Battery recycling policy can vary significantly from one country or region to another, both in application and in incentives or restrictions to build out the value chain.

In some cases, battery recycling-specific policies have not yet been set, whereas in other cases there are legally binding targets for recycled material.

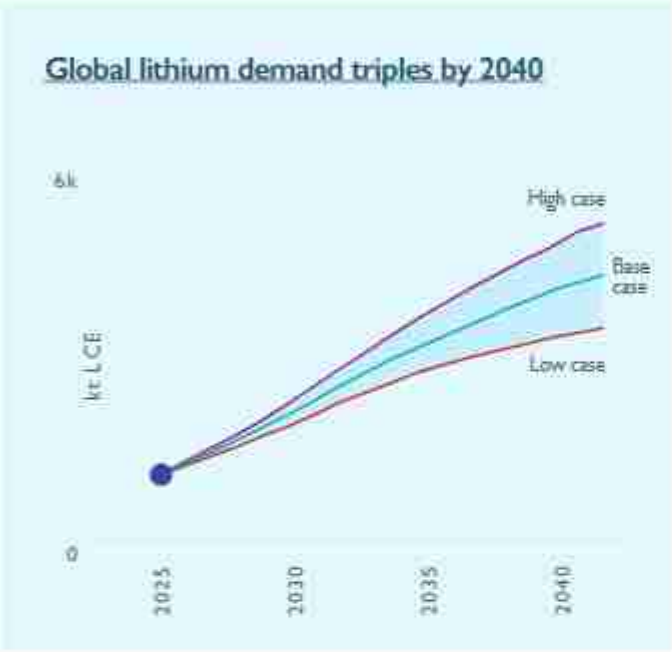
REGION	POLICY ENABLERS	POLICY CONSTRAINTS
CHINA 	• 2024 regulation is legally binding, with mandatory recovery targets (e.g., Li ≥ 90%) and material efficiency standards • Whitelist system drives strict compliance, with dynamic entry/exit criteria • 3% R&D reinvestment supports innovation and process improvement	• Whitelist exclusion can restrict market access • High technical standards can result in compliance burden for small recyclers
USA 	• >US$3Bn DOE & IRA funding confirmed • Section 30D tax credit ties to recycled content • Strong private-sector involvement	• No federal recycling law • Patchwork state-level policies • No mandated recovery targets or EPR system, where producers are responsible for the entire lifecycle of their products
EU 	• Legally binding targets (collection, recovery, recycled content) • Battery passport and due diligence framework • Aligned with circular economy and Green Deal	• High traceability and compliance cost • Burden especially heavy on importers and smaller players
JAPAN 	• OEM-led systems and reuse initiatives • Established voluntary recycling channels	• No EV-specific battery law • No mandatory targets or traceability requirements
SOUTH KOREA 	• New certification and tracking system (2025) • Full battery traceability via unique ID • Pre-disposal testing supports reuse and second life	• No legally mandated recovery or EPR framework • Recycling law not yet unified – still emerging
INDIA 	• Legally binding EPR framework (2022 & 2025 rules) • Digital traceability, labelling, CPCB portal (a centralised digital platform to track and audit recycling activities) • Recyclers must be registered and compliant	• Small producers may face high compliance cost • Enforcement still maturing in some regions

4. The outlook to 2040

The biggest driver for lithium demand is its use in Li-ion batteries.

While outcomes over the next 15 years may vary, global lithium demand is expected to grow from 1.3Mt LCE this year to between 3.6Mt and 5.2Mt LCE by 2040.

The EV sector will continue to dominate battery deployment through 2040. In addition to net-zero targets driving fleet electrification, lower total cost of ownership and reduced maintenance requirements will continue to drive interest for consumers over internal combustion engine (ICE) alternatives.

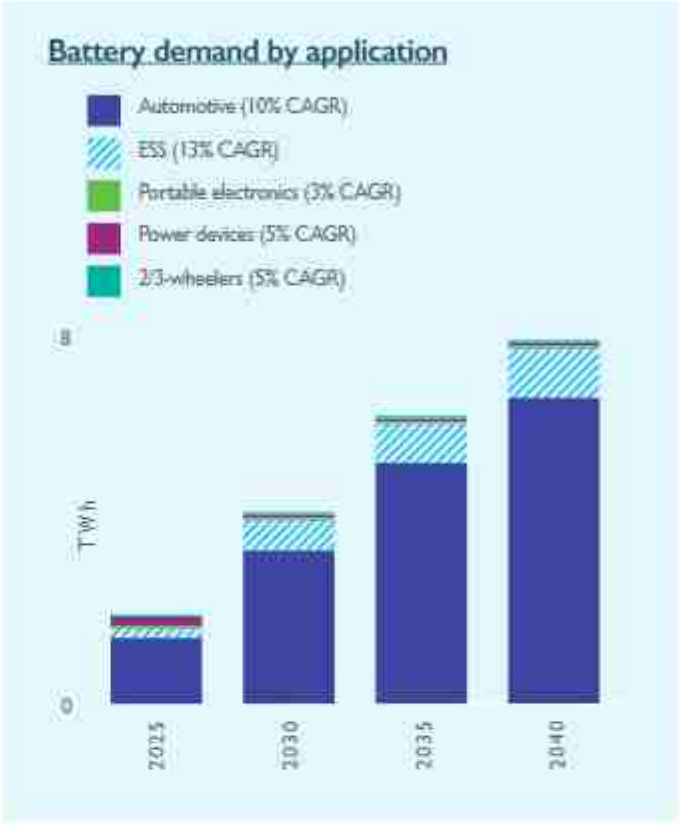


Source: Project Blue

In addition to passenger vehicles, demand from the 2/3-wheeler sector (e.g. e-bikes, e-scooters, e-mopeds) is expected to grow significantly to 2040. Much of the growth will be driven by rental and battery swapping platforms in more urban areas, particularly in Asia and Africa. Alternative future demand streams include e-VTOL (urban air transport such as short-range cargo transport and flying taxis) and robotics applications, which are receiving significant attention currently.

Lithium-ion battery storage is a pivotal enabler of renewables projects by providing flexibility for grid balancing, providing additional electricity during peak times and recharging during periods of low demand. The requirement for such applications is increasing globally, where projects are supported by both government and private funding. As a result, battery demand from ESS applications is forecast to experience the strongest growth rate (albeit from a lower base) between 2025-2040.

Once the main drivers of battery demand, portable electronics have become less prominent due to the sheer size of batteries and growth rate of battery capacity installed in EVs over the past decade. Nevertheless, portable electronics continue to be an integral battery end use sector as a mainstay in our everyday life. In addition, power devices, which include drones and cable-less power tools, are expected to see marginal but steady increases in use owing to rising defense and global construction spending, respectively.



Source: Project Blue

Electric vehicles could account for 60% of global car sales by 2040.

The share of combined BEV and PHEV sales as a function of total vehicle sales is forecast to grow from 20% in 2024 to 35% by 2030 and 60% by 2040. Due to larger battery pack sizes, BEVs will be the primary driver for lithium demand out to 2040, although PHEVs will play a strong supporting role for fleet electrification and decarbonisation.

China is expected to retain majority market share in 2040 at 45%, followed by Europe at 16% and North America at 14%, with the rest of world (ROW) at 25%.

In Europe, new low-cost EVs from both domestic and global OEMs will further accelerate EV adoption. Emissions targets will remain a focus for OEMs in the European market and will continue to drive the rollout of new EV models across the region. Europe also contains global leaders in EV adoption, with Norway at 72% in 2024, followed by Sweden at 51%.

The US and North American EV market saw little growth in 2024, owing to a shift in eligibility of IRA clean vehicle tax credits and uncertainty surrounding the US election towards the latter half of the year. Nevertheless, it is estimated that growth in EV sales will remain strong in the USA through to the long-term as EV uptake becomes increasingly consumer-driven and less policy-driven. PHEV models

represent an excellent opportunity in the US market to increase adoption for consumers less willing or less able to purchase a BEV.

The ROW represents the largest growth market for EV sales throughout the forecast. Although volumes were comparatively low in 2024, subsidy schemes in many ROW countries and the influx of affordable EV models from China will see sales climb over the next 15 years, raising demand for lithium. Countries such as India, Thailand and Malaysia are expected to be at the forefront of electrification within the ROW.

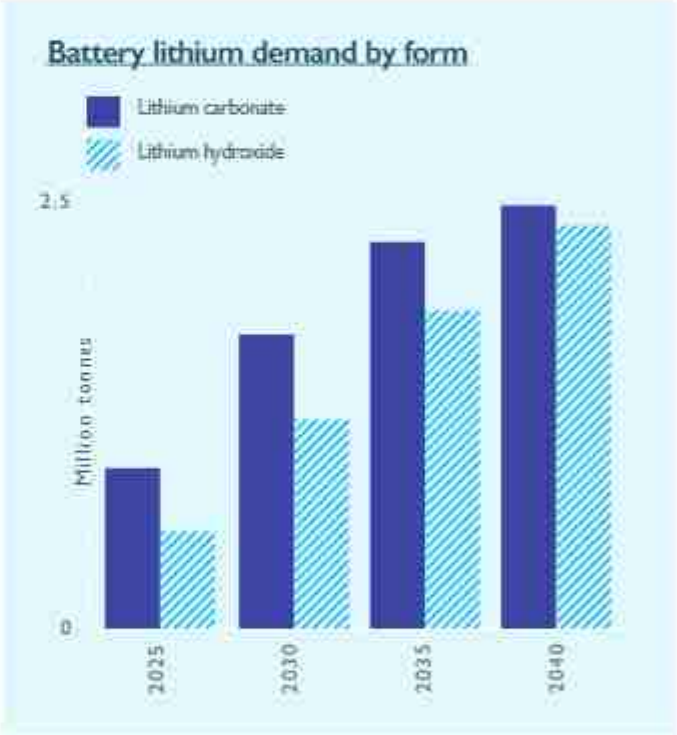
Source: Project Blue

Lithium carbonate and lithium hydroxide are expected to be in near-equal demand by 2040.

Cathode active material production requires significant quantities of lithium carbonate or lithium hydroxide. Whether one form of lithiumx is chosen over another is dependent on the chosen chemistry. Typically, the production of iron-based chemistries (LFP or LMFP) will require lithium carbonate, whilst lithium hydroxide is often favoured for higher-nickel chemistries (NCM, NCMA or NCA).

The drive to lower cell production costs has led the rapid adoption of LFP batteries for EVs in many applications. Moreover, LFP remains the chemistry of choice for most battery ESS applications, owing to its low cost, long cycle life and high safety rating. Combined, this has led to a monumental surge in lithium carbonate demand over the past few years. It is estimated that demand for iron-based cathode active material will increase 150% between 2025-2030, requiring equivalent increases in lithium carbonate.

However, in the period 2030-2040, the quest for more energy-dense batteries and longer EV ranges will provide a boost for lithium hydroxide demand. The 2030s are poised to become the decade for greater solid-state battery adoption, assuming production costs become competitive. Such batteries will likely opt for state-of-the-art high-nickel cathode chemistries to maximise energy density and cell-level efficiency.



Source: Project Blue

Source: Project Blue

Regional outlooks

As rechargeable batteries have become the largest driver for lithium demand, so the geographical centre of demand has shifted to Asia, with China, South Korea and Japan being major consumers. Enterprises in these three countries have scaled up the largest cathode active material and Li-ion battery production globally.

Asia accounted for 94% of global lithium consumption in 2024, though battery production is expected to become more geographically diversified over coming decades. Lithium consumed in industrial applications such as ceramics, glass and metallurgical are also concentrated in Asia, though Europe, the Middle Eastern and North America remain significant markets.

Asia

The Asian market is the largest region for refined lithium consumption, supported largely by the development of leading Li-ion battery component industries in China, South Korea and Japan.

In 2025, Asia is estimated to account for 92% of global refined lithium demand, with demand volumes in the region of 1.2Mt LCE. Over the period to 2040, lithium demand in Asia is forecast to grow at a CAGR of 7%, to reach 3.4Mt LCE by 2040. Most of this growth is driven by production of cathode active materials for Li-ion battery cells.

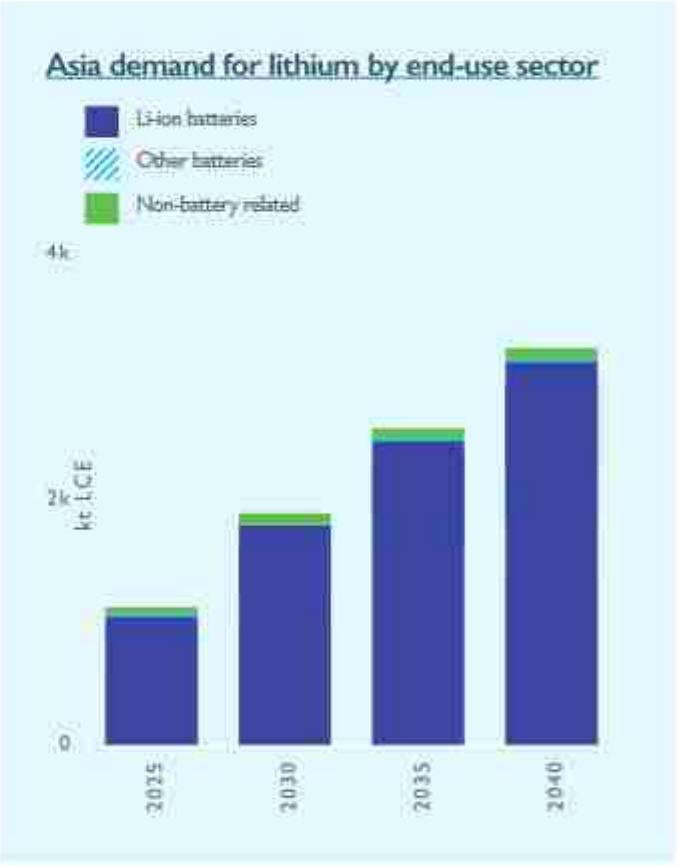
In addition to the Li-ion battery industry, Asia forms the largest producing region for ceramics, glass, glass-ceramics, greases, polymers, metallurgical powders and non-Li-ion battery products using lithium in 2025.

By 2040, 98% of Asia's lithium consumption is expected be in Li-ion batteries.

While China is forecast to maintain a dominant position within the Asian market, the developmentv of Li-ion battery component manufacturing capacity in countries including India and Indonesia, as well as expansion in existing major producing nations such as Japan and South Korea will trim China's market share by 2040.

***A note on demand:** EVs are the largest end use of lithium, and therefore EV sales forecasts are the key driver for demand. However, the 'first use' of lithium compounds in the battery value chain is with the CAM manufacturers, which can be located in a different region than where the EV sales occur.*

Therefore, as with supply chains for the broader automotive market, the geography of lithium demand and EV demand may not always align. But as supply chains diversify globally, lithium trade flows will follow.



Source: Project Blue

China continues to dominate cathode materials manufacturing and EV/ESS installations.

In China, EV sales from 2020-2024 grew at a CAGR of 77%. After such a rapid rise, BEV and PHEV sales growth rates are naturally expected to decline as the market becomes more saturated. Unsurprisingly, EV adoption will be highest in more urban areas where charging infrastructure is most widespread and driving distances are shorten.

It is anticipated that China will continue to utilise iron-based chemistries for most EV and battery ESS applications between 2025-2035 to capture maximum value along the battery supply chain. This will support strong demand for lithium carbonate during the same period through direct consumption during CAM synthesis.

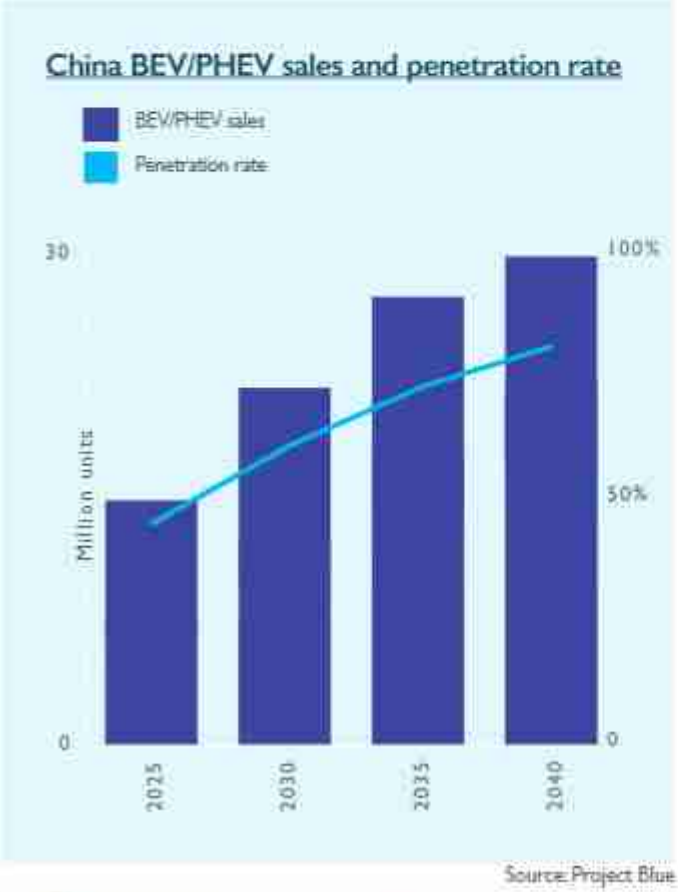
China is forecast to account for 90% of global iron-based CAM supply by 2035, hence a sizeable portion of global lithium carbonate will continue to be consumed here.

Lithium carbonate is also used in mid-nickel NCM (e.g. NCM622) CAM production as a means to lower production costs and for favourable material handling. However, in reality, mid-nickel NCM cathodes could use either lithium carbonate or lithium hydroxide, depending on synthesis, product, feedstock and cost requirements.

China also has strong high-nickel CAM (e.g. NCM811) production capability, where demand for lithium hydroxide in first-use CAM production is forecast to grow 167% between 2025 to 2035.

Ultra-high-nickel cathodes (e.g. NCM9.5.5), which also require lithium hydroxide as feedstock, used in both large format cylindrical cells and next-generation solid-state batteries will push the boundary for energy density gains to deliver EVs with longer driving ranges.

Although carbonate will take preference in China in the short- to medium-term, the arrival of solid-state batteries will increase demand for lithium hydroxide post 2030. Penetration of solid-state will initially be small and future growth will be highly dependent on production costs.



Source: Project Blue

Abbreviations such as NCM622 and NCM811 refer to the stoichiometries of the cathode active material, where the numbers denote the ratio of the metal atoms within the material. For example, NCM622 refers to CAM that has six parts nickel, two part cobalt and two parts manganese.
The complete chemical formula for this is $LiNi_{0.6}Co_{0.2}Mn_{0.2}O_2$
Therefore, NCM811 refers to CAM with a higher ratio of nickel: eight part nickel, one part cobalt and one part manganese.

In addition to EVs, China is forecast to extend its dominance within the lithium-ion battery ESS sector.

China has implemented various subsidy schemes at the national and provincial levels, offering compensation on an RMB/kWh level for battery storage installation.

Such schemes will continue to incentivise the installation of battery capacity for utility scale and residential applications. It is forecast that China will have installed nearly 1,500GWh of capacity for battery ESS applications by 2030, accounting for more than half of global installed capacity.

Other Asian regions are also driving lithium demand growth, either through first-use cathode manufacturing or end-use EV and ESS markets.

South Korea and Japan have both played a core role in the lithium-ion battery story to date, beginning with the commercialisation of the lithium-ion battery in Japan in 1991.

Japan's early role in lithium-ion battery development and deployment was unrivalled, where major advancements were made at the anode, cathode and cell level. Over the past 20 years, Japan has slowed investments in its domestic lithium-ion battery supply chain, although several Japanese companies are active overseas in cell manufacturing, and investing in, or partnering with, upstream lithium projects as well as trading lithium commodities.

Meanwhile, South Korea has seen a monumental rise in domestic production of midstream battery materials to place itself second only to China. Between 2020-2025, South Korean CAM production capacity has grown at a CAGR of 52%, leading to substantial increases in lithium imports. Korean enterprises are also active overseas, either building standalone midstream and downstream manufacturing facilities or partnering with automotive OEMs to supply batteries.

Between 2020-2024, BEV and PHEV sales jumped 485% for the Asia region (ex-China). The continued offerings of affordable EV models from Chinese OEMs, such as BYD, will bolster sales in many countries.

Emerging EV markets such as Thailand, Malaysia and Indonesia are a major target for Chinese OEMs looking to maximize capacity utilization and increase market share, in turn driving lithium demand.

Although sales volumes are currently small, India is a high-potential market, expected to see greater strides with EV adoption between 2030-2040.

Moreover, the electric 2- and 3-wheeler sector (scooters, 3-wheel cargo vehicles, etc.) will be a major growth sector within Asia as ageing ICE-powered products are replaced with electrified alternatives.

Battery swapping for electric motorcycles and scooters is already popular in urban areas and rising competition between third party battery swapping providers across Asia is expected augment demand for lithium in this light electric vehicle (LEV) segment between 2025-2040.

Asia (ex-China) will also see a strong buildout of large-scale renewable energy projects and co-located battery energy storage systems to 2040.

Recently installed and announced projects already consistently exceed the GWh scale, requiring large quantities of lithium at a single site. As an example, in December 2024, Huawei announced a 3.5GW photovoltaic project with 4.5GWh of energy storage project in the Philippines, which would require approximately 2.5kt of lithium carbonate for this single battery ESS project.

North America

Lithium demand in North America is forecast to grow elevenfold by 2040.

The expansion of cathode active material production capacity and other lithium-bearing Li-ion battery components in the region is expected to bring first-use lithium demand to the Americas, rather than importing lithium in the form of consumer products which has been the case to date.

Demand volumes are forecast to increase from 30kt LCE in 2025 to 334kt LCE by 2040, with the Li-ion battery industry accounting for 95% of total demand in 2040 compared to 48% in 2025.

The USA is the main market within North America, given the size of its automotive industry and population, so the adoption rates in this country will continue to be the dominant demand driver for the lithium-ion battery industry in the Americas to 2040.

As a result, the majority of scheduled cathode active material production capacity in the Americas is located in the USA.

North American EV sales track the rollout of new models.

By 2040, it is expected that approximately 50% of passenger sales in North America will be either a BEV or a PHEV.

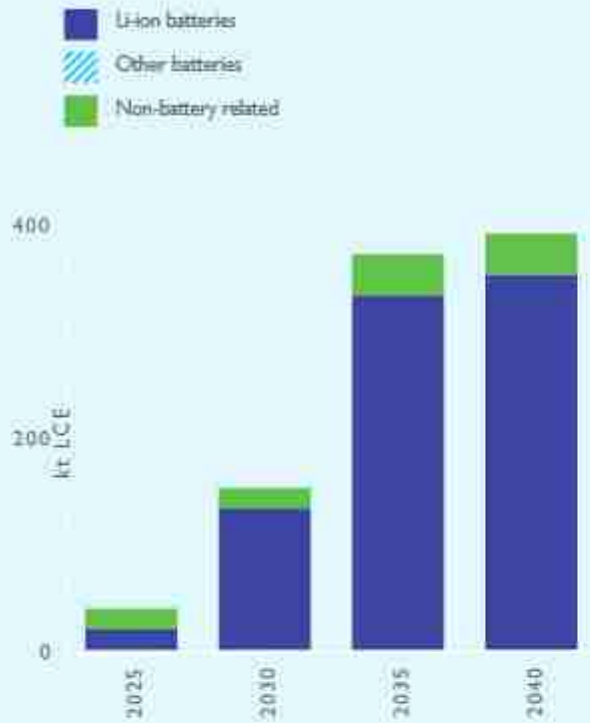
PHEVs represent a major growth opportunity in North America due to longer driving distances, offering consumers greater choice for vehicle electrification. Although PHEV battery packs are smaller than those found in BEVs, pack sizes continue to increase in order to maximise driving range across models. Therefore, as EV sales scale, the intensity for required lithium is also expected to increase for each model, offering additional growth opportunity.

Although the EPA announced early in 2025 that it iends to relax emissions targets, OEMs have been targeting electrification for their model lineups for a number of years. With new and attractive EV offerings being unveiled over the next five years from all major OEMs, consumer themselves, rather than simply policy, is expected to drive the uptake of EVs in North America is expected to follow.

North America is also advancing its battery ESS industry to integrate renewables projects whilst enhancing and balancing the grid. As such, both federal and state-level initiatives have been launched to support the growth of the sector, and as a result, battery ESS projects are becoming larger.

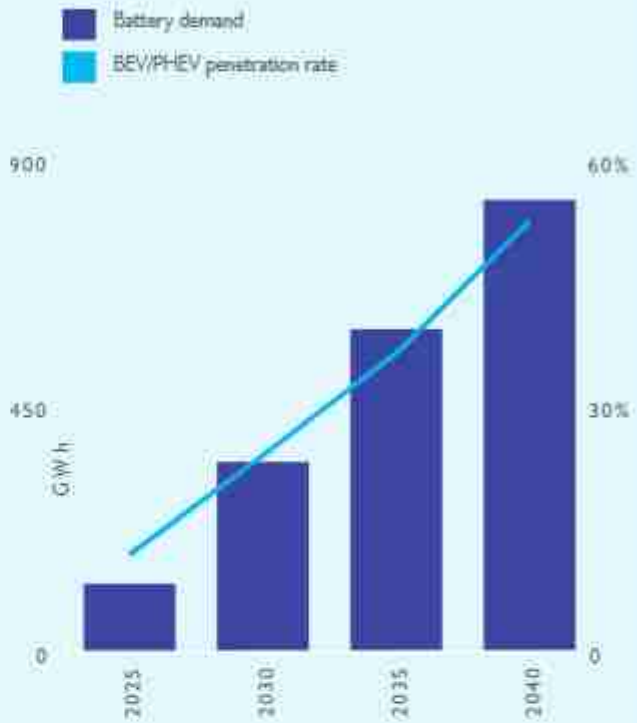
California and Texas lead the way with installed battery capacity and are forecast to remain key driving states for renewables adoption moving forward.

North America demand for lithium by end-use sector



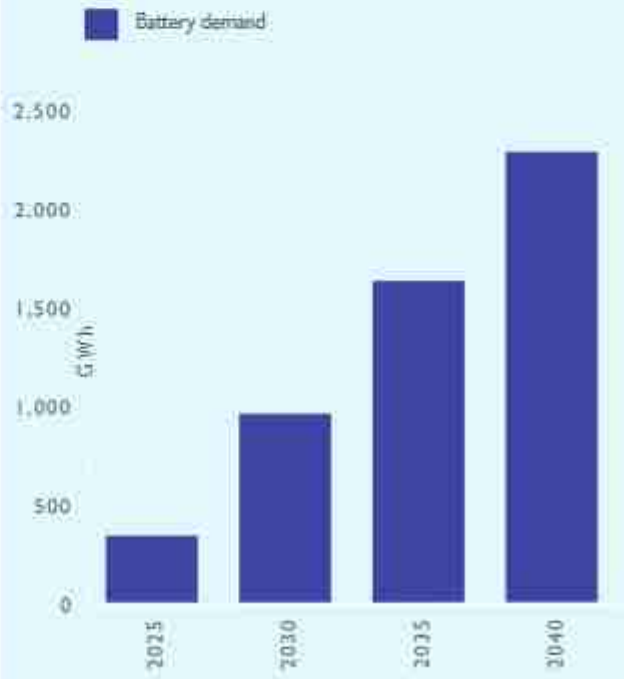
Source: Project Blue

North American battery demand and BEV/PHEV penetration rate



Source: Project Blue

Annual North America cumulative battery ESS installation



Source: Project Blue