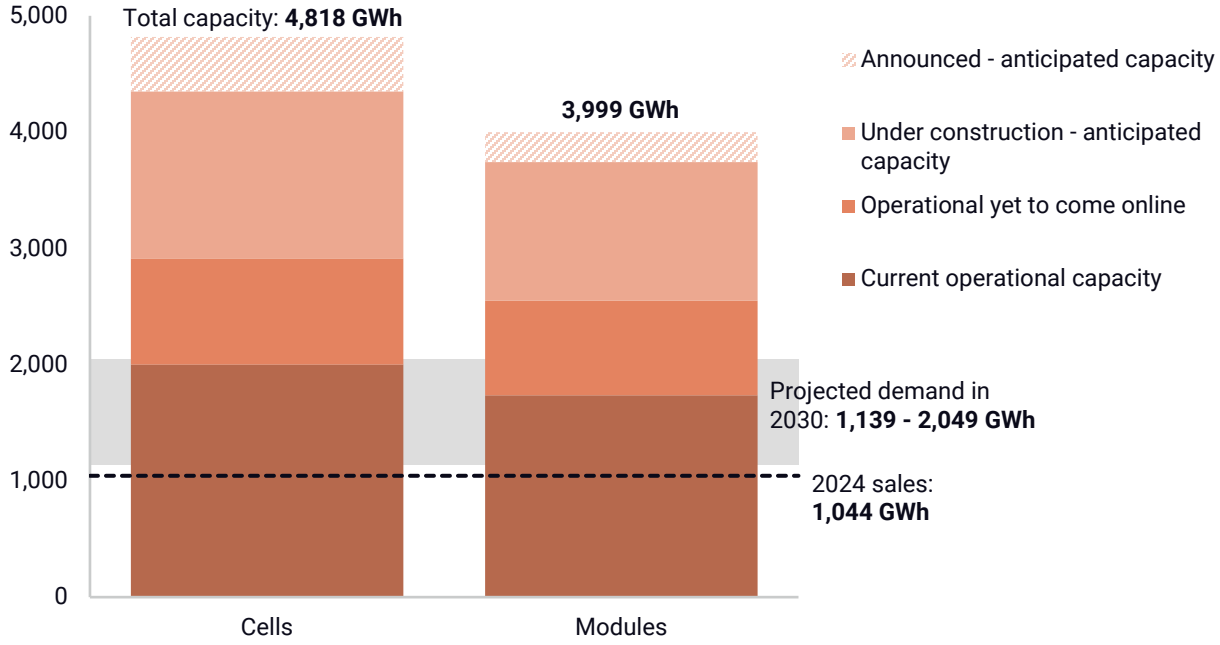
Source: Global Clean Investment Monitor, Rhodium Group, EV Volumes.

The outlook for batteries shows the potential for China's overcapacity in battery manufacturing to worsen if all announced projects make it through to completion by 2030 (Figure 20). Today, China's total battery demand (for both EVs and stationary applications) is around 1044 GWhs. Based on our Rhodium Climate Outlook projections, China's battery demand is likely to grow anywhere from 10% to nearly doubling in the next five years, reaching 1,139 to 2,049 GWhs. Today China's manufacturing capacity for battery cells and modules is almost double domestic demand, with an excess of 956 GWh of cells and 692 GWh of modules. This overcapacity problem will only be exacerbated if all announced projects come online in the next five years, with cell capacity of anywhere from 2.4 to 4.2x expected domestic demand and module capacity at 2.0x to 3.5x expected demand in China.

FIGURE 20

China's planned battery production capacity would far exceed domestic demand in 2030

Current and planned battery cell and module capacity in China in 2030 relative to domestic demand (GWh)

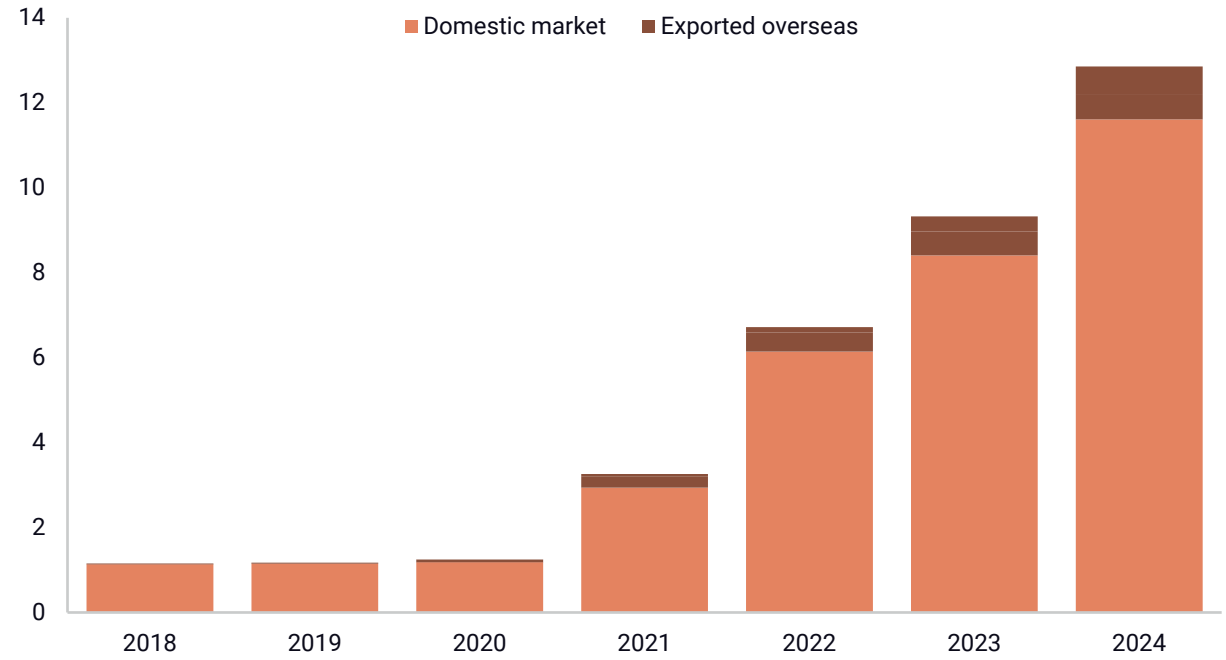


Source: Global Clean Investment Monitor, Rhodium Group, EV Volumes. Note: Demand includes stationary storage capacity additions and EV sales.

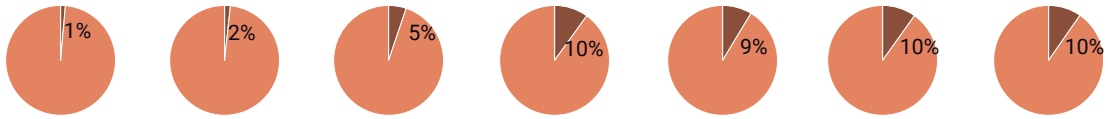
Increasingly, Chinese EV and battery companies have turned to overseas markets to absorb their growing capacity. Although still very small, the share of China-made EVs sold overseas has grown rapidly in the past decades. As a result, the global market share of China-made cars has also grown fast—climbing from around 3% to over 20% in the past three years in the EU, for example. The share of vehicles produced in China that ultimately were exported overseas has risen from just 1% in 2018 to 10% in 2021, where it has remained through 2024, with roughly half destined for Europe and the other half distributed around the world (Figure 21).

Chinese automakers—as well as foreign OEMs operating in China—are signaling a move toward more export-oriented strategies in the coming years. At the 2025 Shanghai auto show, several Chinese and foreign brands announced plans to accelerate their internationalization via overseas investments and exports to utilize idle capacity and make up for local losses. So far, however, the internationalization of Chinese firms has been constrained by weak demand and growing trade barriers in many key economies. These barriers, along with the need to be closer to local markets, have incentivized Chinese companies to relocate production and invest overseas. However, the expansion of investments overseas may be limited as Beijing prioritizes domestic production to support employment and prevent technology transfers.

FIGURE 21
China's EV exports are growing
(a) Destination of Chinese-produced EVs (million vehicles)



(b) Export share (%)



Source: EV Volumes

Over the coming months, the Global Clean Investment Monitor will be regularly tracking investments and capacity additions in EV and battery manufacturing in China to provide real-time data to answer the following key questions about the outlook for China's EV ambitions:

- How quickly does Chinese EV demand continue to grow?
- Are Chinese EV and battery manufacturers rationalizing production and new capacity additions to track closely to domestic demand?
- Or are Chinese companies continuing to invest in new capacity and ramping up production beyond expected domestic demand to leverage EV and battery overcapacity to supply export markets?

CHAPTER 3

United States

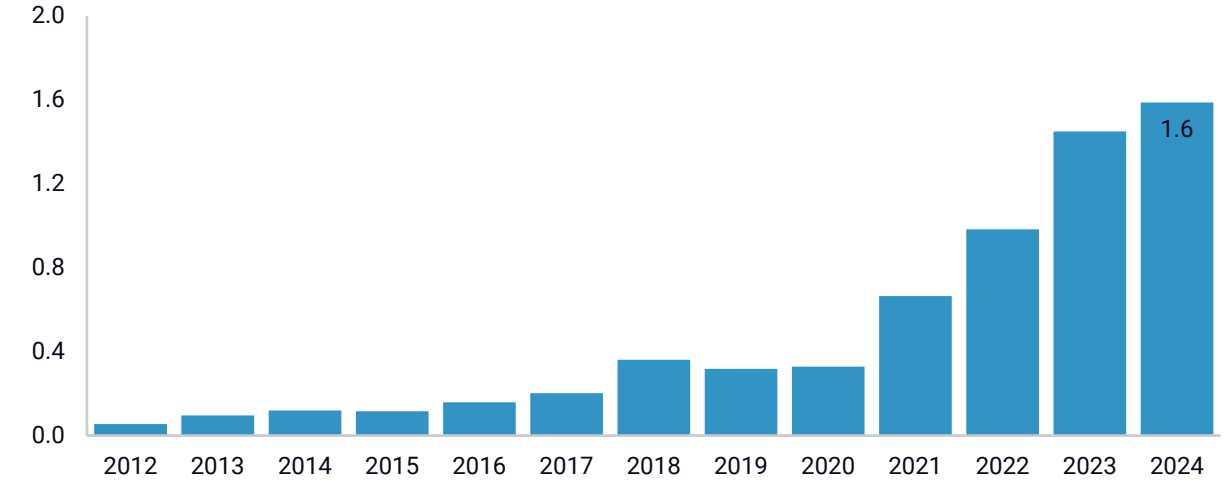
Traditional automaking has long been a cornerstone of manufacturing in the US and a major force shaping American industrial policy. Political support for a transition to electric vehicles therefore places high importance on local production. The passage of the Inflation Reduction Act (IRA) in 2022 kicked off unprecedented investments in domestic EV supply chains by providing direct subsidies for manufacturing battery cells and EVs. The Infrastructure, Investment and Jobs Act (IIJA) further supported the EV supply chain with billions of dollars earmarked for EV charging infrastructure, zero-emission buses and transit, and advanced manufacturing grants. These supply-side policies, coupled with consumer EV tax credits tied to domestic content requirements and stricter tailpipe regulations, have spurred a wave of investment in domestic EV supply chains. While these investments have translated into substantial new operating capacity, more than 70% of both EV and battery projects are still in the development phase as of the first quarter of 2025.

Just as the EV transition was gaining steam, the EV and battery manufacturing sectors risk having core policy support revoked, including a rollback of the IRA tax credits and federal and state vehicle GHG regulations. President Trump's trade policy and signs of slowing demand cast further doubt on the outlook for EVs. Going forward, key questions about the future of an electric vehicle transition in the US include: What happens to domestic production and sales if key policies, including the IRA tax credits, are rolled back? How might trade policy, especially an escalation with China, reshape domestic manufacturing? If market conditions weaken, do planned manufacturing investments become redundant? In the absence of policy to encourage innovation, will US companies be able to compete in a world moving increasingly toward EVs? If not, what does that mean for the prospects of electrifying US transportation if major domestic automakers aren't producing the EVs of the future?

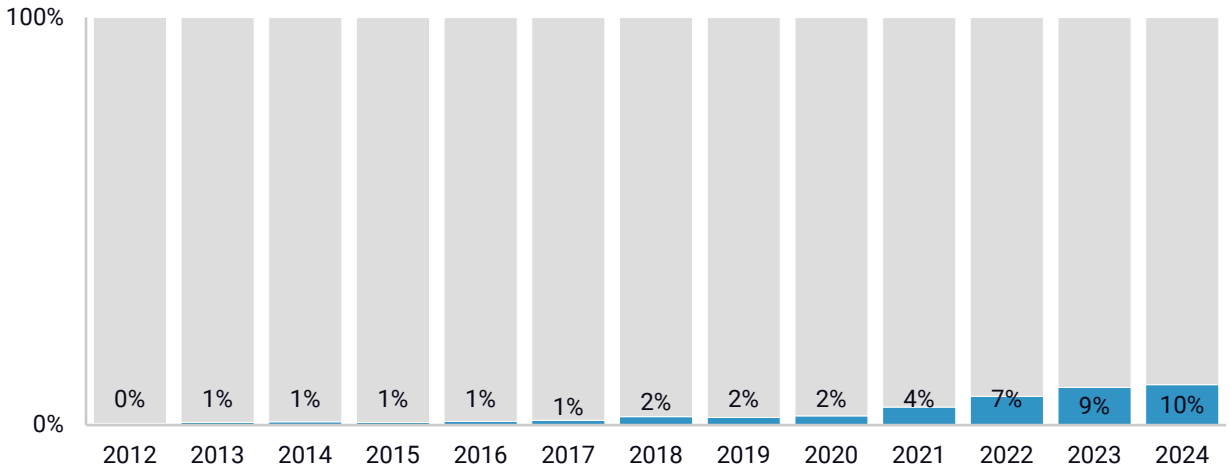
Electric vehicle demand

The US is the second-largest passenger vehicle market behind China, and the third-largest EV market globally, accounting for 10% of the world's EV sales in 2024. Sales have risen quickly over the last decade, from less than 1% in 2015 to 10% in 2024 (Figure 23). Growth in sales softened in 2024, driven by an overall downturn in vehicle sales that disproportionately impacted EVs.

FIGURE 23
The US EV market has grown rapidly over the last decade
(a) US EV sales (million vehicles)



(b) EV sales share of total annual passenger vehicle sales (%)



Source: EV Volumes

The US was home to many of the critical technological milestones in the EV commercialization process (see Figure 1), including breakthroughs in lithium-ion battery technology in the 1970s and GM's first demonstration EV in the late 1990s. However, early policy focused largely on R&D and did little to advance EVs to commercialization or encourage adoption. In the early 2000s, federal and local policies for EVs targeted EV deployment to meet clean air and climate goals. At the federal level, this included GHG vehicle standards and consumer tax credits. California's Zero-Emission Vehicle policy provided a market for credits that helped Tesla get off the ground.

Tesla's rise in the 2010s kickstarted the EV market in the US and over the coming years became a dominant player in markets around the world. While Tesla is still the single largest EV brand in the US, many other players have joined the market. This includes the traditional "Big Three"—GM, Ford, and Stellantis—although their transition to EVs has

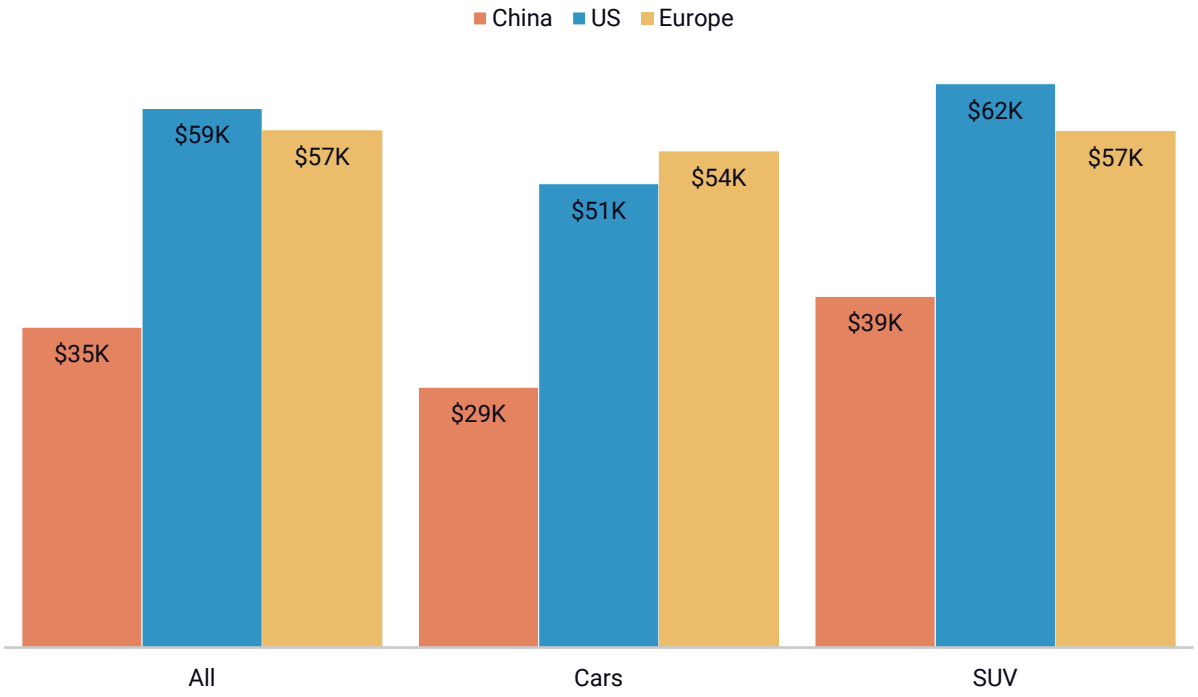
thus far been slow and costly, and all have scaled back their plans. Meanwhile, the market share of foreign players has grown.

High tariffs have long kept virtually all Chinese vehicles—including EVs—out of the US. However, as China has risen as the leader in EV production and cost, US policymakers and companies are increasingly concerned about protecting the domestic auto industry and its ability to compete in global markets. EVs are substantially more expensive in the US than China (Figure 24)—even accounting for Americans' preference for large vehicles—and the market is concentrated in the premium segment, limiting broader adoption. Europe's market is similar.

FIGURE 24

Chinese EVs are significantly cheaper compared to the US and Europe

Sales-weighted sticker price of domestic BEVs by segment in 2024 (2023 USD)



Source: EV Volumes, Rhodium Group. Note: Cars refer to sedans, hatchbacks, or coupes, and SUV refers to generally larger and heavier vehicles that combine car and truck features.

Before the IRA and IIJA, there was no concerted effort in the US to promote a domestic EV industry. Over time, EV policy in the US has broadened from targeting deployment, motivated primarily by environmental concerns, to focusing on manufacturing, with the goal of revitalizing US auto manufacturing and onshoring EV supply chains. The IRA was designed to do just that, making available large subsidies for battery manufacturing along with consumer EV tax credits paired with a domestic content requirement.

Much of this has come under threat by the Trump administration and Congress. Congress's latest budget reconciliation proposal would eviscerate manufacturing and consumer tax credits. Efforts to repeal federal vehicle standards, a pause on many federal grants, and recent and proposed tariffs affecting the auto sector could further slow momentum.

EV and battery manufacturing investment

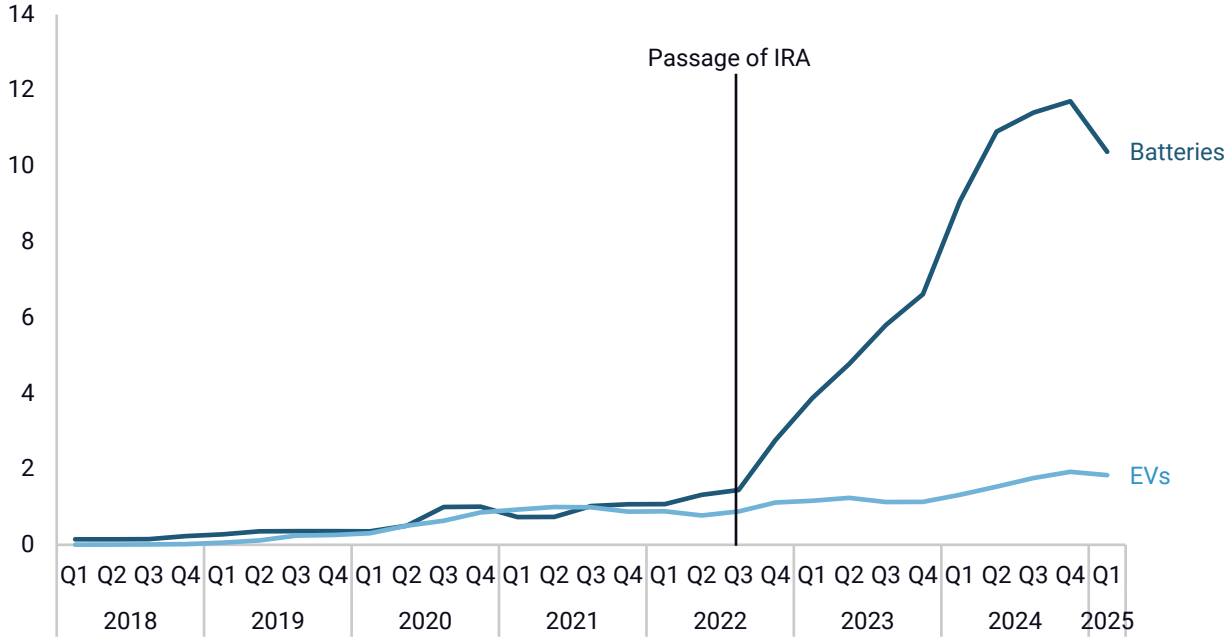
The IRA supercharged EV and battery manufacturing in the US, with annual investment increasing more than six-fold between 2021 and 2024. From Q1 2018 to Q1 2025, companies have announced over $200 billion in investment in these facilities, with three-quarters for battery manufacturing and the remaining for EV manufacturing. The EV supply chain—critical minerals, batteries, vehicle assembly, and charging equipment—has been the largest area of clean tech manufacturing investment in the US every quarter since the IRA was passed in Q3 2022, accounting for 88% of cumulative investment since then. Our GCIM data for the US comes from our ongoing quarterly tracking of clean technology investment through the US Clean Investment Monitor, which is currently updated through Q1 2025.

Previously a niche industry in the US, battery manufacturing investment has boomed, increasing by nearly a factor of twelve since 2021 (Figure 25). Most of this investment has focused on battery cells and modules, although anodes, cathodes, and other upstream components have received a growing share of funds. Recent policy has had a more modest impact on EV investments. The sector has seen slower and steady growth, with annual investments in 2024 70% higher than in 2021.

FIGURE 25

US battery manufacturing investment has boomed, while EVs have seen more modest growth

Investment in EV supply chains in the US (billion 2023 USD)



Source: Global Clean Investment Monitor

Investment has tempered in the last two quarters as manufacturers face growing policy and market uncertainty. After slowing in the fourth quarter of last year, EVs and battery investment fell in Q1 2025 by 4.5% and 11.4%, respectively, relative to the previous quarter.

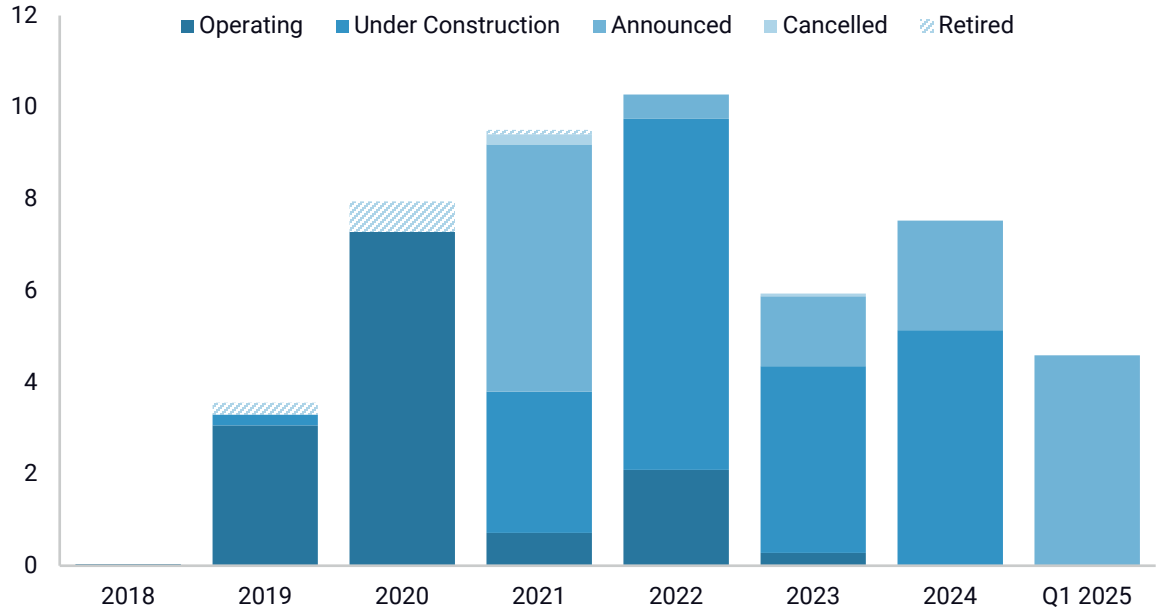
At the same time, companies continue to make new announcements, as we'll see below. Whether the latest quarters reflect early signs of a larger slowdown or a temporary pause is yet to be seen.

To better understand how EV and battery manufacturing investments have evolved, we look across all announced investments, including those currently operating, under construction, and canceled, as well as projects that were announced but have not yet broken ground. Announced investments in EV manufacturing ramped up from 2019 to 2022, mirroring growth in EV sales (Figure 26). Announcements were lower in 2023 and 2024 as the pace of planned builds slowed, likely due to substantial previous investment. Around a quarter of projects announced since 2018 are now operating, and only 7% of those announced since the passage of the IRA. Notably, companies announced $4.6 billion of investments in Q1 2025, despite mounting policy headwinds.

FIGURE 26

Announced investments in EV manufacturing ramped up before slowing in recent years

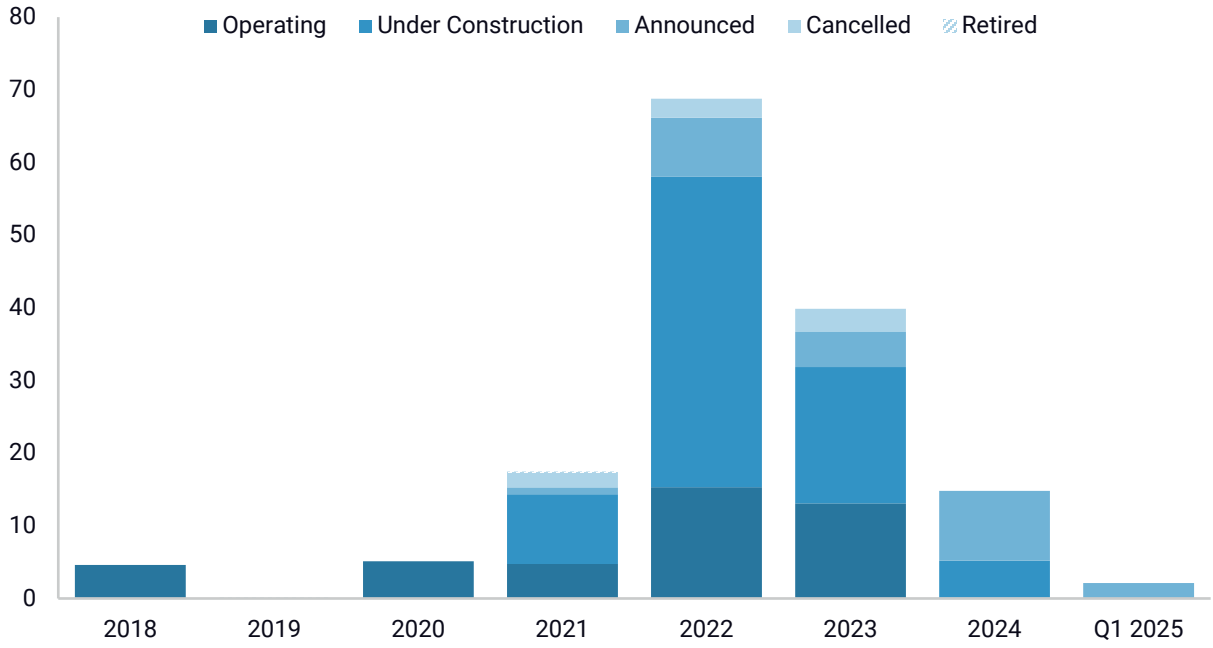
Current status of EV manufacturing investments by announcement year (billion 2023 USD)



Source: Global Clean Investment Monitor

Battery announcements have appeared more sensitive to policy changes. Sustained announcements in the battery supply chain began to grow after 2020, a couple of years later than EVs. Announcements spiked in 2022 following the passage of the IRA, quadrupling from 2021 levels. This fever pitch cooled off in subsequent years, with 2024 announced investment volumes falling nearly 80% below the 2022 peak. Similar to EVs, a little more than a quarter of announced investments have translated into operating capacity since 2018 (Figure 27). However, whereas most EV investments that are now operational were announced pre-IRA, the majority of battery projects online today were announced after it passed. A small but growing share of battery announcements have been cancelled, accounting for 5% of announced investments since 2018. Announcements slowed to a glacial pace in Q1 2025, likely reflecting the current climate of policy uncertainty.

FIGURE 27
Announced investments in battery manufacturing peaked following the IRA before falling off
Current status of battery manufacturing investments by announcement year (billion 2023 USD)



Source: Global Clean Investment Monitor

EV and battery manufacturing capacity

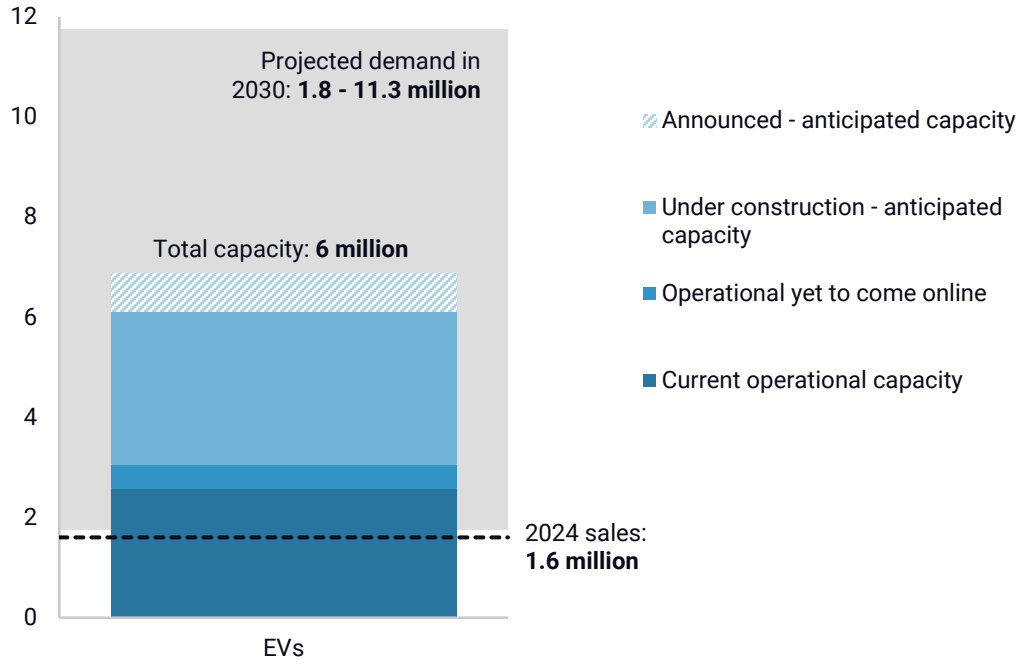
The US Clean Investment Monitor tracks 79 EV manufacturing facilities with an aggregate annual production capacity of 2.58 million vehicles. This puts current operational capacity comfortably above 2024 sales (Figure 28). Looking ahead, the US has capacity in the pipeline equivalent to more than 150% of what's online today. This includes operating facilities ramping up production and facilities under construction, which together would more than double today's operational capacity. If built, announced projects would add another 760,000 vehicles.

Whether or not planned manufacturing capacity will be enough to meet future demand is highly uncertain. This reflects immense uncertainty in the direction of future policy, which we model based on recent US analysis. On the low end, EV sales fail to accelerate due to the rollback of federal vehicle standards and repeal of key IRA tax credits, combined with cheap oil prices, more gradual reductions in battery costs, and moderate GDP growth—all market conditions that weaken EV sales. In this future, there's enough capacity operational today to meet 2030 sales, calling into question whether the pipeline of future builds is warranted. Most planned battery capacity has already broken ground, raising the possibility of stranded investments if policy and market conditions are weaker than expected. The high end reflects much more robust EV sales in a scenario where federal support for EVs survives the current political moment, coupled with stronger market conditions. In this world, planned capacity falls well short of 2030 sales and substantially more investment is required to fill the gap.

FIGURE 28

US policy uncertainty creates challenges for domestic manufacturers to gauge demand

EV current and planned capacity relative to current and 2030 demand (million vehicles)



Source: Global Clean Investment Monitor, Rhodium 2024 Taking Stock, Rhodium Trump 2.0. Note: The upper bound for 2030 EV demand reflects state and federal policy on the books as of June 2024 coupled with high GDP growth, low oil prices, and faster reductions in EV battery cost. The lower bound reflects rollbacks of Biden-era climate regulation and repeal of all components of the IRA starting in 2025, coupled with moderate GDP, high oil prices, and slower EV battery cost reductions.

Battery cells and modules have an even larger pipeline of expected projects than EVs (Figure 29). If all planned projects come online, it would increase today's cell and module manufacturing capacity by a factor of five and four, respectively. The US Clean Investment Monitor tracks 123 battery manufacturing projects with the capacity to manufacture over 200 GWh of both cells and modules. This stacks up well with current demand, although actual production is likely to be substantially lower. Under our most pessimistic outlook for EV sales, today's operational capacity is already sufficient to cover 2030 demand, including batteries for both vehicles and stationary storage. This potentially puts hundreds of gigawatts of anticipated battery projects in jeopardy, most of which are either operational and ramping up or under construction. Planned cell manufacturing capacity is on track to meet even the upper bound for 2030 sales, while module manufacturing has room to grow.

Looking ahead

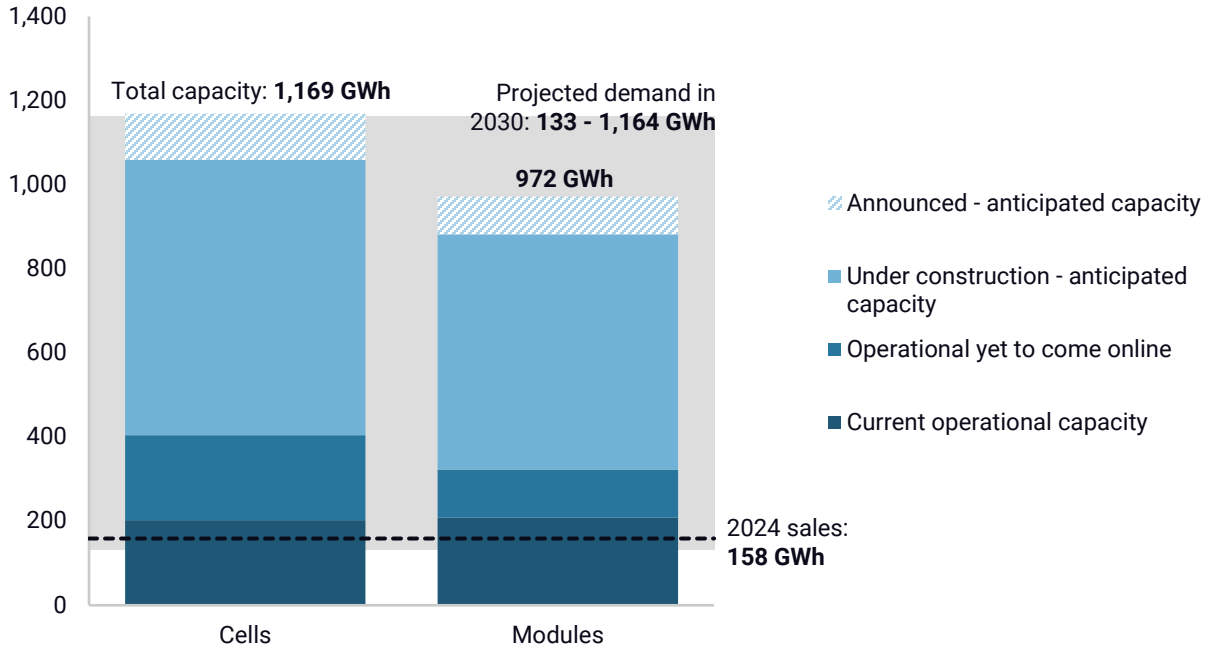
Since the passage of the IRA, investment in the domestic EV supply chain has boomed. However, most of the investment to date is still under development, making the still-nascent industry vulnerable to today's shifting policy landscape. Many investments were predicated on the IRA tax credits, contingent on receipt of federal grants, or reliant on imported components at a certain price. Without these, the economics may not pencil out. The same threats putting manufacturing at risk could also weaken demand. If trade policy

raises prices, consumers may opt for a cheaper gas-powered car over an EV or hold off on a new car altogether. If Congress repeals the consumer EV tax credit, this would deal a further blow.

FIGURE 29

Weak demand would make planned battery manufacturing capacity redundant

Battery current and planned capacity relative to current and 2030 demand (GWh)



Source: Global Clean Investment Monitor, Rhodium 2024 Taking Stock, Rhodium Trump 2.0, EV Volumes, Global Energy Monitor.
Note: The upper bound for 2030 EV demand reflects state and federal policy on the books as of June 2024 coupled with high GDP growth, low oil prices, and faster reductions in battery cost. The lower bound reflects rollbacks of Biden-era climate regulation and repeal of all components of the IRA starting in 2025, coupled with moderate GDP, high oil prices, and slower battery cost reductions. Demand includes stationary storage capacity additions and EV sales.

Regardless of what ultimately happens to policy and prices, the current ambiguity and volatility in market conditions alone pose a risk. In Q1 2025, companies canceled more than $6 billion in battery projects—the highest quarterly value of cancellations on record. Time will tell whether this represents an anomaly or signals the start of a sustained downturn in domestic manufacturing.

Over the coming months, we will be tracking investments and capacity in the US EV supply chain to understand how the EV market responds as policy and markets evolve. Key questions include:

- How do policy and market changes and uncertainties impact the current wave of manufacturing investment?
- Will there be sufficient EV demand going forward to justify investments to date?
- If the US steps back from the global EV race, how will this impact the competitiveness of US automakers and battery manufacturers, and which countries and companies will fill the gap?

CHAPTER 4

Europe

Europe was a first mover on EVs and now stands as the second-largest EV market in the world. The EU and other major markets in the region have set ambitious and binding targets to transition to 100% EVs in the coming decade. Policy to date has focused primarily on promoting EV deployment over manufacturing, although concerns about China's growing market share have led policymakers to boost support for onshoring supply chains and put up additional trade barriers with China. Domestic manufacturing has responded to these supply and demand-side signals, with particularly high growth in battery supply chain investment.

Key questions going forward include whether the region's commitment to zero-emission vehicles remains unwavering, and if so, how they get there. How will policymakers balance the need to promote domestic manufacturing of clean technologies—which may be essential for sustaining public backing of aggressive climate policies—against the potential consequences of restricting imports from China on both costs and market demand? If Europe stays the course on EVs and domestic supply chains prove politically important, will traditional automakers and the nascent battery industry be able to step up to meet rapidly growing demand?

Electric vehicle demand

Europe—defined here as the EU27, Norway, the UK, and Switzerland—is the second-largest EV market in the world after China, with EVs now accounting for more than one in five cars. In the EU, adoption has been driven by a combination of regulatory pressure and consumer incentives, combined with falling costs and model availability. In 2019, the EU set a binding target that all newly registered cars and vans must be zero-emission by 2035. This, combined with country-level consumer subsidies, helped supercharge sales in the years that followed. EVs accounted for roughly a fifth of Europe's sales in 2024, following a modest decline as governments phased out consumer subsidies and OEMs held back in anticipation of stronger CO_2 standards in 2025.

In addition to sales targets and subsidies, adoption has been buoyed by affordability and choice. Roughly 15% of EVs sold in Europe were Chinese brands in 2024, which are often cheaper than domestic options. More than the US, the European auto sector is highly integrated with China, with many European automakers selling into the Chinese market through joint ventures and growing Chinese investment in European EV and battery factories. On one hand, this collaboration offers European OEMs access to Chinese technology and potentially lower prices. On the other hand, there are growing competitiveness and security concerns about China's rising dominance in Europe's EV market and upstream supply chain.

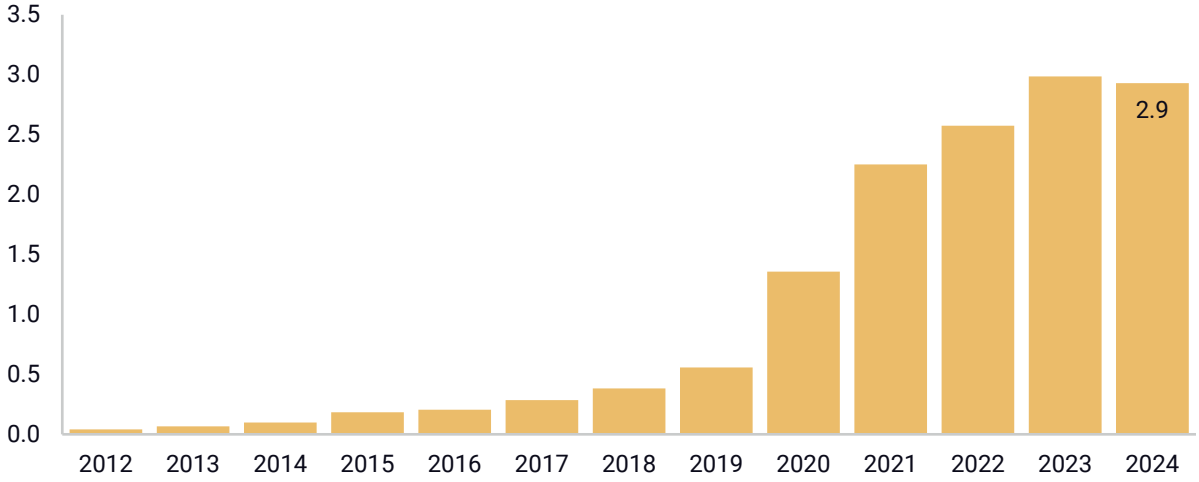
In light of these concerns, policymakers have introduced industrial policy targeting EV and battery manufacturing in Europe. In the context of the Green Deal, the EU made funding available to member states to support domestic clean technology manufacturing, including EV supply chains. This includes two Important Projects of Common European Interest for batteries in 2019 and 2021, multi-national projects with the goal of stimulating investment in the battery supply chain. However, industrial policy has been more modest

than in the US, with less funding available and a more complex application process. While taking a softer stance than the US, the EU has also ramped up trade protections against China, imposing countervailing duties on Chinese-made EVs in 2024. Policymakers continue to negotiate with China, working to find the right balance that protects domestic industry without compromising EV deployment.

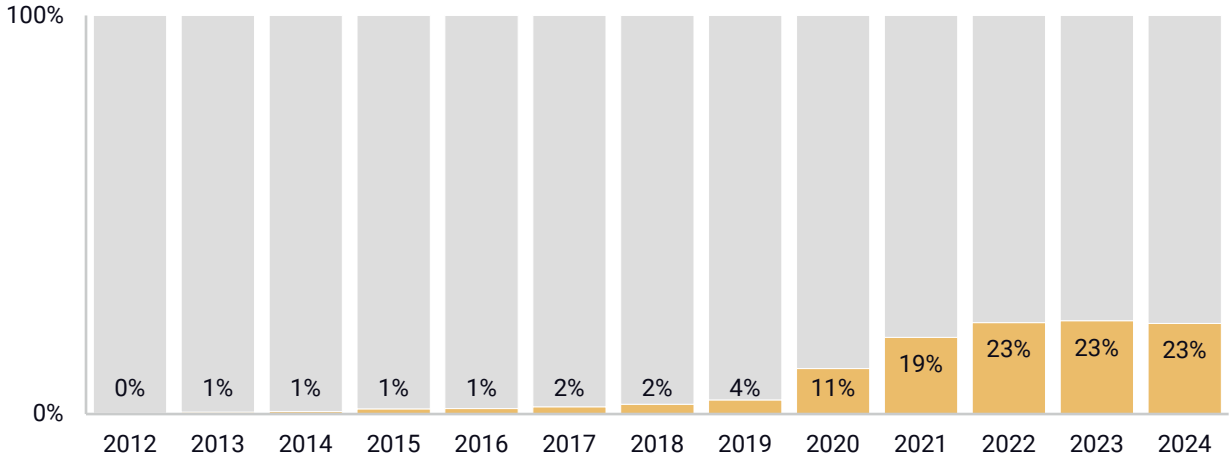
FIGURE 30

EVs have grown quickly in Europe, and now account for one in five cars

(a) Europe EV passenger vehicle sales (million vehicles)



(b) EV sales share of total annual passenger vehicle sales (%)



Source: EV Volumes

Europe appears committed to meeting its emission targets in transportation, despite pushback from automakers and certain member states. Earlier this year, the European Parliament softened the interim CO_2 vehicle standards through 2027 in response to weakening demand and uncertainty around President Trump's proposed tariffs. The concessions aim to provide flexibility in the short term, while maintaining political support for the longer-term transition. As the interim CO_2 targets tighten—and the EU Emissions Trading Scheme extends to cover transport emissions in 2027—policymakers will need to balance short-term challenges with long-term climate and industrial policy objectives.

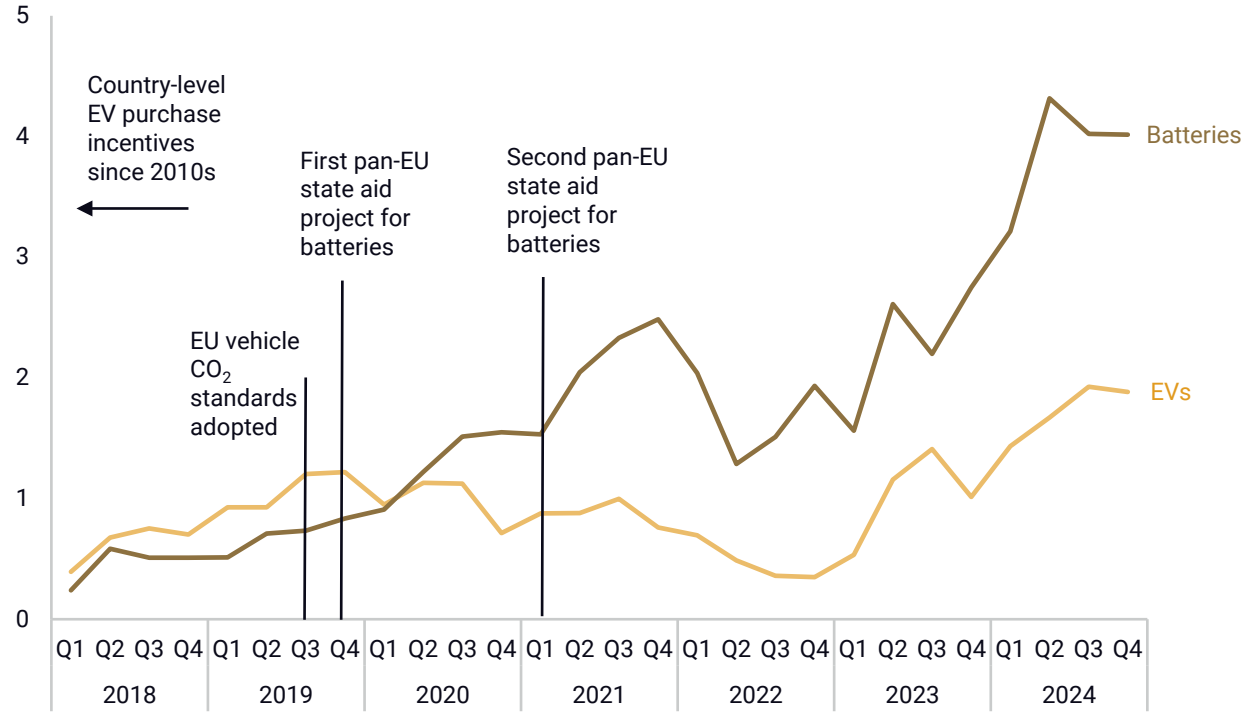
EV and battery manufacturing investment

Like the US, Europe was home to very little battery manufacturing in the early 2010s. Battery investment began to see steady growth starting in 2018, driven by rising EV sales and the push to onshore EV supply chains (Figure 31). Investments rose sharply in 2023 as the domestic battery industry gained traction. Investment in Europe's EV industry started earlier than batteries and has seen less dramatic growth over time, although funding bumped up in 2023, mirroring batteries. Investments in both batteries and EVs faced headwinds in the last two quarters of 2024, likely due to a combination of substantial previous investment, slower EV demand growth, and competition from Chinese producers.

FIGURE 31

Standards and subsidies have driven Europe's investment in EV and battery manufacturing

Europe's actual EV and battery manufacturing investments (billion 2023 USD)



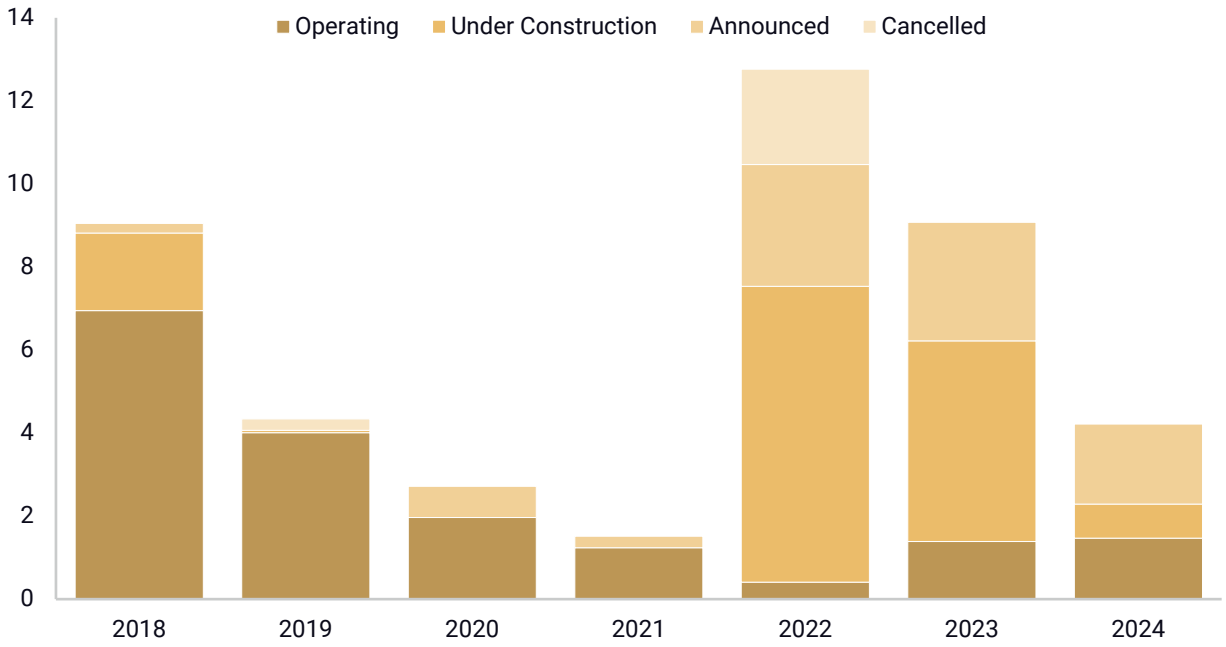
Source: Bruegel European Clean Tech Tracker, Global Clean Investment Monitor

Announced investments show a fuller picture of how policy has driven activity in the sector. Announced investments in EV manufacturing spiked in 2018 in anticipation of the EU's 2019 CO_2 standards (Figure 32). Announcements shot up again in 2022 in response to tightening emission targets in 2020 and 2021, and possibly bolstered by renewed enthusiasm for onshoring domestic supply chains following Russia's invasion of Ukraine and the ensuing energy crisis in Europe. The pace of investment announcements has since cooled off. Since 2018, 40% of all announced projects are operating today, with over half under construction or in the planning phases. A total of 6% have been cancelled.

FIGURE 32

Announced investment in EV manufacturing peaked twice, largely driven by policy

Current status of EV manufacturing investments by announcement year (billion 2023 USD)

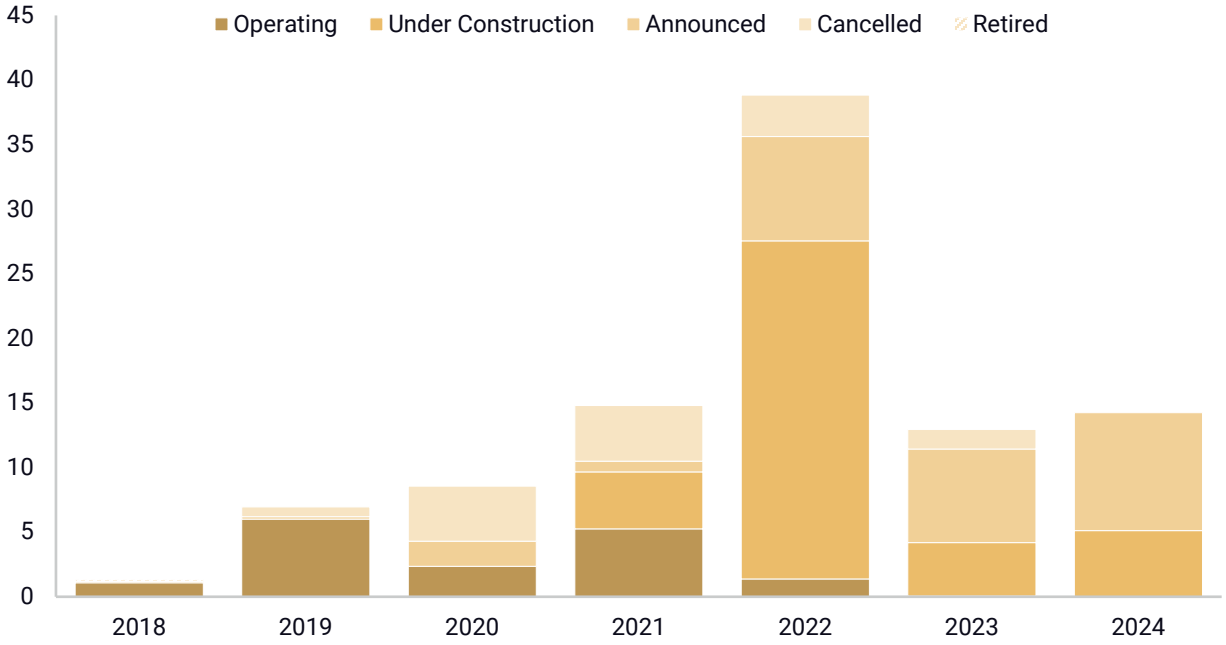


Source: Bruegel European Clean Tech Tracker, Global Clean Investment Monitor

FIGURE 33

Announced investment in battery manufacturing came later but rose higher

Current status of battery manufacturing investments by announcement year (billion 2023 USD)



Source: Bruegel European Clean Tech Tracker, Global Clean Investment Monitor

Announced investments in battery manufacturing started more slowly but quickly surpassed EVs by 2019, growing steadily through 2021 (Figure 33). Like EVs, batteries saw a flurry of announced investments in 2022, before falling off dramatically in subsequent years. With the bulk of announcements happening in the past three years, less than a fifth of battery projects have translated into operating facilities. Battery projects in the region have had a number of false starts, with 14% of projects cancelled since 2018. This includes the highly anticipated Northvolt project—funded heavily by state aid—which had planned to serve a quarter of Europe's battery market by 2030.

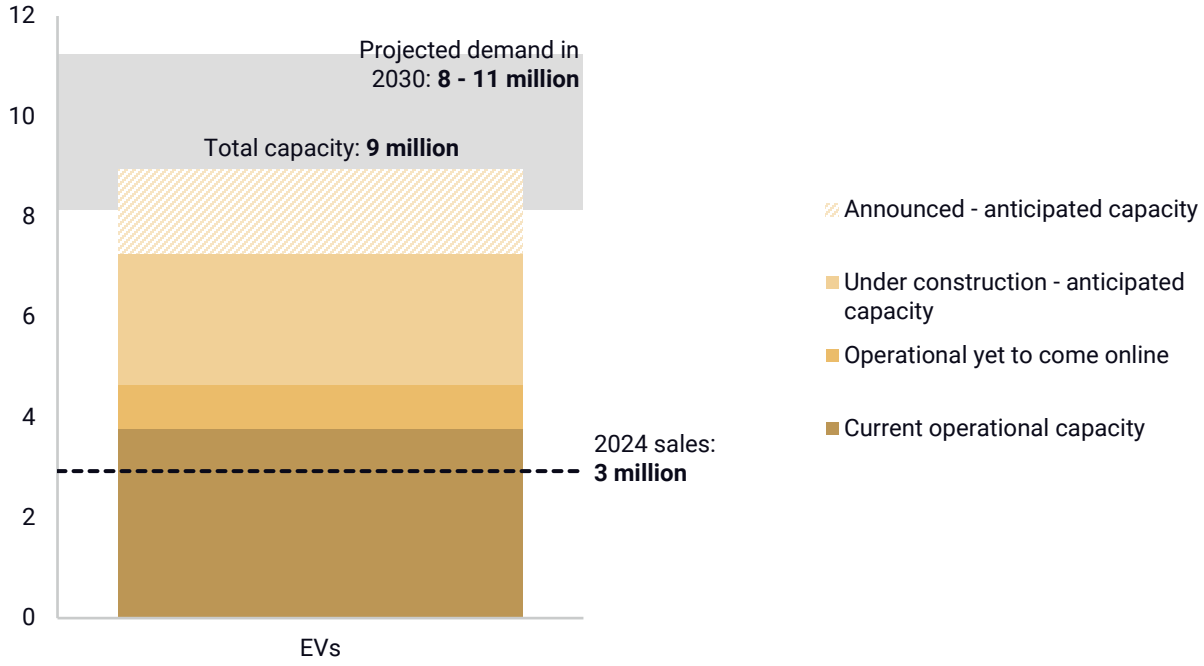
EV and battery manufacturing capacity

Thanks to investments in domestic EV and battery manufacturing over the last decade, Europe's ability to produce EVs has grown steadily from 600,000 vehicles in 2018 to 3.8 million in 2024 (Figure 34). While today's operational capacity covers nearly all of Europe's demand for EVs, facilities often produce far below full capacity, in response to changing demand or other labor or supply chain constraints. Unlike the US and China, this means current facilities likely fall short of fully covering sales.

FIGURE 34

Europe's planned EV production capacity may fall short of rapidly growing demand

Europe's operating EV manufacturing capacity vs. European EV sales today (million vehicles)



Source: Bruegel European Clean Tech Tracker, Global Clean Investment Monitor, 2024 Rhodium Climate Outlook.

Using probabilistic projections of Europe's EV demand from the 2024 Rhodium Climate Outlook based on current policy, EV sales are expected to grow substantially through 2030, driven by the region's ambitious EV targets. If sales are on the higher end—driven by high GDP growth, expensive oil prices, and low-cost EV batteries—the anticipated growth in EV sales is not fully matched by an equivalent growth in supply, despite a meaningful pipeline of projects under construction and announced. Even if all planned projects come online, which would more than double today's operational capacity, Europe

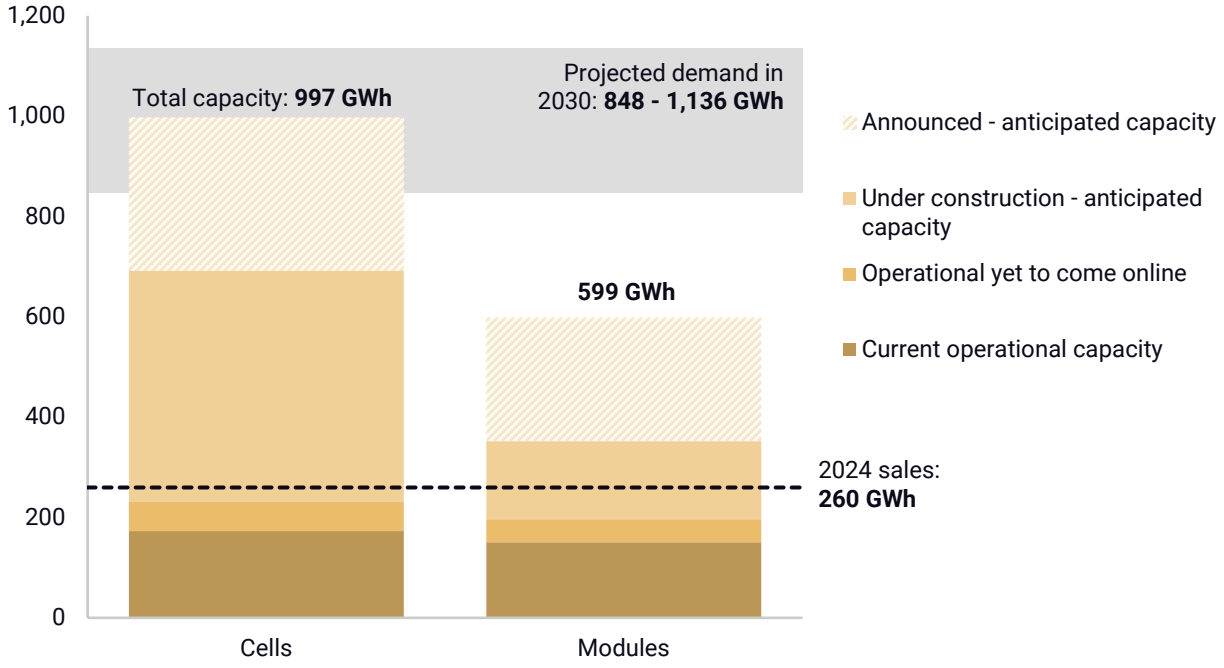
would fall behind in its ability to meet demand locally. If EV sales in 2030 are on the lower end—driven by weaker economic and market conditions—planned EV manufacturing capacity meets demand only if nearly all projects come online, including those in early stages of development.

The outlook for batteries is similar—even with substantial anticipated growth, planned cell and module manufacturing capacity will have a hard time keeping up with future demand. Steady investment means European production of cells and modules has grown substantially, from around 5 GWh of each in 2018 to 170 and 150 GWh in 2024, respectively, but falls shy of current demand (Figure 35). The region has a substantial amount of planned projects compared to today's operational capacity. Using our Rhodium Climate Outlook projections for battery demand, cell capacity would exceed annual demand in 2030 if demand is limited and all projects are built as planned. However, cell capacity falls behind if demand is high. The pipeline for module manufacturing is less robust and meets only 50-70% of annual demand in 2030. More than a third and a half of planned capacity for cells and modules, respectively, are tied to facilities at early stages of development ("announced"). This means substantial portions of the pipeline are at risk if policy or market conditions weaken.

FIGURE 35

Europe's planned cell production capacity may fall short of growing demand, modules further behind

Europe's domestic battery manufacturing capacity and actual production (GWh)



Source: Bruegel European Clean Tech Tracker and the Rhodium Global Clean Investment Monitor, 2024 Rhodium Climate Outlook.
Note: Demand includes stationary storage capacity additions and EV sales.

Looking ahead

Europe stands at a critical juncture. After years of strong EV sales growth, the market is poised to reach escape velocity. The EU and other major EV markets in the region have to date provided policy certainty that has boosted both sales and domestic manufacturing. Over the coming months, the GCIM will be tracking the evolution of EV and battery manufacturing in Europe with a view to answer the following questions:

- Will Europe stay the course on an all-electric future, continuing to provide policy certainty on the path to 100% zero-emission vehicle sales?
- How essential is domestic manufacturing in sustaining public backing of aggressive EV goals?
- How open is the region to EV imports from China, and to what extent will Europe's posture towards China set the stage for other countries?
- Can the European auto industry keep pace in light of highly competitive imports from China?

CHAPTER 4

Comparing Dynamics Among China, the US, And Europe

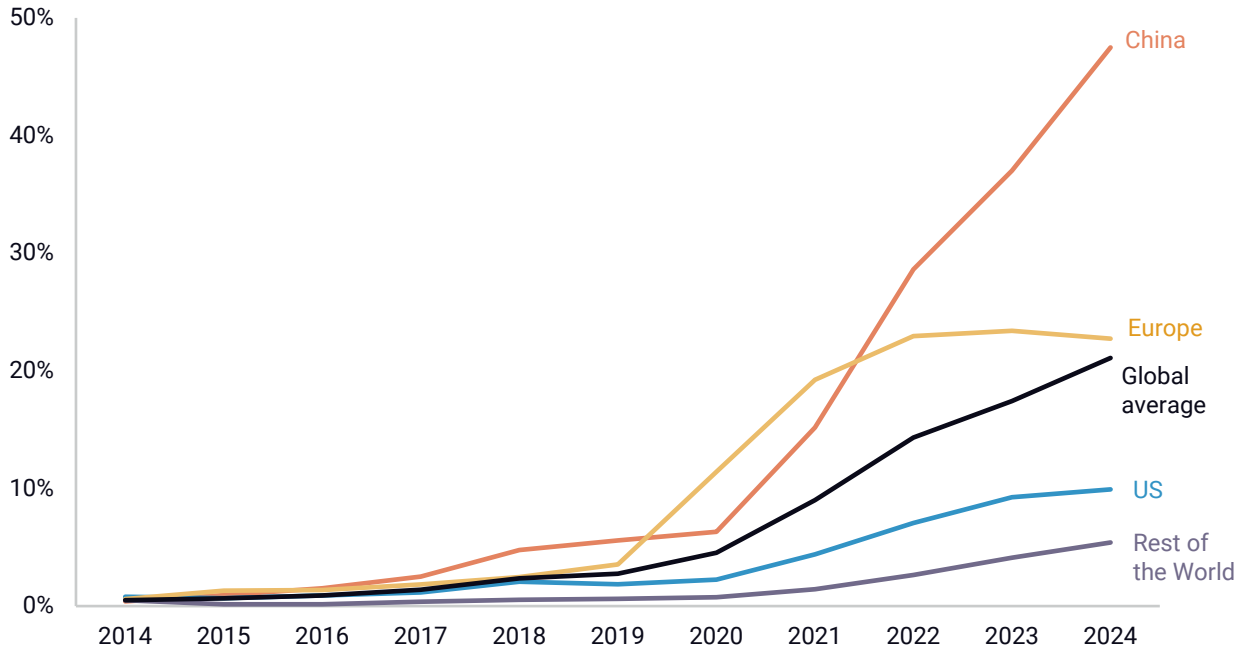
Looking across the three big regional drivers of the electric vehicle supply chain—China, the US, and Europe—provides an important perspective on how they have navigated the EV transition over the past decade and how they are positioned to capitalize on the critical decade ahead.

We've seen that early demand-driven policies and large markets in these three regions drove EV sales there faster than other regions, with demand taking off in China and Europe by 2020, and a much more moderate rise in the US a few years later. (Figure 36).

FIGURE 36

China, Europe, and the US have driven global EV sales

EV share of total passenger vehicle sales by region (%)



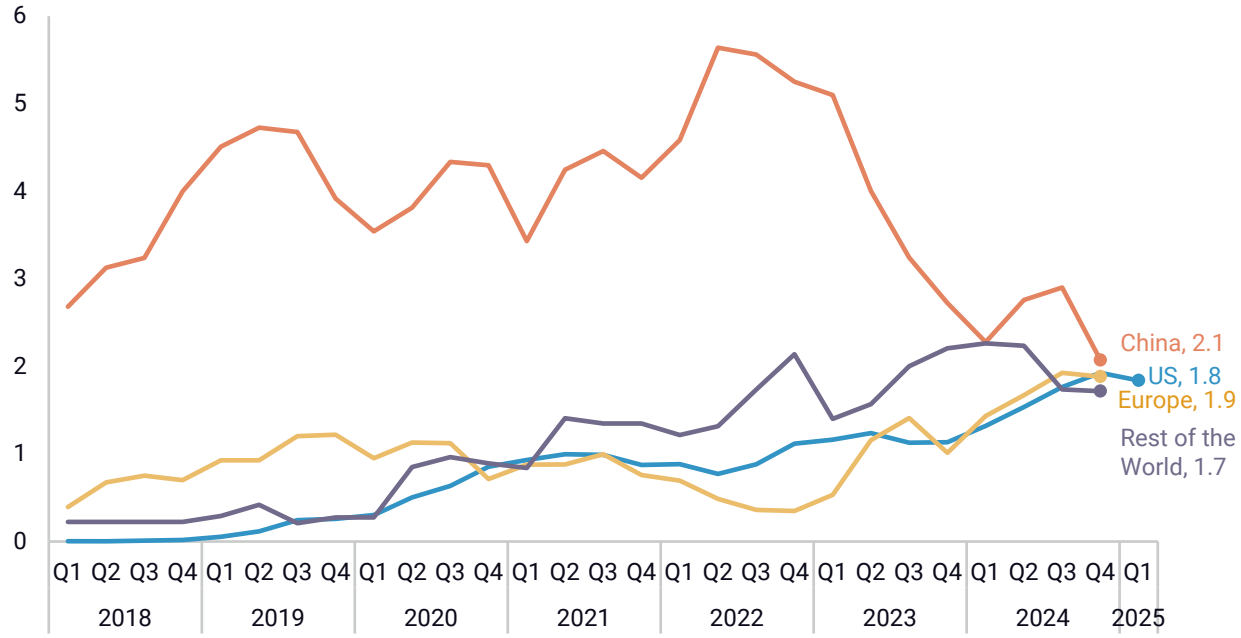
Source: EV Volumes

In response to growing demand, the three all ramped up investment in domestic EV and battery manufacturing. China had an early start compared to Europe and the US, ramping up EV manufacturing investments in 2017 and 2018 to have sufficient supply when its new EV crediting policy took effect in 2019. China sustained high levels of investment through its peak in 2022, but investments have declined precipitously through the end of 2024 as subsidies were ramped down after they effectively created a mature, competitive EV market in China. EV manufacturing investments in the US and Europe were only a small fraction of China's until they began to ramp up in 2023, just at the moment when China's overcapacity put the brakes on additional investments there. By the fourth quarter of 2024, actual EV manufacturing investments in the US and Europe were on par with those in China.

FIGURE 37

China's lead on EV manufacturing investments has narrowed as the US and Europe ramp up

Quarterly EV manufacturing investment by region (billion 2023 USD)



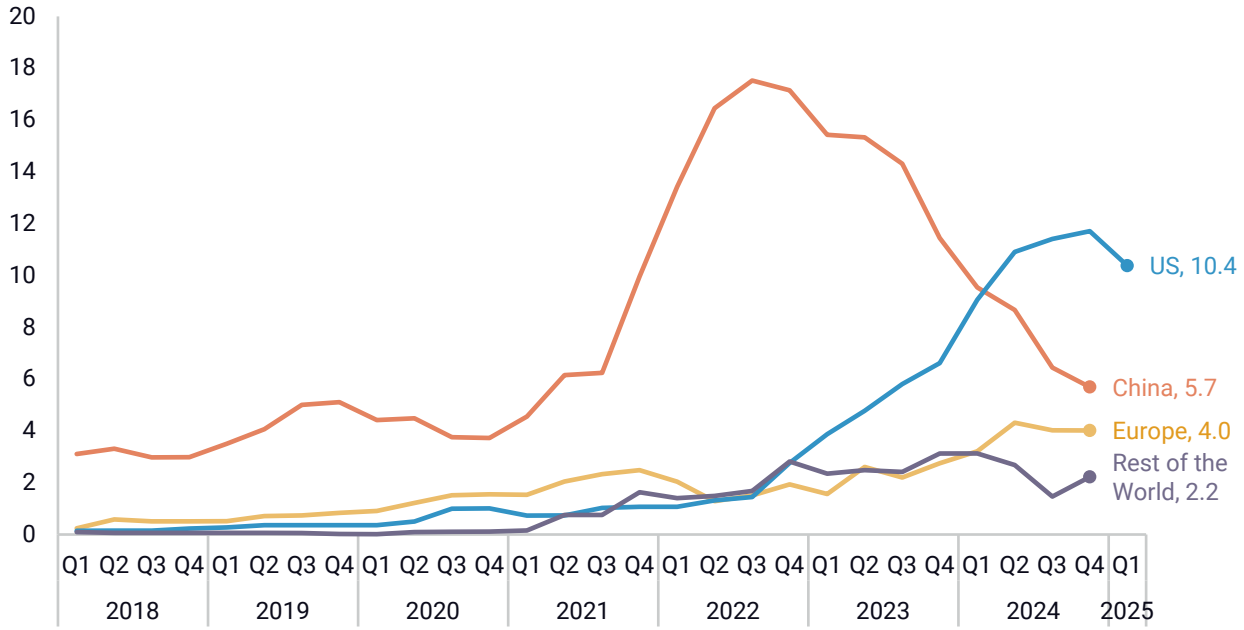
Source: Global Clean Investment Monitor

We see a similar story when it comes to the timeline for battery manufacturing investments across the three regions. China got the edge on the rest of the world, ramping up investments steadily through 2021 with a rapid spike in 2022, then steadily declining throughout the end of 2024 once overcapacity dampened additional investment. European and American battery manufacturing investments didn't begin to take off until late 2022 in the US and late 2023 in Europe. Unlike EV manufacturing, US battery manufacturing investments ramped up to levels exceeding China's starting in the second quarter of 2024, and ended the year with investment levels more than double China's. However, there are signs of slowing momentum in the US, where Q1 2025 EV and battery investments combined fell 10% from the previous quarter.

FIGURE 38

China's battery manufacturing investment surged before the US took the lead

Quarterly battery manufacturing investment by region (billion 2023 USD)



Source: Global Clean Investment Monitor

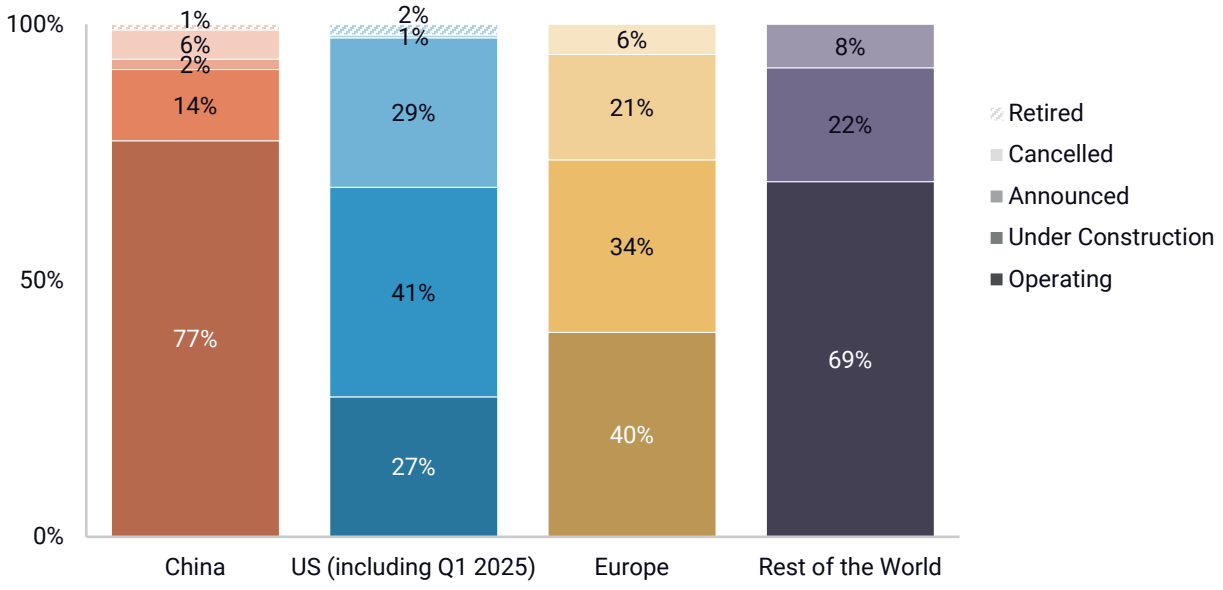
China has also had the greatest success turning announced manufacturing projects into operational facilities over the past six years. Of all EV manufacturing investments announced in China between 2018-2024, 77% are operational today and 14% are under construction, with only 2% of announced investments still waiting for shovels in the ground. The bulk of American and European announcements have come in the past year or two, which means more investments—55% in Europe and 70% in the US—are yet to come online.

A similar trend emerges when looking at announced battery manufacturing investments from 2018–2024, with China leading in operational buildout—57% of projects are already operational and another 29% are under construction. The US and Europe are further behind in bringing projects online, with just 29% of US and 17% of European projects currently operating. A significant share—51% in the US and 41% in Europe—is still under construction, reflecting how much of the buildout is still in progress. Cancellations remain modest in China and the US (3% and 5%, respectively), while Europe and the rest of the world have seen slightly higher rates. The large share of still-announced or under-construction projects in the US means many investments remain at risk, especially if IRA tax incentives are scaled back or overturned.

FIGURE 39

China has translated more announced EV investments into operational projects than other regions

Current project status of announced EV manufacturing investments 2018-2024 (%)

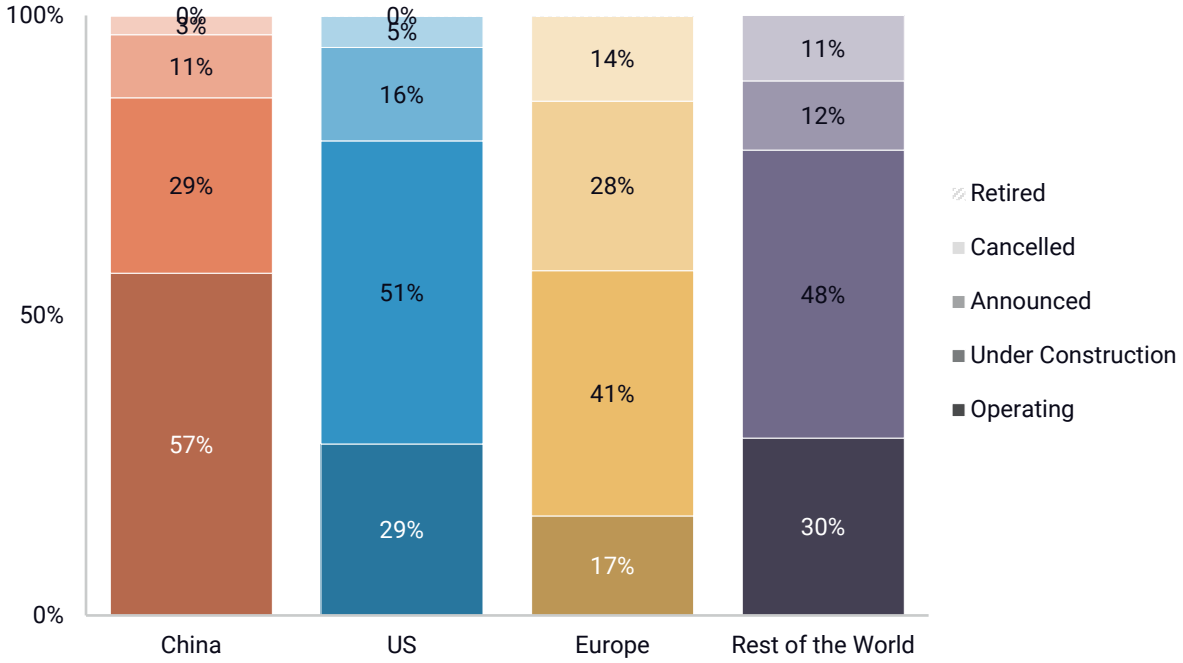


Source: Global Clean Investment Monitor

FIGURE 40

China has translated more announced battery investments into operational projects than other regions

Current project status of announced battery manufacturing investments 2018-2024 (%)



Source: Global Clean Investment Monitor

2030 outlook

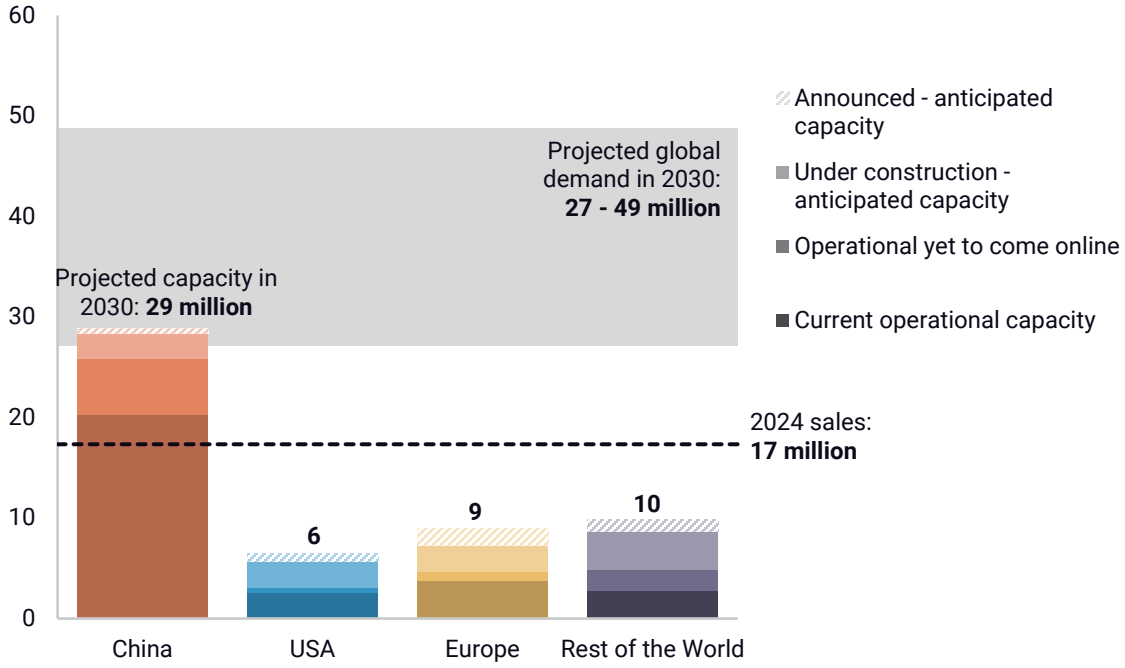
China's early jump on EV and battery manufacturing in the mid-2010s and early 2020s gave it the edge when it comes to the sheer volume of overall operating capacity today. And given all the announced investments in the pipeline, we can say with relative certainty that the outlook for 2030 remains the same, with China's EV manufacturing capacity (at 54% of the global total) far exceeding any other region—at 3.2x European capacity and 4.5x US capacity (Figure 41). In fact, China's full EV manufacturing capacity—if it were all to come online and operate at full capacity by 2030—would be nearly sufficient to meet the low end of total global EV demand in 2030.

A much larger portion of announced EV manufacturing capacity expected to come online in the rest of the world by 2030 is not currently operational. The recent upswing in announcements from the US and Europe will be forced to compete in a world where Chinese overcapacity is already tamping down China's own domestic EV manufacturing investments. More than half of EV manufacturing capacity outside China in 2030 is still under construction today or waiting to commence construction.

FIGURE 41

China is poised to dominate global EV capacity through 2030

Projected EV manufacturing capacity in 2030 and expected global demand (million vehicles)



Source: Global Clean Investment Monitor, Rhodium Group, EV Volumes.

When it comes to batteries—both modules and cells—we see a similar picture when it comes to China's dominance, which we do not expect to abate in the coming five years. China's current operational battery capacity already exceeds global demand today. We expect global battery demand to rise dramatically in the next five years, rising anywhere from 49 to 227%. Yet China's *current* battery capacity—including facilities online and ramping up—is nearly sufficient to meet the low end of expected global demand in 2030, even if all announced projects or those under construction today are cancelled. And if all

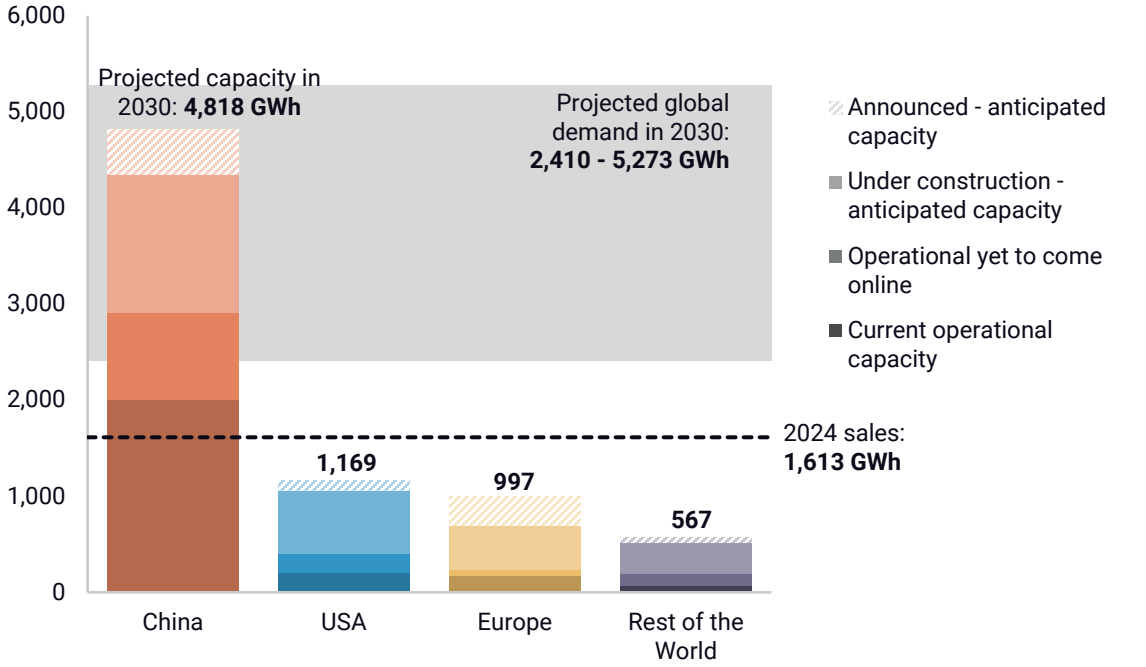
anticipated Chinese capacity comes online in the coming five years, China could produce enough battery cells and modules to meet projected global demand in 2030.

FIGURE 42

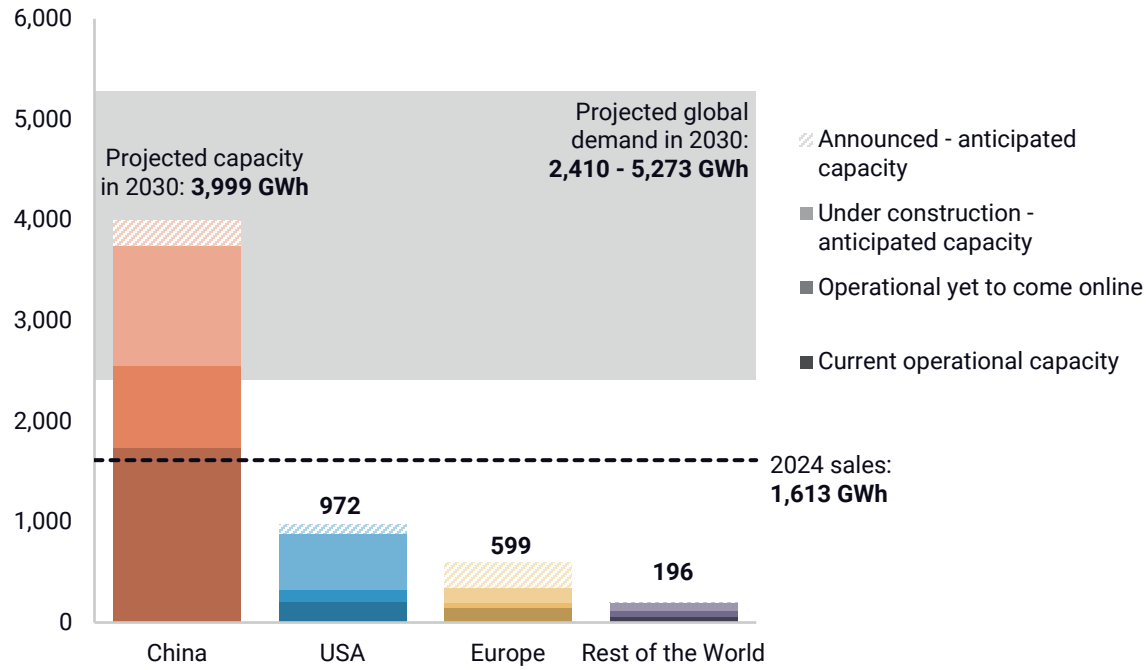
China alone is on track to meet global demand for batteries in 2030

Projected manufacturing capacity in 2030 and expected global demand (GWh)

a) Cells



b) Modules



Source: Global Clean Investment Monitor, Rhodium Group, EV Volumes. Note: Deployment includes stationary storage capacity additions and EV sales. Note: Demand includes stationary storage capacity additions and EV sales.

CHAPTER 5

The Rest of the World

While China, Europe, and the US dominate EV markets today, EV sales in the rest of the world are rising. By 2050, EV sales outside today's three major markets grow from 10% to 30-40% of global EV sales in our Rhodium Climate Outlook. Just in the last few years, sales have surged in Turkey, Brazil, and many Southeast Asian countries. In many markets, this growth has been driven by low-cost Chinese models, both imported and built in-country. In other countries, sales have been fueled largely by domestic brands. This includes established and export-driven car manufacturing economies like Japan and South Korea, as well as new entrants like Vietnam and India.

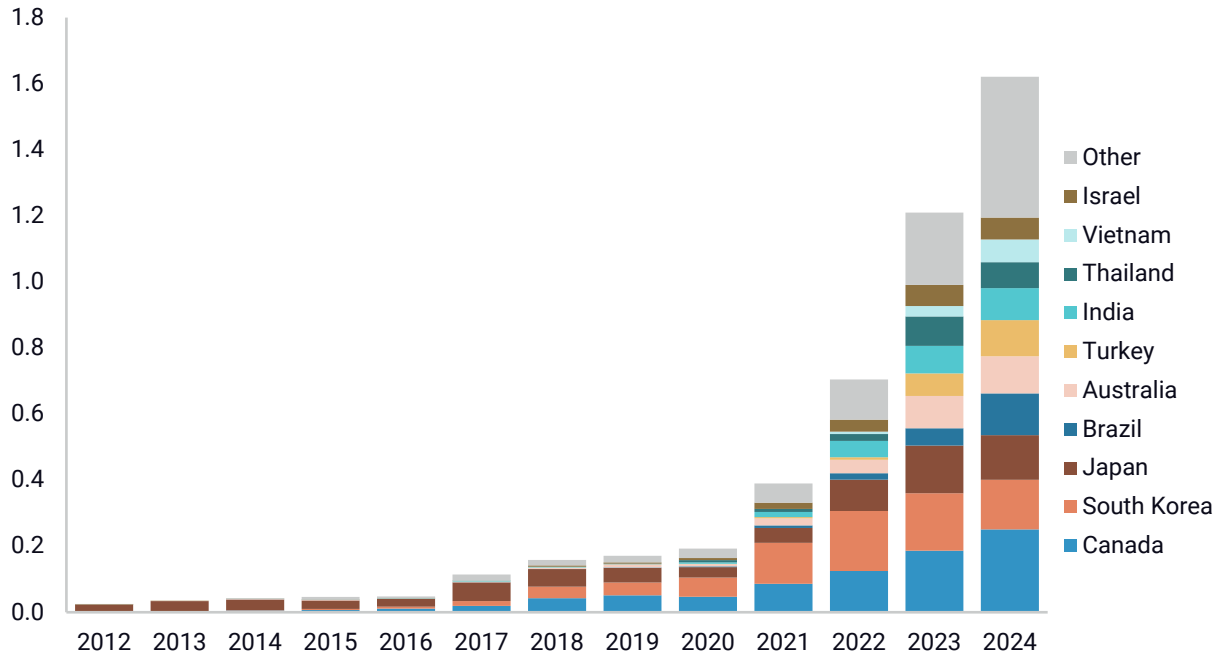
In the US and Europe, EVs to date have largely served a premium market. For consumers in emerging economies, EVs must be affordable to gain market share. Low-cost Chinese imports and foreign investment present opportunities for widespread adoption, but risk crowding out domestic manufacturers. Going forward, key questions include: How do EVs compete with traditional vehicles? Where are EV sales beginning to take off? Which countries are investing in domestic manufacturing? To what extent are both sales and manufacturing driven by imports and investment from China, versus domestic brands? What pressures do policymakers face to carve out market share for domestic manufacturers, versus allowing access to low-cost Chinese EVs?

Electric vehicle demand

While EV sales are expected to grow across all regions, China, Europe, and the United States will account for a diminishing share of the global market as adoption in the rest of the world accelerates. In 2024, only 10% of global EV sales occurred outside these three regions. According to our Rhodium Climate Outlook, this share grows to 30-40% by 2050 as vehicle ownership and EV adoption grow in the rest of the world.

Even now, new EV markets are beginning to emerge across the world. EV adoption in Japan, South Korea, Canada, and Australia began picking up speed in the mid to late 2010s. More recently, EVs have spread to many other markets, including Brazil, Turkey, Vietnam, India, and Thailand (Figure 43).

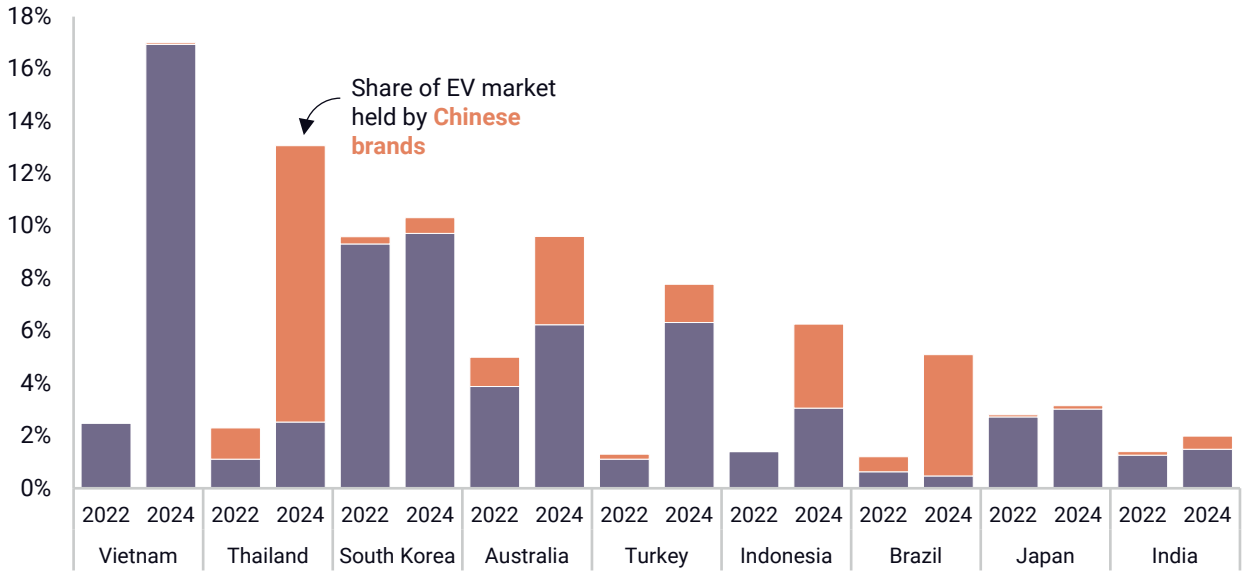
FIGURE 43
EV sales are growing in countries around the world
EV sales (million vehicles)



Source: EV Volumes

Wider adoption has been made possible in large part by falling costs, with EVs now price-competitive with internal combustion engine vehicles in many markets. In many parts of the world, this shift has been driven by the growing presence of Chinese manufacturers offering low-cost models. Chinese brands increased their share of EV sales in the rest of the world from 1% in 2018 to 35% in 2024, including exported Chinese EVs and those built abroad. The growth in EV sales—and the rise in China's market share—has been stark in many emerging markets in just the last two years. In Thailand, where EVs have grown from 2% to 13% of light-duty vehicle sales since 2022, Chinese brands have grown from 50% to 80% of EVs over the same period (Figure 44). Turkey, Indonesia, Brazil, as well as more mature auto markets like Australia, have all seen EV sales skyrocket alongside rapid growth in the sale of Chinese models.

FIGURE 44
EV market share has surged, with Chinese brands playing a major role in many markets
EV sales share and fraction from Chinese brands



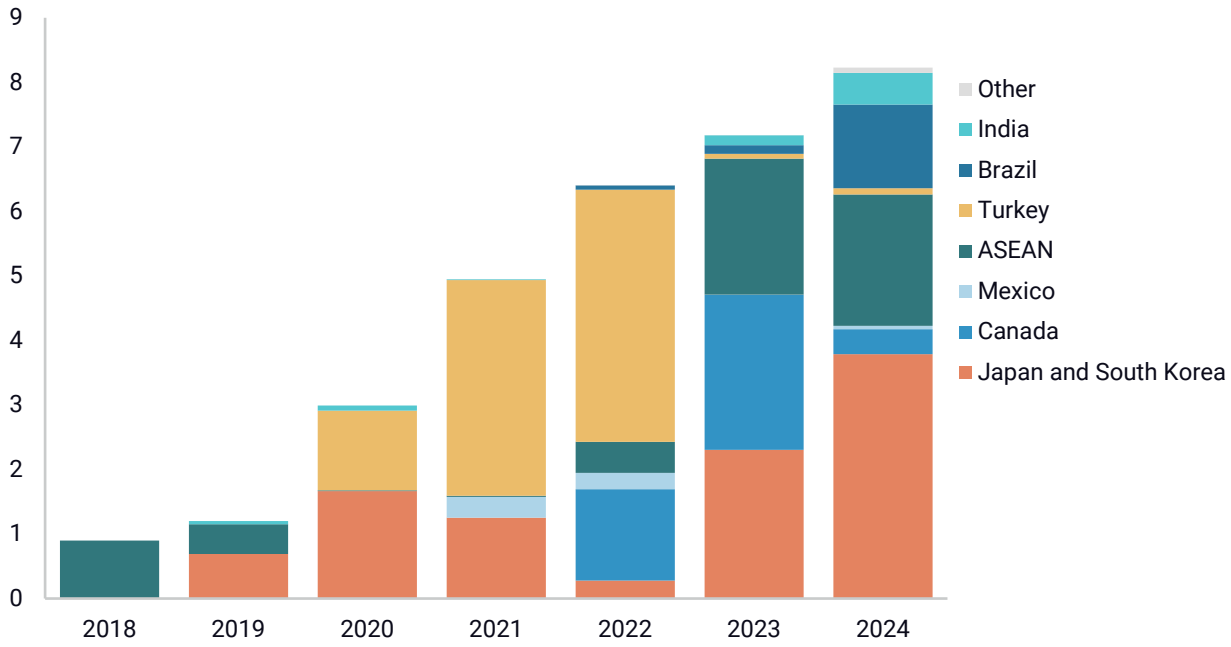
Source: EV Volumes, IEA

India has taken a different path. High import tariffs have limited the presence of Chinese imports, in a bid to encourage domestic manufacturing and foreign investment. Local production met more than 80% of EV sales in 2024, even though a growing share of locally-produced EVs are foreign brands. India's EV sales share remains modest, however, hitting just 2% of total vehicle sales in 2024. In Vietnam—a rapidly growing market—EV sales surged from 3% of total vehicle sales in 2022 to 17% in 2024, driven by domestic brand VinFast. These trends highlight how affordability—whether through imports or local production—continues to shape EV adoption in emerging markets.

EV and battery manufacturing investment

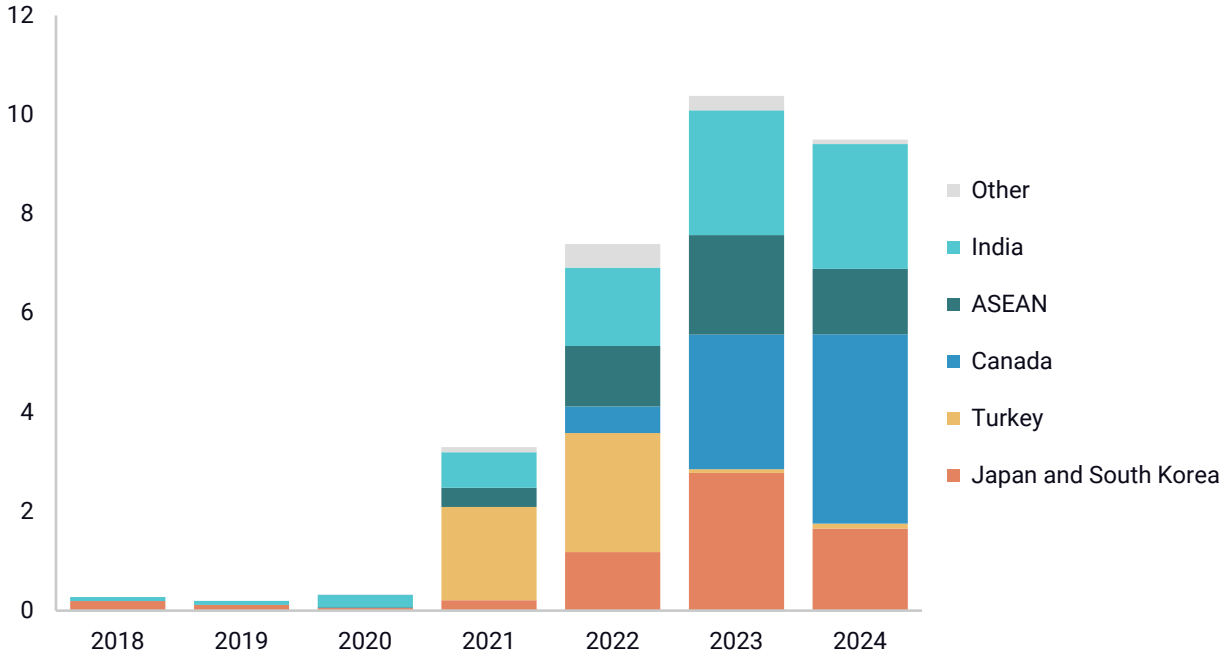
As global EV sales grow, many countries are working to stimulate investment in domestic EV and battery manufacturing, both local and FDI. Investment in Japan and South Korea—both home to established automakers with extensive experience in EV and battery production—started before 2018 and has continued to rise (Figures 45 and 46). Countries like Turkey, Mexico, and Southeast Asian countries—including Indonesia, Malaysia, Thailand, and Vietnam—began expanding their EV manufacturing bases between 2018 and 2020, with ASEAN and Canada taking the lead in 2023. On the battery front, India has rapidly become a standout player, surpassing Canada and ASEAN in investment by 2023 and maintaining a strong lead into 2024. These investment trends signal a broader shift: while EV and battery manufacturing continues to be dominated by China, the US, and Europe, investments in the industry are increasingly global, with new manufacturing ecosystems taking shape across the rest of the world.

FIGURE 45
Investment in EV manufacturing has grown in countries around the world
Investment in EV manufacturing by geography of investment (billion 2023 USD)



Source: Global Clean Investment Monitor

FIGURE 46
Investment in battery manufacturing has grown in countries around the world
Investment in battery manufacturing by geography of investment (billion 2023 USD)



Source: Global Clean Investment Monitor

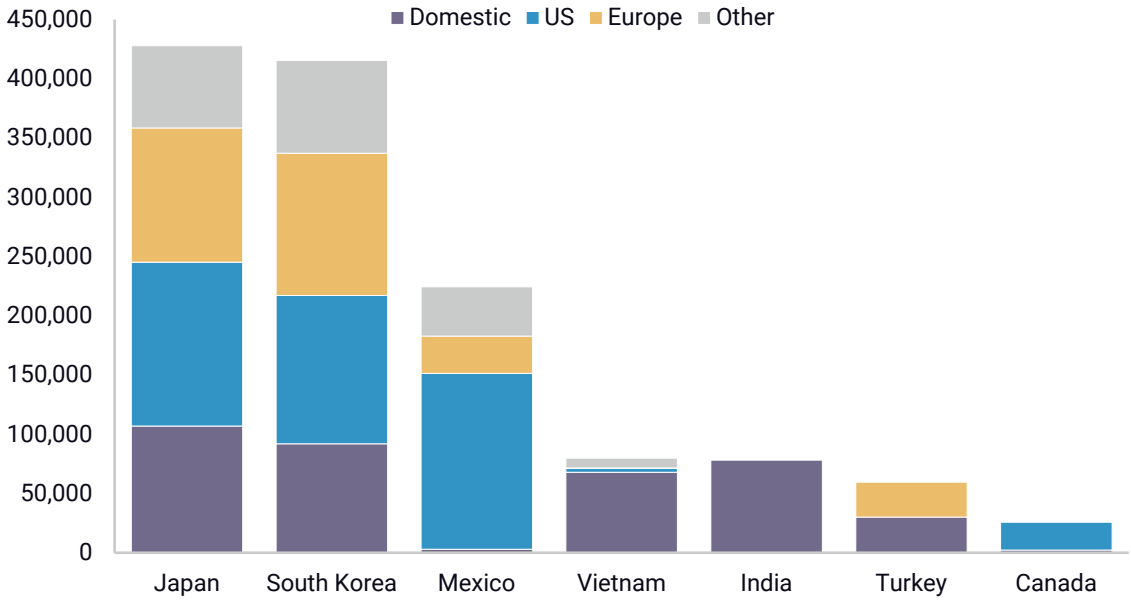
The policy and market conditions driving manufacturing investments differ by country. Both Japan and South Korea are home to automakers with a long history of battery innovation and manufacturing. The largest EV producers behind China, the US, and Europe, Japanese and Korean OEMs continue to invest in EV supply chains to serve both domestic and export markets (Figure 47), buoyed by government subsidies and incentives. Mexico and Canada have expanded EV production primarily to supply the US market, but recent and proposed tariffs, along with weakening US EV demand, threaten those exports.

Without the economic scale or technological base of larger markets, countries like Indonesia, Thailand, and Brazil are increasingly relying on Chinese OEMs to build out domestic EV manufacturing, most of which is largely still under development. These investments enable local production without requiring full-scale technology development. The result is a hybrid model—anchored in foreign direct investment but leveraging local assembly—that allows countries to participate in the EV supply chain while keeping vehicle costs down. Vietnam stands out as the exception, where local manufacturer VinFast holds more than 90% of the domestic EV market. Even then, VinFast is increasingly moving to source low-cost batteries from China.

FIGURE 47

East Asian and North American EV hubs serve own and export EV market, while newer entrants largely supply domestic demand

EV production by geography of sale in 2024 (number of vehicles)



Source: EV Volumes

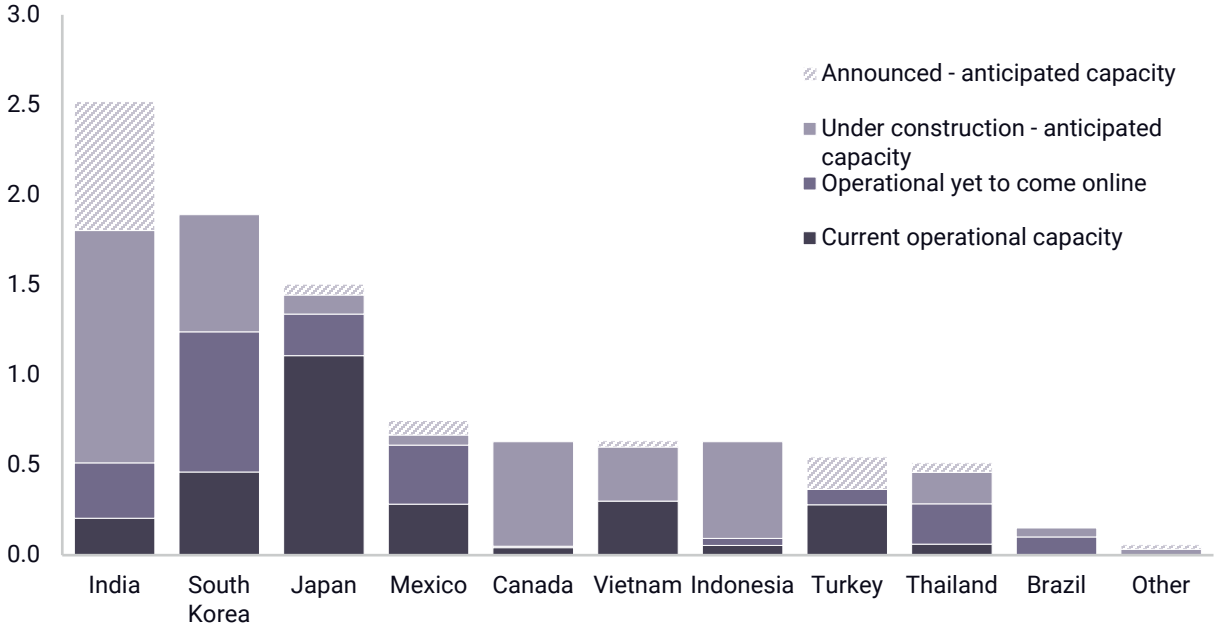
India has charted a distinctive path in developing its EV industry, combining industrial policy with market incentives and a protectionist trade policy. The country launched consumer subsidies tied to tightening localization requirements, coupled with incentives for manufacturers of advanced batteries and EV components and an effort to expand charging infrastructure. To protect local manufacturers, India has maintained import tariffs of up to 70–100% on fully built EVs. This protective stance has helped domestic production grow but also limits consumer choice and raises costs. Nearly 100% of India's EV manufacturing is for its domestic market.

Other regions are investing in EVs and batteries primarily for export. In Turkey, two major projects in the early 2020s are responsible for the bump in EV and battery manufacturing investment, with EVs now being sold at home and across the European Union (EU). Similarly, Mexico and Canada have invested in building out their EV industries largely to serve the US market.

2030 outlook

While today's operational EV manufacturing capacity outside of China, Europe, and the US is concentrated in countries like Japan, South Korea, Mexico, Turkey, and Vietnam, GCIM facility-level data reveals a shifting landscape by 2030. India emerges as the leading player outside of China, Europe, and the US, edging out Korea and Japan in anticipated capacity (Figure 48). Indonesia and Thailand also see a significant rise, surpassing traditional players like South Korea and Japan if all projects under construction come online as planned. New entrants like Canada and Brazil begin to carve out a notable share of capacity as well, signaling a broader diversification in the global EV supply base in the coming five years.

FIGURE 48
The pipeline of EV manufacturing shows a shifting landscape for capacity
EV current and planned capacity in 2030 (million vehicles)



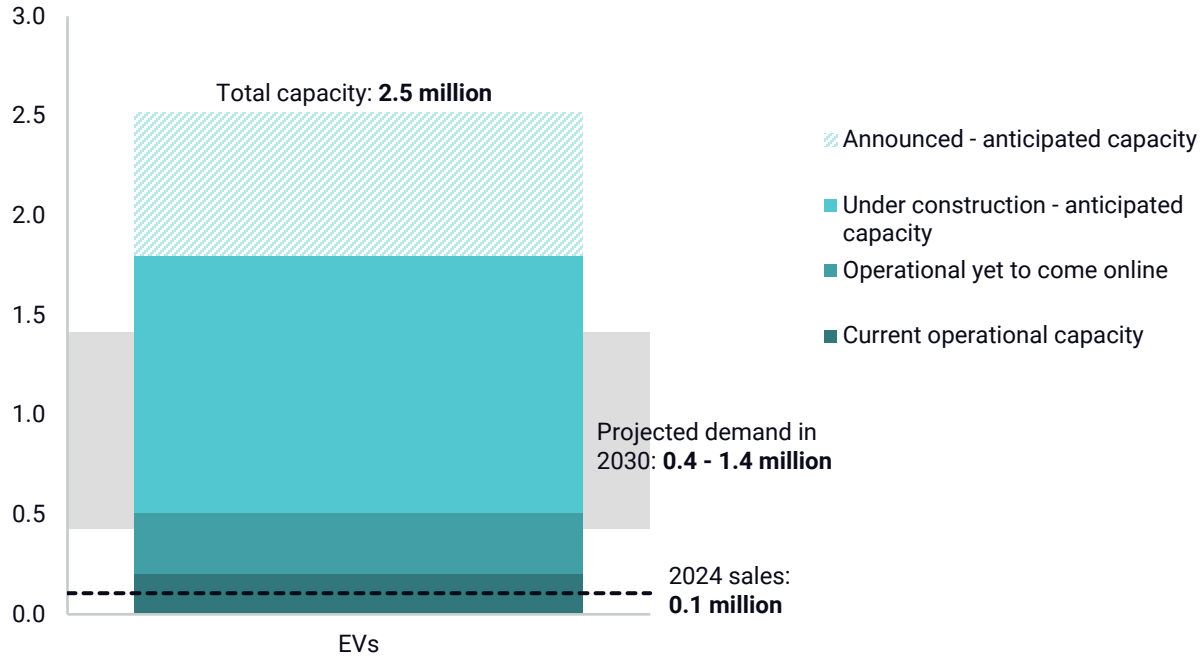
Source: Global Clean Investment Monitor

India stands out among the new entrants for actively shaping its domestic EV manufacturing landscape through a combination of industrial policy and trade protection. India's planned EV production capacity for 2030 could reach around 2.5 million vehicles, with roughly 1.8 million already under construction or operational (Figure 49). This far exceeds India's projected 2030 EV demand (which likely reaches anywhere from 43,000 to 1.4 million vehicles depending on the pace of policy and battery costs), suggesting the potential for future exports. This push aligns with the government's strategy to "Make in India for the world", but Indian companies will need to drive down costs if they want to compete with exports from China.

FIGURE 49

India's EV industry is on track to far exceed domestic demand

India's current and planned EV capacity in 2030 and projected demand in 2030 (million vehicles)

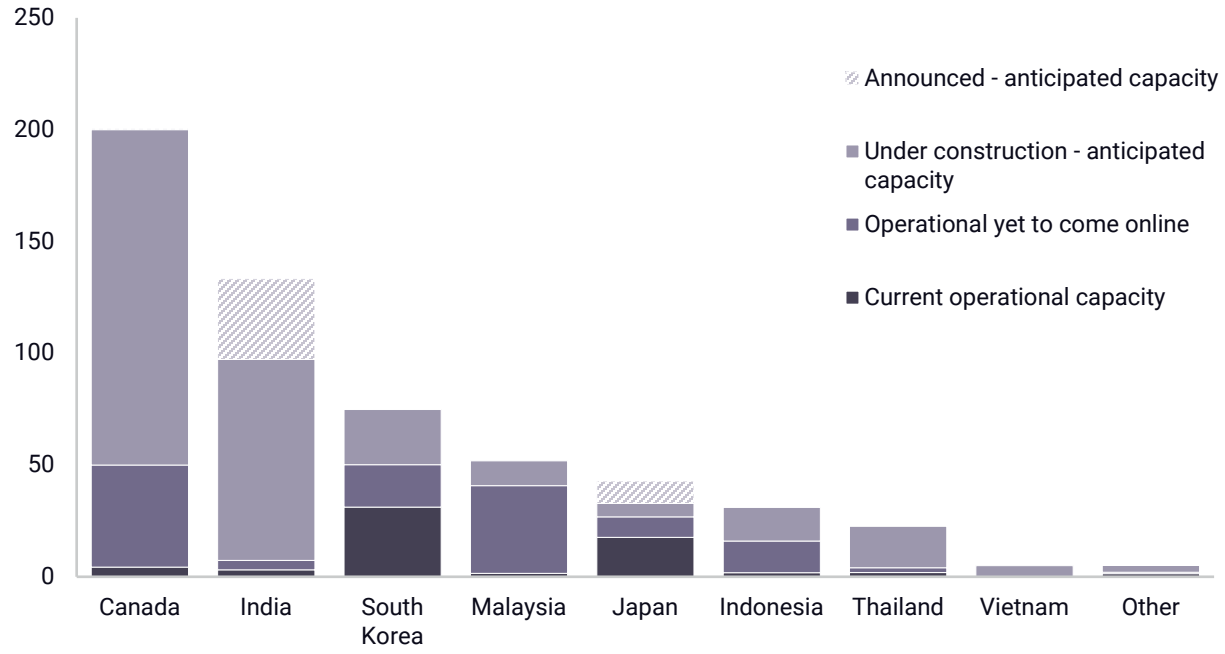


Source: Global Clean Investment Monitor, 2024 Rhodium Climate Outlook, IEA.

Current operational capacity for battery cells and modules is still relatively concentrated among a few players—Canada leads in cell production, while South Korea and India show meaningful activity in both cells and modules (Figures 50 and 51). However, looking ahead to 2030, a shift in leadership becomes clear. India is set to become the largest module producer outside China, the US, and Europe, with significant capacity already under construction and announced. Canada also solidifies its position with major growth in both cells and modules. Meanwhile, ASEAN countries and Turkey begin to scale up, particularly in modules, signaling a broader diversification of battery manufacturing hubs outside the traditional leaders like Japan and Korea.

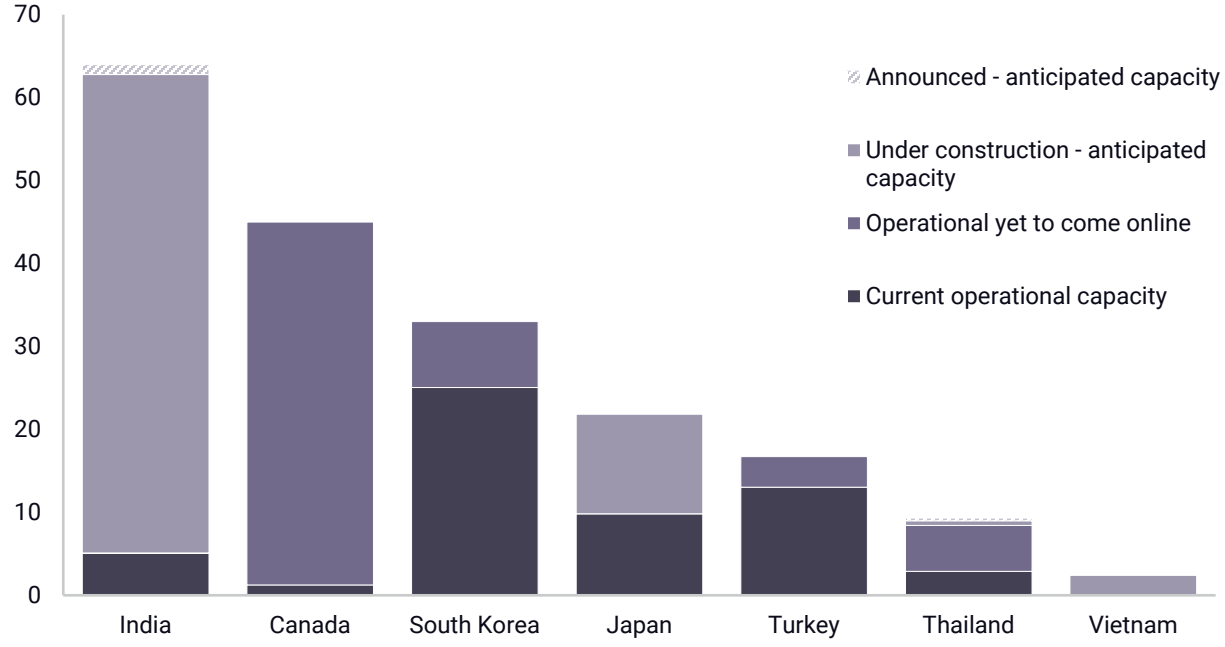
The path to battery manufacturing leadership varies across countries, with differences in how advanced projects are. South Korea and Japan, for example, have already brought a substantial share of their cell and module capacity online, signaling a more mature battery industry. In contrast, India's growth is primarily driven by projects still under construction or newly announced, indicating rapid recent momentum but more risk around delivery. ASEAN countries are also just starting to scale, with most of their cell and module capacity still in the early stages. Compared to EV manufacturing, where we anticipate countries like Japan and Korea to still have strong footprints by 2030, the battery space is dramatically reshuffling. Some countries emerging as battery hubs—like Canada—are not yet major EV producers, while others, like Mexico and Turkey, which show EV activity, have more limited battery plans. Meanwhile, India is investing heavily in both. This divergence highlights differences in how countries are gearing up to participate in EV supply chains, and the extent to which those plans might rely on global trade.

FIGURE 50
New leaders emerge in battery cell manufacturing
Cells current and planned capacity in 2030 (GWh)



Source: Global Clean Investment Monitor

FIGURE 51
New leaders emerge in battery module manufacturing
Modules current and planned capacity in 2030 (GWh)



Source: Global Clean Investment Monitor

Looking forward, the GCIM will be monitoring the evolution of the global auto market outside of China, Europe, and the US, with a view to provide insights on the following questions:

- Are EVs competitive with ICE vehicles in key markets?
- Where are we seeing signs of an EV transition, either in domestic sales or manufacturing?
- What tradeoffs do countries face between access to low-cost Chinese EVs and political pressures to support domestic production? To what extent will countries adopt the policy approach of China, the US, or Europe?
- To what extent will countries build out their own domestic EV supply chains?

Conclusion

After several decades of debate and policy trial and error, the world is well on its way to transitioning to a future powered by clean energy and driven by electrified vehicles. Today, technologies that took decades to mature—like wind, solar, and now electric vehicles—have finally reached escape velocity as they deploy rapidly worldwide. This has ushered in a new era of intense competition to innovate and manufacture the technologies of the future. Policymakers intent on speeding the transition and accelerating decarbonization will need to understand not only the local implications of clean energy and transportation policies and industrial policy, but also the geopolitical tensions surrounding trade and securing supply chains. To understand this complicated web of dynamics, policymakers need real-time information about how the clean energy and transportation transition is unfolding not only at home, but abroad as well.

For the past two years, the US Clean Investment Monitor—a joint project of Rhodium Group and MIT's Center for Energy and Environmental Policy Research (CEEPR)—has provided a comprehensive, real-time, source of information on quarterly investment in the manufacture and deployment of clean energy technologies at a local level across the US. The CIM provides timely insight into whether US clean energy policy is having its intended effect, both in accelerating deployment and in supporting local economic development to build the case for continued action and investment to sustain the US's commitment to the clean energy transition and position the US to compete globally.

Now we are expanding this resource to provide the same real-time data at a country-level to the rest of the world. In the coming year, the **Global Clean Investment Monitor** will expand to include other clean energy technologies beyond the vehicle sector, including wind, solar, critical minerals, clean steel, clean cement, and sustainable aviation fuels (SAF). This real-time data, collected from facility-level investments across the world, will provide policymakers and investors with up-to-date information on manufacturing investments at various stages of completion (e.g., announced, under-construction, operational or cancelled), and estimates of annual production capacity by country, as well as current and projected country-level demand to assess the balance of domestic supply and demand and its implications for import or export markets.

Methodology

The Global Clean Investment Monitor (GCIM) tracks public and private investment in clean technology manufacturing with a view to provide real-time, project-level information on GHG emission-reducing technologies across the world. In this first phase of the GCIM, we focus on manufacturing investments in electric vehicles (EVs) and batteries.

To establish a historical benchmark for evaluating recent clean investment trends, the GCIM includes all investments in our covered technologies from 2018. This results in a database with roughly 1,248 individual facilities as of Q4 2024. All investment figures are in 2023 US dollars.

Individual project tracking

This first installment of the GCIM covers investment in the manufacturing of EVs and batteries. These include EV assembly plants, as well as facilities producing battery cells, modules, packs, and associated materials like anodes, cathodes, and electrolytes. For EVs, we track manufacturing investments related to battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell vehicles (FCVs). On the battery side, we track key components including electrode active materials (EAMs), battery cells, and modules.

We track investment at the facility level, relying on a combination of company announcements, financial filings, government records, and trusted third-party sources. Our database includes over a thousand individual manufacturing projects globally and monitors projects across all project stages: announced, under construction, and operational, as well as retired and cancelled projects.

We classify projects into one of five statuses based on their stage of development. Projects are considered announced when a specific location and construction timeline have been confirmed, but construction has not yet begun. For larger projects, we additionally require signs that pre-construction engineering (such as Front-End Engineering Design studies) is underway. If ground has been broken or equipment procurement is underway, we categorize the project as under construction. Once a facility begins production—whether at full scale or during an initial ramp-up period—it is considered operational. We also track project retirements and cancellations. To ensure comparability across geographies and over time, all investment figures are reported in constant 2023 U.S. dollars.

If companies report total project investment amounts, we use those directly. When investment data is not disclosed, we estimate it using facility-specific information—such as nameplate capacity or output—and apply technology-specific investment cost assumptions calibrated from similar recent projects. Total investment is distributed over the expected construction period. When timelines are not available, we assign durations based on historical averages for similar facilities.

Capacity

In addition to investment figures, GCIM tracks production capacity and operational status for each facility. Where capacity is not publicly disclosed, we estimate it using reported production targets or historical averages for similar facilities. For multi-phase projects, we disaggregate capacity across expected operational years.

Like investment, we categorize projects by their current status. For existing facilities, we further split operational facilities into current operational capacity and anticipated capacity associated with these operating facilities that have yet to come online. We do so by tracking project ramp-up schedules when available. Where this data is not available, we assume production capacity ramps up to full expected capacity over time based on peer facilities and regional industry norms.

Demand

To put manufacturing investments into perspective, we compare current and planned EV and battery capacity numbers to actual 2024 levels of deployment, as well as the range of projected deployment of these technologies in 2030. 2030 deployment ranges are based on the 2024 Rhodium Climate Outlook, which provides projections of EV and battery deployment based on overall economic growth, policies driving EV adoption and charging infrastructure, battery costs, and oil prices—which we treat probabilistically to provide a likely range of outcomes. Deployment is consistent with the current policy projections in our RCO Baselines, which chart the likely evolution of climate action over time based on historical trends. We updated our US deployment range to include the potential for US EV policy rollbacks, based on Rhodium analysis. We leveraged Rhodium's in-house China expertise to update deployment ranges for China to reflect the latest market outlook for passenger vehicle sales through 2030.

About Rhodium Group

Rhodium Group is an independent research provider with deep expertise in policy and economic analysis. We help decision-makers in both the public and private sectors navigate global challenges through objective, original, and data-driven research and insights. Our key areas of expertise are China's economy and policy dynamics, and global climate change and energy systems. More information is available at www.rhg.com.

About the Authors

Michael Delgado leads the Energy & Climate Data Platforms team, which develops data products and manages research & delivery platforms for the Energy & Climate practice. As part of this role, Mike leads Rhodium's research team working on the Clean Investment Monitor, a collaboration with MIT's Center for Energy and Environmental Policy Research. Mike's team also manages the ClimateDeck, Rhodium's energy & climate data platform. Prior to this role, Mike led a team building tools to quantify asset-level physical climate risks for the financial sector.

Jessica Yin Tsit Chan is a Research Contractor at Rhodium Group supporting projects on China's clean energy supply chains. Jessica specializes in conducting research and analysis on the interaction between regulatory and market trends, with a focus on the energy sector in China.

Kate Larsen is a Partner at Rhodium and specializes in analysis to drive deep decarbonization strategies and accelerate the global transition toward clean energy economies. She manages a multi-disciplinary team of energy modelers, technology experts, policy specialists, and systems analysts focused on accelerating the global clean energy transition.

Anne Luo is a Senior Research Analyst with Rhodium Group's China Data Services team, focusing on cross-border investment trends and policies. Anne also supports the buildout of Rhodium Group's proprietary databases, especially on China's foreign direct investment and environmental, social, and governance (ESG) work.

Charlotte McClintock is a Senior Analyst with Rhodium's Energy & Climate practice and leads the team tracking clean investment in the US.

Mahmoud Mobir is a Senior Analyst in Rhodium's Energy & Climate practice, leading Rhodium's global analysis of electric power transition and maintaining Rhodium's Global Energy Model.

Shweta Movalia is a Research Analyst in Rhodium's Energy & Climate practice, focusing on global energy systems modelling, international policy research, and low-carbon transportation.

Abbie Olson is a Senior Analyst with Rhodium's Energy & Climate practice.

Hannah Pitt is a Director in Rhodium's Energy & Climate practice and manages the firm's international energy research and global modeling tools. Hannah's research focuses on

the impact of policy and investment on clean technology deployment and greenhouse gas emissions. She leads the development of Rhodium's Global Energy Model, an integrated modeling platform that captures uncertainty in the pace of economic and population growth, fossil fuel prices, and clean energy technology costs to provide probabilistic energy, emissions, and global temperature rise projections through the end of the century.

Alfredo Rivera is a Senior Analyst with Rhodium Group's Energy & Climate practice, focusing on global greenhouse gas emissions trends and energy policies. Alfredo joined Rhodium from Goldman School of Public Policy at the University of California, Berkeley. At Goldman, he focused on electricity markets research to deploy large-scale solar farms in the US-Mexico border and helped to measure the carbon intensity of energy consumption in rural Thailand for the United Nations.

Harold Tavarez is a Research Analyst with Rhodium Group's Energy & Climate practice, primarily focusing on research for the Clean Investment Monitor.

Yvonne Yu is an Independent Consultant at Rhodium Group with extensive experience in policy research and consulting. Yvonne specializes in developing data products that empower stakeholders to uncover risks and opportunities, enabling informed decision-making.

Xinyu Zheng is a Research Assistant with Rhodium Group's China Data Services team, focusing on clean technologies and policies.

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Disclosures

New York | California | Washington, DC | Paris

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