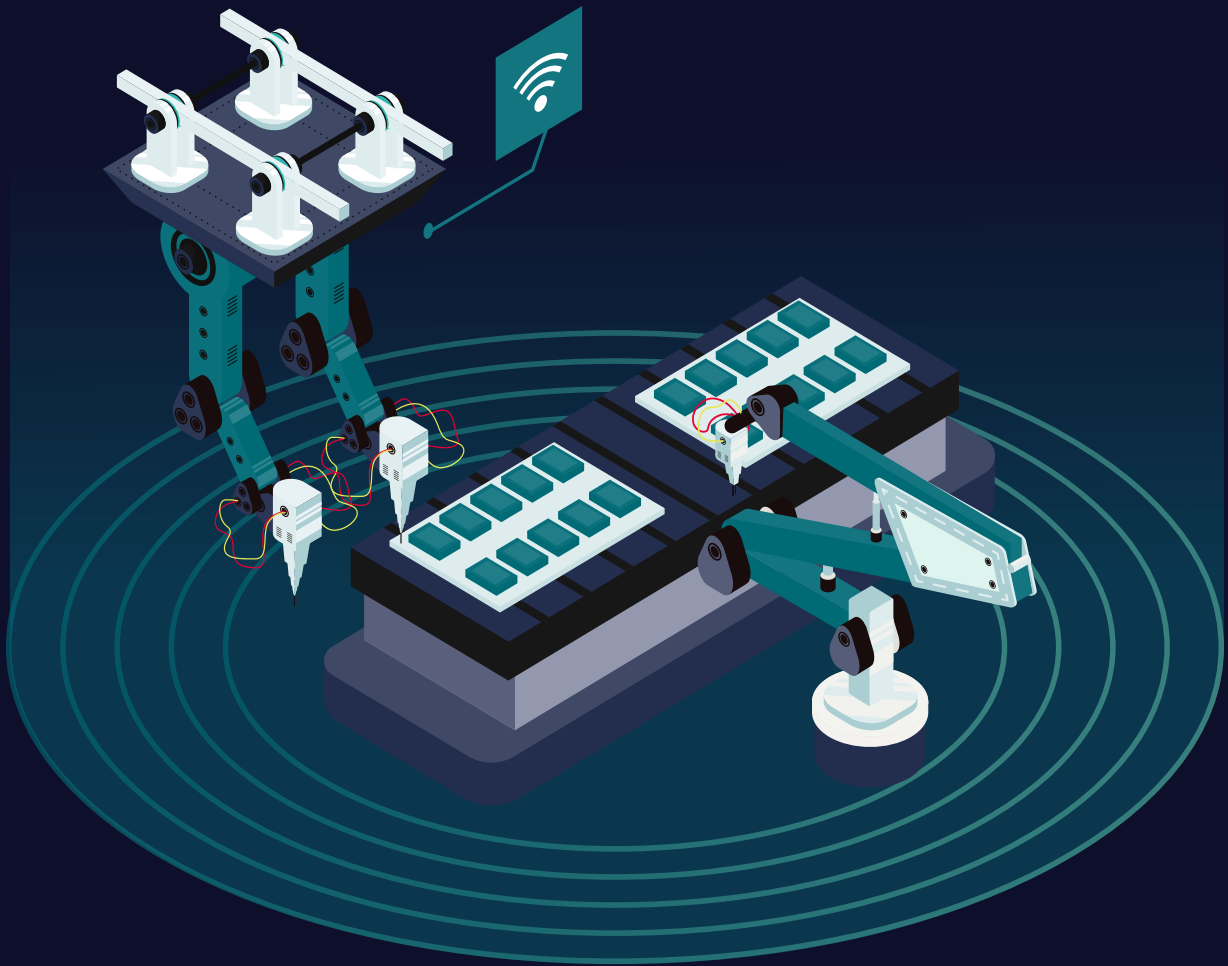


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# The global race to electrification

Battery value chain

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# 1. The global race to electrification

The global EV industry landscape is rapidly changing as thousands of new startups look to break into the market to provide a wide range of goods and services from materials and components, battery life management services, to pop up manufacturing facilities and recycling services.

In this series, we share industry insights across aspects of EV Supply Chain, Battery Manufacturing and Circular economy including what businesses can do to create certainty around business growth.

## 1.1 Emerging markets

The global electrification journey has established itself as a key feature in the future of the automotive industry- driven by government targets and legislation. With both established operators and startups looking to meet requirements, it has brought up both exciting and complex challenges, from developing a portfolio of new products, to securing the supply chain and strategic partnerships, through to establishing clarity on capital investment requirements to scale up manufacturing and operations.

**Current estimates indicate that there are currently over 300 battery gigafactories in the construction or planning stages around the world representing some 6,388 GWh worth of battery capacity, a 68% increase compared to the figure in 2021.**



### USA

22+ projects

Supported by Inflationary Reduction Act



### EU

45+ projects

Supported by EC Battery Alliance



### CHINA

136+ projects

~60% of Global Capacity

## 1.2 The big picture

With a global drive to move to electrification of vehicles, this space is becoming increasingly competitive across the value chain; from OEMs building their strategies to electrification, to start ups offering new and innovative solutions that reaches and appeals to a breadth of consumers. Much of the accelerated technological advancements being developed in Asia, particularly China, with Bloomberg reporting that EVs accounted for a quarter of all passenger cars sold in China last year, far ahead of the roughly one in seven in the US and one in eight in Europe, and HSBC expects the EV penetration rate in the world's second-largest economy to reach 90% by 2030.

On the other side, the US made a big statement with its introduction of Inflationary Reduction Act to help businesses in this space achieve net zero goals without creating an adverse impact on the market. According to a recent study by the International Council on Clean Transportation (ICCT), the IRA will have a significant impact on EV sales in the US,

both for light-duty and heavy-duty vehicles. The study estimates that by 2030, EV sales shares will range from 48% to 61% in the light-duty sector, and from 39% to 48% in the heavy-duty sector. This is more than double the pre-IRA forecast of EV sales.

On the other side of the Atlantic and more recently, we've seen the UK Government delay the ban on petrol and diesel cars creating some strong reaction from industry, particularly given the amount of financial investment sunk into R&D for new EV technology and relating operational needs. Many industry leaders are looking to continue their journey into the electrified market, and they're looking to secure a return on investment. Whilst we're on the journey to seek clarity on many of areas from technology to the commercial implications of industrialization, a number of risks will need to be prepared for around securing supply, ramping up production, maturing manufacturing processes.

## In the UK

According to the Faraday Institute, it is estimated that around 5-6 Gigafactories will need to be up and running by 2030 in the UK alone to meet the eventual battery demand in-country, leaving less than a decade for businesses to raise the capital investment, find and recruit capability, select the right battery chemistry and manufacturing processes, build the plants and that's once they're convinced that the UK is a prime choice for manufacturing. We are quickly reaching the cross-roads of decisions on what our supply chains can do and manage and depending on how it's structured and where the key sources of supply are, will swing a pendulum between affordability and accessibility for consumers. Established OEMs and start ups will need to make some big decisions on where to set up their factories and what that looks like in real and practical terms, to make business models both financially viable and operationally sustainable. Whilst key factors such as the delay in introducing the Rules of Origin; and the Government's UK Battery , and "Powering up Britain" strategies, the industry faces a window of investment opportunities with key decisions making big impacts on the UK's Automotive Industry.

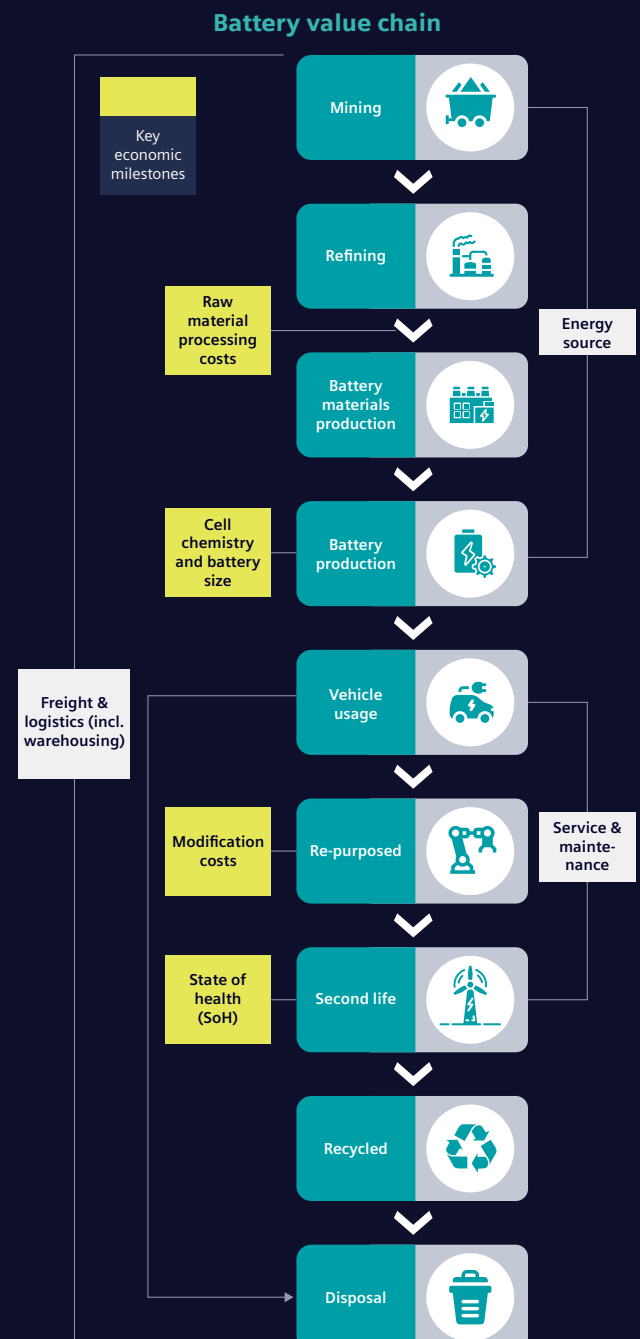
## 1.3 Getting the value chain right

With thousands of new entrants entering into the market in the Electric Vehicle sector, and long established organizations transitioning into this space-across the entire EV value chain, this industry is seeing an influx of innovative products and services. Established OEMs are investing heavily in R&D to transform their products and startups are seeking investment to launch innovative options into the market. Across both new and established organizations, launching new products into the market with commercial transparency from concept to full-rate production will be imperative.

**Currently across the globe, car manufacturers are partnering with battery makers to industrialize this new technology but are facing challenges in controlling costs throughout their supply chain to build BEVs that can compete with the affordability of more established ICE vehicles.**

In a space where EV technology, and in particular, batteries are undergoing some extensive R&D, with many variants out in the market and organizations seeking to develop products that are sustainable, enduring and safe, there is a continuum of evolution in requirements and design, creating complex challenges in forward planning from sourcing, manufacturing and processing approach, and decisions on manufacturing and operational locations.

With increasing focus being placed on supply surety, cost of manufacture, and circular economy; robust battery lifecycle strategies must be considered with commerciality and sustainability in mind.







## 2. Procurement & supply chain

### 2.1 Shaping agile supply chains to secure profitable routes to market

With current estimates of around 300 gigafactories estimated to be either built or in plans covering most continents there are key trends emerging; showing a shift in industries seeking to focus on localizing their supply chains. This can create a number of benefits, not just in terms of de-risking supply, but improving GDP and reinvigorating manufacturing capabilities. Key risks however, continue to be focussed on the mining of key commodity materials that make up a large portion of battery chemistries currently in the market and the associated carbon footprint of newly developing supply chains.

Having the right supply chain doesn't start at nominating the right partner however, over the next few years with an increasing pipeline of gigafactories and EV plants, the demand pressures from raw materials to processing and production equipment will destabilise price-points. Tesla and Ford in the US as an example have already made statements about slowing down some of their plans until inflation eases off. The importance of procurement could not be overstated here, supplier relationship management, cost control and lifecycle management will be key to ensure affordable price-points for consumers whilst protecting profitability and return on investment.

It's important that the data offers a holistic, independent view that provides a complete picture within the organization. Once this has been achieved, it can be used as part of an efficient and robust decision-making process and can also be leveraged to ensure buy-in across an organization when implementing any change.

#### Resetting the supply chain

It is key that organizations do not lose sight of building the right Procurement function and team to get spend under control and quickly, particularly in the midst of New Product Development. Effectively sourcing, developing and establishing the right supply partners can help organizations meet demand with the level of agility required to keep pace with technology that is still evolving.

The rush in the global mobility market to achieve net zero has accelerated demand for products and materials that have traditionally seen a much lower level of pull- such as lithium- In 2022, about 60% of lithium, 30% of cobalt and 10% of nickel demand was for EV batteries.

In addition, demand for manufacturing and smart technology to achieve the level of production required has created additional risks in the supply chain in terms of securing capital manufacturing equipment, continuing to tie many organizations with reliance on Asian markets. Decades of globalization of our supply chains has introduced dependency on low-cost country sourcing to deliver profitable growth and healthy margins, and arguably coming at a cost: the erosion of local capability in manufacturing and a decline of skilled workforces across sectors.

#### Empowering procurement

Procurement professionals in this space are going to enter an exciting and challenging new phase of procurement and supply chain management as they seek to develop and establish suppliers that can help their organization enter the market in a cost conscious and secure way with much investment riding on having the right procurement and supply chain outcomes.

The combination of innovation and capabilities is giving rise to an increasing number of partnerships and joint ventures between traditional OEMs and battery makers to capitalize on knowledge and capacity as organizations seek to leverage experience to de-risk their supply chain and route to market with a level of cost consciousness. Getting early supplier (and procurement) involvement, establishing more partnership agreements, and tapping into developing expertise with careful timing and planning will ultimately help shape successful outcomes for both buying and manufacturing scalability.

## 3. Cost & value engineering

### 3.1 Maximising the lifetime value of battery configuration and design; with cost engineering principles

An appropriate level of consideration needs to be afforded to a product lifecycle strategy including lifetime monetization, split of production and procurement, potential future product innovation, carbon footprint and associated working capital. Here, Cost Engineering principles can bring a whole new level of transparency across the value chain that traditional ERP or database systems can't offer, such as tear down and baselining across design and manufacturing of products down to a granular material level.

In an industry that will ultimately see some saturation as new and established players race to the top, businesses need to reflect on the impact of demand and availability of supply across materials, energy and capital equipment to quickly understand their ramp up profiles with visibility of budgeting and investment needs. A cost-conscious approach can provide a granular view to organizations about the potential COGS of their new portfolios and can also help manufacturers and buyers to make informed make vs buy decisions in an increasingly competitive and strained supply market.

### 3.2 Developing an informed make vs buy investment case

#### Cell Configuration

Different cell configurations, chemistries, cell types, and dimensions combined with the manufacturing and processing steps will have lifetime cost implications.

#### Manufacturing & Operations Costs

Having a detailed view of the manufacturing and operational landscape across aspects of capital equipment, production capacity, rates, energy consumption, headcount and throughput needs to be calculated to understand and evaluate rate of return on investment. These calculations need to be balanced against levels of product innovation and production automation, and for manufacturing organizations, this is an important consideration when determining which core competencies are to remain 'in-house'.

One of the major challenges within scaling Gigafactories is calculating the scrap rates and volume ramp up profiling requirements. Consideration needs to be made to right-size the production process to deliver the desired throughput and gigawatt hours.

#### Sensitivity Analysis

A robust understanding of how electrode formulations is overlayed against indexed prices. Assess macro factors such as regional labour rates, government incentives, utility prices (and availability) and even carbon footprint. This will future proof and de-risk factory commissioning while leaving decision makers fully equipped with the information needed to develop the right manufacturing strategy.





## 4. Operational strategy

### 4.1 Navigating challenges in manufacturing scalability

There are some key areas to consider when looking at establishing battery production at scale. Whether this is funded privately or through government-backed schemes, having commercial and operational transparency on how manufacturing can scale up efficiently in a cost-controlled way, with products that have a clear roadmap on return on investment and growth potential, is of utmost importance.

Ultimately, whilst understanding the “how” is critical, underpinning this with “how much will it cost” will shape the operational strategy and the uncover the lifetime opportunity and viability of the product portfolio.

#### Energising gigafactories

The power required to produce an electric vehicle (EV) battery depends on several factors, such as the size, capacity, and chemistry of the battery, as well as the manufacturing process, efficiency and location. According to some sources, the average power consumption for producing a 66 kWh EV battery is around 15,000 kWh, which is equivalent to the annual electricity use of a typical UK household.

Access to clean and green energy is increasingly part of location selection studies as battery makers seek to decarbonize production. As such, industry players are exploring options on leveraging renewable sources to battery plants for possibilities on lowering costs to ramp up production across a range of capacities and locations.

#### Capital Equipment

Currently there is a high demand placed on equipment makers. There is an increasing lead time for manufacturing equipment for gigafactories, especially for battery-specific equipment, such as electrode coating machines, cell assembly machines, formation and aging equipment and

OEMs are looking to secure critical equipment up to 2 years in advance. With many of the equipment suppliers located in Asia, and in particular, China, this comes with its own set of challenges. Whilst the region possess the capital and skills to tool up in a flexible and cost competitive way that is crucial to NPD, the distance and language barriers mean that communicating the details of these highly technical specifications, as well as the allowances necessary for the time it takes to transport the components once they are produced can be limiting.

#### Initial production performance and throughput

Consideration needs to be made to right-size the production process to deliver the desired throughput and gigawatt hours as manufacturing ramps up. With predicted 18-24 months to achieve full scale manufacturing followed by further times to increase OEE, embedding transparency early on through digital manufacturing solutions will be key on tracking and optimizing performance.



## 4.2 Macro impacts on operational viability

Industry trends show that global businesses are increasingly looking to near shore their operations to their consumer base, investors will be looking closely to the domestic policies and disruptions before deciding on investing further with some recent examples of Chinese battery manufacturers ruling out the UK completely out of its operational growth plans. The second emerging market for gigafactories is Europe which is aiming to become self sufficient in battery production and reduce its dependence on Asian suppliers. The European Commission has launched the European Battery Alliance, a strategic initiative to support the development of a competitive and sustainable battery industry in the region.

The US is also now fast emerging, supported by the Inflationary Reduction Act furthering investments in-country and motivated by the success of Tesla the pipeline of factory plans is rapidly building.

### Talent and capability

With automation in manufacturing only addressing a fraction of challenges in capability, ramping up manufacturing across new technologies will initially and always have a lower throughput. In order to improve the maturity of production, a whole host of new capabilities are required around battery design, productionisation and equipment calibration and maintenance. Global industries will need to collaborate with local government to accelerate investment in qualifications, and training to develop the skills and knowledge needed across the battery lifecycle from innovation, production, through to in-vehicle maintenance.

This will be imperative to support nearshoring of EV production and market accessibility, otherwise consumers could face the impact of higher-costs of goods imported through a carbon intensive supply chain.

### Infrastructure for consumers

Given what is currently available to the consumer in the BEV space and with costs remaining high, affordability and accessibility still needs improvement. Combined with broader infrastructure investment challenges and access to charging and grid, uptake has still got a way to go- impacting demand forecasts for EV makers.

### Geopolitical

A gigafactory needs a suitable site that has access to reliable and sufficient sources of electricity and water, as battery production is energy-intensive and requires cooling systems. The location also needs to have a stable political and regulatory environment, as well as incentives and support from the local government. Our carbon calculators and macro economic data can model scenarios across global locations and regions which can inform businesses of factory locations or how to reduce costs through renewable energy sources in high-cost countries.





# 5. Creating certainty around business growth

Despite the challenges faced in creating an effective and sustainable Battery Value Chain, by taking the right steps now businesses can gain more clarity and, ultimately, competitive advantage.





## 6. Conclusion

Latest analytic projections suggests that the world's top automakers are expected to spend nearly \$1.2 trillion through 2030 across the EV value chain, having already attracted around \$400 billion in the last decade alone. **This global race to electrification presents us with some exciting challenges, leap-frog in technological advancements, and a resurgence of ambition throughout the industry to drive growth with geographical self-sufficiency.**

We're witnessing an industrial revolution first hand; automotive professionals are working together with laser focus and at pace - and this monumental effort is clearly demonstrating that the automotive industry has not lost its ability to innovate and deliver the next tranche of vehicles for a greener and more sustainable world of tomorrow.

**About Siemens Advanta**

Siemens Advanta is a strategic advisor and trusted implementation partner for digital and sustainability transformations on an enterprise level. Drawing on the Siemens tech stack, Siemens Advanta delivers end-to-end solutions, from strategy and operations consulting to solution architecture and implementation. With comprehensive expertise in IT and OT, Siemens Advanta combines extensive experience from Siemens' own transformation journey with an established reliability stemming from customer projects across diverse industries and countries. By leveraging the power of Siemens businesses and its partners, Siemens Advanta helps customers unlock the full value of Siemens technologies across their entire value chain. Headquartered in Munich, Germany, Siemens Advanta operates with a global network of about 800 employees in 18 countries and 47 offices.

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