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Business and Trade Committee

Batteries for electric vehicle manufacturing

First Report of Session 2023–24

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Batteries for electric vehicle manufacturing

First Report of Session 2023–24

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Business and Trade Committee

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Summary

Harnessing power has been at the core of the UK's industrial success since the Industrial Revolution. Today, the UK is in a global battery race with competitor countries that want to develop their industrial capabilities in the battery sector. China is dominating the race, while the UK lags far behind many of its competitors. Other countries, especially in Europe and North America, are rapidly expanding capacity and are expected to gain a larger share of the global battery market by 2030.

Gigafactories in the UK

Large scale production of batteries takes place in gigafactories. The UK faces a gigafactory gap, because of insufficient domestic manufacturing capacity to satisfy UK industry's demand for batteries. Satisfying demand from the UK's automotive industry and other sectors will require 100GWh of battery manufacturing capacity by 2030. That requirement will increase to 200GWh by 2040. The UK, however, currently has only one gigafactory, which has less than 2GWh of capacity. It is run by Envision AESC near Nissan's plant in Sunderland. More gigafactories are under development, albeit at different stages of planning and construction. At best, announced plans satisfy a little over half the capacity the nation needs by 2030. Time is now running short. The UK has a limited window in the next three years to attract further investment into this sector.

A failure to invest in battery manufacturing could cause a gradual decline in automotive production in the UK because global original equipment manufacturers (OEMs) might prefer to locate electric vehicle production overseas in countries hosting clusters of gigafactories. There are 160,000 people directly employed in the automotive industry, but the sector supports many more jobs in the wider economy. Employment in this industry is concentrated outside of London and the South East, especially in the West Midlands, North East and North West of England. Many of these jobs could be at risk if OEMs decide to locate electric vehicle manufacturing elsewhere because of a lack of domestic battery manufacturing capacity. Building an industrial base of gigafactories in the UK is strategically important for the UK's energy security, for national security and for the UK's ability to reach Net Zero and to unlock the benefit of economic growth, new jobs and new tax contributions from green industries.

Automotive manufacturers comprise most of the demand for batteries. Large global OEMs with vehicle assembly plants in the UK are expected to have enough demand for batteries to justify building gigafactories. However, the UK needs gigafactories that can cater for the diverse array of vehicles built in the UK, and other sectors outside the automotive industry that are likely to need batteries from 2030 onwards. Serving those markets will deliver strategic benefits.

The battery supply chain

Global battery supply chains, and especially the upstream supply of critical minerals, have environmental, social and governance challenges. Battery supply chains are heavily concentrated in China. The UK's dependence on such supply chains creates a strategic vulnerability for the country, especially if China restricts exports of materials and components that the UK needs. The UK Government must continue to collaborate

internationally, especially with our allies, to diversify the battery supply chain, safeguard the thousands of tonnes of critical minerals required for future battery production, ensure that batteries are produced to high environmental and social standards and to safeguard UK consumers from the risks of consuming products made in unethical ways.

The UK cannot have a self-sufficient supply of lithium-ion batteries and will continue to rely on imports of raw minerals, materials and components. There are strategic benefits to building the UK's industrial capabilities across the battery supply chain, but especially in midstream processes such as the refining of raw minerals and the manufacture of cathodes and anodes.

A battery supply chain in the UK would enable businesses based in this country to manufacture batteries sustainably and ethically. Such a supply chain would offer the UK a competitive advantage over other markets, especially among the many consumers who demand higher environmental, social and governance standards. The UK's access to low-carbon sources of electricity means that batteries produced in the UK will be produced more sustainably than those in China and many European countries.

The Government must:

- explain how it will ensure the UK develops the capacity to build the battery supply needed by the nation to achieve our targets for Net Zero.
- specify strategically critical industrial capabilities within the battery supply chain and set out the key interventions to incentivise businesses that can deliver those capabilities to locate in the UK. Those specifications and interventions could be explained either in the forthcoming UK Battery Strategy or in the Government's response to this Report.
- explain how the Government plans to promote robust environmental, social and governance structures across the battery industry domestically and globally to promote transparency and a green and clean battery supply.
- introduce regulations requiring batteries available on the UK market to come with a battery passport explaining for consumers how sustainably and ethically such batteries were constructed.

Encouraging investment into the battery supply chain in the UK

Global competition in relation to the electric vehicle supply chain has intensified following the passing in 2022 of the Inflation Reduction Act in the United States. The Inflation Reduction Act has caused investment to flow into the electric vehicle supply chain, especially gigafactories, in the United States at the expense of Europe. The UK Government must urgently respond to intensified global competition with an internationally competitive package of long-term support to attract private investment into gigafactories and the wider battery supply chain within the UK.

The UK is in a race with other large markets that are offering significant subsidies to boost domestic production of electric vehicles and batteries and onshore businesses in the supply chain. The UK Government does not necessarily need to match the scale

of subsidies on offer in these markets, if the UK's overall package is internationally competitive. However, the UK Government must provide a long-term stable business environment, with conditions that de-risk investments in the UK's battery supply chain. The Government needs to set out a package of measures on subsidies, land access, low cost power, skills, de-risked supply chains, tariff-trade and research and development support. Specifically, the Government must:

- **improve the UK's offer of financial support to ensure that it is globally competitive**. The Government needs to substantially increase the amount and variety of financial support available. It should conduct a benchmarking review to determine the scale, scope and diversity of financial support required.
- **provide longer-term certainty that UK businesses in the battery supply chain can access electricity at a comparable cost to competitors in other international markets**. For example, the Government could underwrite long-term contracts between energy suppliers and businesses in the battery supply chain.
- **designate strategically important gigafactory sites and work with local partners to put together a targeted package of support to attract investors and ensure gigafactories are built faster.** These sites should be given priority for improvements to energy and transport infrastructure. The Government should work with local partners to grant those areas special economic status.
- **address gaps in the skills needed to support gigafactories and other businesses in the battery supply chain.** The Government should ensure that mayoral combined authorities or local councils—especially those that govern strategically important sites where gigafactories could be built—have adequate and flexible funding to tailor support for local training programmes. Offers of financial support to businesses in the battery supply chain should be conditional on these companies investing in upskilling and reskilling employees from the automotive industry and other sectors.
- **secure tariff-free access to global markets for electric vehicle and batteries manufactured in the UK and de-risk access to the requisite critical minerals and supply chains through agreements with our allies.**
- **put research and development into battery technology on a long-term footing to ensure that the UK remains at the cutting-edge of battery technology.**

It is vital that the UK government simplifies and accelerates the speed with which complex packages of support can be developed for potential investors.

EU-UK rules of origin

We support the localisation of more of the electric vehicle supply chain in Europe. However, the UK Government and the European Commission have underestimated the timeframe required for these supply chains to develop. Introducing stricter rules of

origin requirements from 1 January 2024, as they[1] currently plan to do, could lead to serious unintended consequences for the UK and the EU. For instance, placing a 10% tariff on electric cars, but not on petrol and diesel cars, would send the wrong message to consumers, who should be encouraged to buy zero emission vehicles. Manufacturers in the UK and the EU are also at risk of losing market share to cheaper electric vehicles imported from China. The UK and the EU should agree at least a three-year extension to the current rules of origin requirements to allow more time for a supply chain in Europe to develop.

1 UK Government and the European Commission

Introduction: The role of batteries in the green transition

1. People have used batteries for centuries. In 1859, scientists built on the work of Alessandro Volta, an Italian physicist, to produce lead batteries.[2] In the mid-20th century, lithium became the focus of research efforts into batteries. A series of breakthroughs in the 1970s and 1980s led to the creation of lithium-ion batteries. One of these breakthroughs was a result of the work of John B. Goodenough, an American scientist, and his co-workers at Oxford University. John B. Goodenough was one of three scientists to be awarded the Nobel Prize in 2019 for their work which led to the creation of lithium-ion batteries.[3] Lithium-ion batteries, which were eventually commercialised in Japan in 1991 by Sony, are now ubiquitous.[4] The electrochemical potential of the metals within these batteries, coupled with their weight-to-energy ratio, has made them suitable for a wide range of applications.[5] Laptops, mobile phones and a range of electronic devices all over the globe today are powered by lithium-ion batteries.

2. Lithium-ion batteries are the dominant battery chemistry used in electric vehicles. There are different types of lithium-ion battery chemistries. The two main types are nickel manganese and cobalt (NMC) and lithium iron phosphate (LFP). NMC batteries have a higher energy density, which makes them better for vehicles with a longer range, whereas LFP batteries are safer, because they are less likely to ignite, and have a longer lifespan.[6] Lithium-ion batteries are likely to continue to dominate the market for the next decade. Other battery chemistries, such as sodium-ion batteries and solid-state batteries, are under development, but they have not yet been commercialised (see Chapter 4).

3. Batteries will help to decarbonise not only the way we travel, but other sectors of the economy. In some sectors, such as cars and vans, batteries have emerged as the leading alternative to fossil fuels. Other green technologies, such as hydrogen, are likely to be better suited to other applications.[7] Demand for batteries is likely to increase substantially across a range of sectors (see Chapter 1). That increase is already happening in the automotive industry, although other sectors are likely to experience increased demand from the 2030s onwards.

Our inquiry

4. On 17 January 2023, the then Business, Energy and Industrial Strategy Committee launched an inquiry on the supply of batteries for electric vehicle manufacturing in the UK.[8]

2 EuroBat, Batteries 101 [accessed on 7 November 2023]
3 The Royal Swedish Academy of Sciences, Scientifc Background on the Nobel Prize in Chemistry 2019: Lithium-ion batteries, October 2019
4 EuroBat, Batteries 101 [accessed on 7 November 2023]
5 EuroBat, Batteries 101 [accessed on 7 November 2023]
6 Green Alliance, Powering up the UK battery industry: Annexes, September 2023
7 The Faraday Institution, The Role of Hydrogen and Batteries in Delivering Net Zero in the UK by 2050, April 2023
8 In April 2023, following changes to the machinery of government, the Business, Energy and Industrial Strategy Committee was renamed as the Business and Trade Committee to scrutinise the work of the newly formed Department for Business and Trade. The responsibility of scrutinising of the Government's energy policy was passed on to the new Energy Security and Net Zero Committee.

5. The launch of that inquiry coincided with news that Britishvolt, a UK battery start-up, had entered administration after struggling to raise sufficient investment to proceed with its gigafactory near Blyth in Northumberland (See Annex 1). We received more than 50 written submissions in response to our call for evidence from a variety of organisations and individuals. We began taking oral evidence in May.

6. The picture has continued to evolve. This summer, Tata Group's (the owners of Jaguar Land Rover) plans to build a gigafactory in the UK to supply Jaguar Land Rover as well as BMW's multi-million-pound investment in Oxford provided some welcome news for the UK. More recently, the Prime Minister announced plans to delay the ban on the sale of new petrol and diesel cars and vans from 2030 to 2035.

7. The UK Government plans to publish an Advanced Manufacturing Plan, covering the automotive industry and other sectors, as well as a UK Battery Strategy. Those plans are urgently needed to help support the UK's automotive industry and the UK's wider transition to a greener economy.

8. We are grateful for the valuable contributions we received from everyone who engaged in public and privately with our inquiry. We heard from automotive manufacturers, battery manufacturers and supply chain companies as well as NGOs, academic institutions, think-tanks and trade unions.

1 Gigafactories in the UK

9. Gigafactories are large factories capable of manufacturing battery cells or fuel cells at scale.[9] Gigafactories typically take two to three years to build, but construction can take longer depending on whether the site has planning permission and whether the gigafactory is a new design or a replica.[10] Other parts of the battery supply chain (e.g. mining of raw minerals) have longer lead times to bring into operation.[11] The upfront capital costs of building a gigafactory are high and can be prohibitive.[12] Once built, gigafactories do not operate at full capacity immediately. Instead, operational capacity is gradually built up over a few years.[13]

10. The UK Government is working to secure investments in gigafactories.[14] However, the UK is in a global battery race with other countries that have the same objective.[15] China is far ahead in the race, because the production of battery cells is heavily concentrated in China.[16] China's global position is the product of more than a decade of policies designed to develop an integrated battery supply chain.[17] China dominates the refining of raw materials and manufacturing battery components. That domination in midstream processes has enabled China to secure the lead position in the production of batteries and electric vehicles.[18] China is expected to retain its lead to the end of the decade.[19] Other countries, especially in Europe and North America, are rapidly building their own capacity and are expected to gain a larger share of the global market by 2030.[20] Benchmark Mineral Intelligence, a market data reporting company, described the UK as a "bystander" in this race, with "no comprehensive commercial position" in today's global battery industry.[21] Other informed commentators, such as the Faraday Institution, a battery research institution, have suggested that the UK is already behind, or is losing ground to, international competitors, especially to the EU and US.[22]

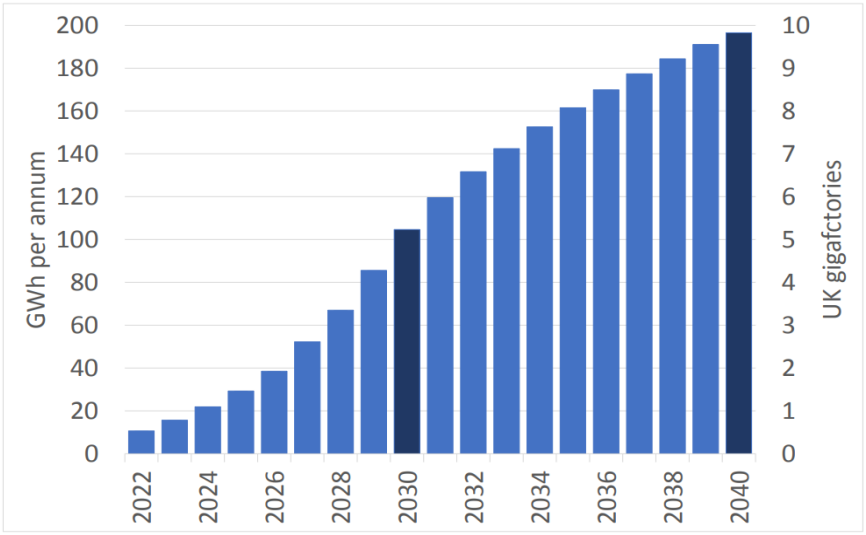
11. Many gigafactories are in operation or under development across Europe. The European Battery Alliance[23] has set an objective for 90% of Europe's annual battery

9 House of Lords Science and Technology Committee, Battery strategy goes flat: Net-zero target at risk, 1st Report of Session 2021–22 - published 27 July 2021 - HL Paper 53
10 UK Battery Industrialisation Centre (BEV0028)
11 Benchmark Mineral Intelligence (BEV0010); Q110 [David Wong]
12 The cost of building a gigafactory vary depending on the location, the product and the company. However, battery manufacturers include Asia have reported that it costs around $40–50million to build 1GWh of cell manufacturing capacity. See Green Finance Institute, Powering the Drive to Net Zero: Unlocking Public and Private Capital for the UK Battery Sector, May 2022
13 Q77 [Jeff Pratt]
14 PQ 18521 [Electric Vehicles: Manufacturing Industries] answered on 24 May 2023
15 Benchmark Mineral Intelligence (BEV0010)
16 Benchmark Mineral Intelligence (BEV0010)
17 Benchmark Mineral Intelligence (BEV0010); IEA, Global Supply Chains of EV Batteries, July 2022
18 IEA, Global Supply Chains of EV Batteries, July 2022
19 Benchmark Mineral Intelligence (BEV0010)
20 Benchmark Mineral Intelligence (BEV0010)
21 Benchmark Mineral Intelligence (BEV0010)
22 UKRI Faraday Battery Challenge (BEV0032); West Midlands Gigafactory (BEV0017); Transport & Environment (BEV0012); Intelligent Energy (BEV0020); Midlands Engine (BEV0022); Cornish Lithium Limited (BEV0042); The Faraday Institution (BEV0011)
23 Launched in 2017 by Maros Šefcovic, Vice President of the European Commission, the European Battery Alliance brings together national authorities and regions in the EU as well as research institutes and other stakeholders across the battery supply chain. The alliance is supported by the European Commission and the European Investment Bank. The aim of the alliance is to build up manufacturing capacity and battery technology in the EU.

demand to be supplied from within the EU by 2030.[24] By 2030, Germany is expected to have the largest amount of battery manufacturing capacity in Europe.[25] Eastern European countries, such as Hungary and Poland, have also attracted significant investments from leading Asian battery manufacturers, partly due to the cheaper land and labour in these countries but also because of their proximity to the German car industry.[26] The pipeline of gigafactories planned in the United States has grown rapidly at the expense of investments in Europe since the Inflation Reduction Act was introduced in August 2022.[27]

Demand for batteries in the UK

12. The automotive industry and other sectors are likely to generate sufficient demand to justify building multiple gigafactories within the UK between now and 2040. The Faraday Institution, for example, has projected that the UK will need 100GWh of battery manufacturing capacity by 2030 to satisfy demand for batteries from the UK's automotive industry and other sectors.[28] That demand is due to increase to 200GWh by 2040. Benchmark Mineral Intelligence argued that the UK would need 175GWh of battery manufacturing capacity by 2030 focused on both NMC and LFP chemistries to be "a serious industrial player."[29]



Source: The Faraday Institution (July 2022). UK electric vehicle and battery production potential to 2040.

Automotive sector

13. Automotive manufacturing, especially for electric cars and vans, is expected to make up the majority of demand for batteries. By 2030, for example, the UK's automotive industry will need 90GWh of battery manufacturing capacity to supply electric vehicles

24 European Commission, COMMISSION STAFF WORKING DOCUMENT for a Regulation of the European Parliament and of the Council on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act), June 2023

25 Transport &Environment, How not to lose it all Two-thirds of Europe's battery gigafactories at risk without further action, March 2023

26 Transport &Environment, How not to lose it all Two-thirds of Europe's battery gigafactories at risk without further action, March 2023; The Faraday Institution (BEV0011); Policy Exchange, The future of the UK auto industry: What role for Government? June 2023

27 Transport &Environment, How not to lose it all Two-thirds of Europe's battery gigafactories at risk without further action, March 2023; IRA supercharges USA's gigafactory capacity pipeline as it overtakes Europe for first time, Benchmark Mineral Intelligence, 2 June 2023

28 The Faraday Institution (BEV0011)

29 Benchmark Mineral Intelligence (BEV0010)

built in this country. Of that capacity, some 79 GWh is expected to be needed for passenger cars.[30] The UK's automotive industry is diverse with a variety of manufacturers producing an array of vehicles in the UK (See Box 1).

- **Large volume manufacturers**. The UK hosts global manufacturers, such as Nissan, Jaguar Land Rover, Stellantis, BMW MINI and Toyota, that supply cars and vans to the mass market in large volumes.[31] These global OEMs are expected to generate significant demand for batteries.[32] Investments by those manufacturers are critical to anchoring demand in the UK and incentivising gigafactories and other parts of the supply chain to locate here.[33] Gigafactories are being built to serve Nissan and Jaguar Land Rover, the two largest manufacturers in the UK. Other global OEMs build electric vehicles in the UK or plan to do so. It is not clear if these OEMs plan to source batteries from within the UK.

- **Smaller volume manufacturers**. Niche vehicles such as luxury cars, sports cars, taxis, buses, coaches and lorries are also constructed in the UK. The UK is home to premium brands such as McLaren, Bentley, Aston Martin and Lotus. Individually, demand from those manufacturers is unlikely to be sufficient to justify building a dedicated large-scale gigafactory.[34] Smaller-scale gigafactories or even megawatt-scale factories could be used to cater for these manufacturers.[35] Alternatively, these manufacturers could develop alliances, although that approach has potential demerits.[36] Retaining these niche segments of the market has strategic benefits. In particular, highly specialised, high-value manufacturers could be early adopters of innovative battery technologies.[37]

30 Advanced Propulsion Centre, Q2 2023 Automotive industry demand forecast, September 2023

31 These global OEMs have all have plans to transition to zero emission vehicles. However, they have different timelines and different technology strategies for doing so. For more information see International Energy Agency, Global EV Outlook 2023: Catching up with climate ambition, April 2023 and Professor Ian Henry (Managing Director at AutoAnalysis) - (BEV0009)

32 The Advanced Propulsion Centre told us that there are several large volume OEMs in the UK that are expected to have a large demand for batteries, in excess of 8–10GWh per annum. The APC added that to be economically viable gigafactories are estimated to need a capacity of > 10 GWh, although this capacity is "lower for specialist or high-performance cells." For more information see Advanced Propulsion Centre UK Limited (BEV0047)

33 Q40 [Ian Constance]

34 Advanced Propulsion Centre UK Limited (BEV0047)

35 Advanced Propulsion Centre UK Limited (BEV0047)

36 The Advanced Propulsion Centre told us it can be difficult, for example, for these smaller OEMs to align on a "single supplier and cell type" for technical reasons, competition and differences in the timing of models. See Advanced Propulsion Centre UK Limited (BEV0047)

37 Green Alliance, Powering up the UK battery industry, September 2023; Cross Sector Battery Systems Innovation Network Advisory Board (BEV0025)

Box 1: The UK automotive industry

The UK is the sixth largest car manufacturer in Europe. The sale of vehicles and parts contributed over £13 billion to the UK economy in 2022.[38] Around 160,000 people are employed in automotive manufacturing in the UK, mostly outside London and the South East. The West Midlands, the North East and the North West are the regions with highest levels of employment in the industry.[39] The sector is estimated to support almost 350,000 jobs in the wider economy.[40]

The UK's automotive industry is diverse. The sector is made up of 25 manufacturers that build more than 70 models of vehicles in the UK.[41] Global OEMs, including Nissan, Jaguar Land Rover, Stellantis, Toyota and BMW MINI, have factories in the UK. These global OEMs manufacture large volumes of vehicles in the UK and overseas. They are foreign owned, with headquarters outside the UK.[42] The UK is also home to premium brands of luxury cars, such as Aston Martin, Rolls-Royce and Bentley, and high-performance sports cars, such as McLaren and Lotus. The UK also hosts manufacturers such as the London Electric Vehicle Company, Alexander Dennis, Wrightbus and Leyland Trucks that specialise in the production of public transport and commercial vehicles, such as taxis, buses, coaches and lorries.

The UK's automotive industry is export-oriented.[43] Some 80% of the vehicles manufactured in the UK are exported. The EU is the UK's largest export market, followed by the United States and China. However, vehicles manufactured in the UK are sold in more than 130 countries around the world.[44]

In the mid-2010s, more than 1.5 million cars a year were manufactured in the UK. After 2015, output began to fall. A variety of reasons have been advanced to explain this decline, including uncertainty surrounding the UK's future relationship with the EU, lower demand in other markets and new testing requirements, which led to backlogs in production.[45] Car production was also adversely affected by the Covid-19 pandemic and by the global shortage of semi-conductors.[46] The Society of Motor Manufacturers and Traders (SMMT) has projected that the UK will produce around 860,000 cars this year. However, the SMMT does not expect production levels to reach one million cars again until 2028.[47]

Honda and Ford, two global OEMs, no longer manufacture vehicles in the UK, although Ford has a factory in Halewood that is being converted to manufacture components for electric vehicles.[48] Honda announced its decision to close its factory in Swindon in 2019. That plant, which opened in 1992, had employed 3,500 people. This decision followed declining sales in Europe and the company's decision to focus on larger electric vehicle markets outside the UK. The recent EU-Japan trade deal allowed exports from Honda's Japanese factories to be exported into the EU tariff-free.[49]

38 Department for Business and Trade (BEV0051)
39 The Faraday Institution (BEV0011)
40 Department for Business and Trade (BEV0051); Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
41 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
42 Policy Exchange, The future of the UK auto industry: What role for Government? June 2023
43 Department for Business and Trade (BEV0051)
44 SMMT, Manufacturing Data [accessed on 7 November 2023]
45 House of Commons Library, UK automotive industry, 5 September 2023, CDP-0189
46 House of Commons Library, UK automotive industry, 5 September 2023, CDP-0189
47 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
48 House of Commons Library, UK automotive industry, 5 September 2023, CDP-0189
49 House of Commons Library, UK automotive industry, 5 September 2023, CDP-0189

Non-automotive sectors

14. In addition to the automotive industry, domestic production of batteries could serve a variety of other markets. Those markets include other forms of transport, such as maritime, aviation, rail and forms of micro-mobility, stationary energy storage, military applications, drones, robotics, power tools, construction, mining and agriculture.[50] Examples of the potential uses of batteries outside of the automotive sector is set out in Table 1.

15. Batteries in some of these sectors are likely to play a role alongside other low-carbon alternatives, such as hydrogen. The Faraday Institution told us that "these other domestic markets will become increasingly valuable from 2030 and 2040 in terms of both economic and decarbonisation impacts."[51] These markets are at different stages of development. Energy storage, in particular, is already growing rapidly and could constitute a substantial share of UK demand for batteries by 2040 and 2050.[52] There is also a strategic opportunity for the UK manufacturers to take a lead in supplying batteries to non-automotive markets. Unlike the automotive industry, these markets are not subject to the same legislative requirements that mandate zero emission options or require localised content.[53] To date, support for the battery sector has been directed primarily towards businesses looking to serve the automotive industry.

16. ***In the forthcoming UK Battery Strategy, the Government should specify the extent to which future demand for batteries in the UK should be supplied by domestic sources in 2030 and 2040, along with a 10-year plan for scaling-up this capacity and an estimate of the public money required to do so. To match our competitors, the UK Government should consider targeting at least 90% of the UK's annual demand for batteries to be met from domestic supplies by 2030.***

17. **The UK needs gigafactories that can cater for the diverse array of vehicles, including luxury cars, public transport and commercial vehicles, manufactured in this country. Retaining niche segments of the automotive market in the UK is strategically important, because the highly specialised nature of these vehicles provides an opportunity to encourage innovative battery manufacturers into the UK. The UK also has an opportunity to take the lead in supplying forms of transport (rail, maritime, aviation and micro-mobility) and sectors of the economy (e.g. energy storage and military applications), which are expected to see demand for batteries rise, especially from 2030 onwards. To capitalise on these opportunities, the Government should:**

- ***outline, in the Advanced Manufacturing Plan, what UK battery manufacturing capacity will be needed to cater for the diverse needs of niche segments of the automotive industry, and by when, together with the measures required to secure this.***

50 The Faraday Institution (BEV0011); Cross Sector Battery Systems Innovation Network Advisory Board (BEV0025); Nyobolt (BEV0036)

51 The Faraday Institution (BEV0011)

52 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023; British Lithium Limited (BEV0016); UKRI Faraday Battery Challenge (BEV0032); AMTE Power plc (BEV0034); Nyobolt (BEV0036); Advanced Propulsion Centre UK Limited (BEV0047)

53 UK Battery Industrialisation Centre (BEV0028)

- ***support battery manufacturers looking to supply batteries to non-automotive sectors by stimulating demand for batteries in these industries and ensuring government support is available to manufacturers targeting these market segments.***

Table 1: Examples of battery applications outside of the automotive sector

Sector	Potential battery applications
Stationary energy storage	Stationary energy storage has a variety of potential uses from multi-megawatt batteries that provide grid-level storage through to applications in industrial (e.g mini-grids, local microgrids, off-grid industrial facilities) and residential settings.[54]
Aviation	A variety of technologies are likely to be involved in decarbonising aviation, including batteries, hydrogen and sustainable aviation fuels. The technology mix is still evolving and fully battery-powered flight is still in its infancy. By the mid-2030s, however, battery-powered aircraft could be used for short haul flights and to support vertical take-off and landing.[55] Batteries may be used in hybrid form, alongside hydrogen, for medium-long haul flights.[56] Vertical Aerospace, a UK manufacturer, is building an all-electric vertical take-off and landing aircraft.[57] Battery powered aircraft will allow aircraft to take-off and land closer to cities and other urban areas because they are quieter and more environmentally friendly.[58]
Maritime and shipping	A mix of technologies (e.g. batteries, hydrogen, anomia and methanol) are likely to be used to decarbonise the maritime industry. Batteries are expected to gain a large share of the market in short distance and domestic shipping.[59] For example, batteries could be used to power ferries, cruise ships, fishing boats, workboats, merchant vessels and research vessels, either in purely electric or hybrid form.[60] Battery-only operation over longer distances is unlikely, although batteries could be used in hybrid vessels.[61] The Cross Sector Battery Systems Innovation Network Advisory Board, for example, noted that the "shipping industry is increasingly using batteries, across all vessel types, to optimise power use in propulsion and auxiliary power to save fuel and reduce maintenance costs."[62]
Defence	Batteries could have multiple potential military applications (e.g. in vehicles, soldier systems and infrastructure).
Rail	Decarbonising rail will involve a mix of technologies including electrification, batteries and hydrogen.

54 The Faraday Institution (BEV0011); ZPN Energy Limited (BEV0007); Cross Sector Battery Systems Innovation Network Advisory Board (BEV0025); AMTE Power plc (BEV0034); WAE Technologies Limited (BEV0035)
55 The Faraday Institution (BEV0011)
56 The Faraday Institution (BEV0011)
57 Vertical Aerospace (BEV0023)
58 Cross Sector Battery Systems Innovation Network Advisory Board (BEV0025)
59 The Faraday Institution (BEV0011)
60 Nyobolt (BEV0036)
61 The Faraday Institution (BEV0011)
62 Cross Sector Battery Systems Innovation Network Advisory Board (BEV0025)

Pipeline of gigafactories in the UK

18. The UK only has one gigafactory in operation today, run by Envision AESC, a Chinese company, near Nissan's plant in Sunderland.[63] More gigafactories are in the pipeline, albeit at different stages of development. However, without further investment the UK faces a significant shortfall of battery manufacturing capacity by 2030 to satisfy increasing demand from the UK's car industry and other sectors, such as energy storage.[64]

- Envision AESC is building another larger gigafactory in Sunderland to supply batteries for Nissan's successor model to its Leaf car. Production is due to begin in 2024.[65] The gigafactory will have an initial capacity of 12GWh. There is scope to expand the site. Nissan is in discussion with the Government about allocating its manufacturing of two new electric vehicle models to the UK.[66] See Box 3 for more information.

- The Tata Group plans to build a gigafactory in the UK to supply batteries to Jaguar Land Rover. That gigafactory will have an initial capacity of 40GWh and is due to begin production in 2026 (See Box 2).

- Recharge Industries, the new owners of Britishvolt, is reportedly still seeking to secure investment and access to Britishvolt's gigafactory site near Blyth in Northumberland.[67] This site has planning permission for a 38 GWh gigafactory.[68]

- AMTE, a battery manufacturer, has plans to build a 0.5GWh gigafactory by 2026.[69]

Box 2: Tata Group, Agratas and Jaguar Land Rover

Jaguar Land Rover (JLR) is the second largest car manufacturer in the UK. The company has traditionally competed with up-market brands such as BMW, Mercedes and Audi.[70] Jaguar Land Rover is aiming to transition to a fully zero emission fleet by 2036.[71] However, its Jaguar brands are due to be all-electric by 2025.[72] In April 2023, Jaguar Land Rover announced an £15 billion investment over five-years in a new suite of seven new electric vehicles, starting with a fully electric Range Rover.[73]

Jaguar Land Rover is owned by the Tata Group, an Indian conglomerate. In July 2023, Tata Group announced plans to invest £4 billion to build a gigafactory in the UK. The new gigafactory will supply batteries for all Jaguar Land Rover's (JLR) future battery

63 There are smaller facilities, such as AMTE's factory in Thurso in Scotland.

64 The Department for Business and Trade, in September 2023, noted that the UK, following investments from Envision AESC and Tata, is due to have 13GWh per year of capacity by 2024, rising to 67 GWh by 2030. The Minister of State and officials told us that the investments from Envision AESC and Tata mean the UK is most (over 60%) of the way towards securing enough capacity to cater from demand from the automotive industry. Much of the capacity announced so far is designed to support the needs of specific OEMs.

65 Nissan Motors UK (BEV0045)

66 Nissan Motors UK (BEV0045)

67 Britishvolt aims to supply batteries to Australian military, BBC News, 19 October 2023; Britishvolt staff warn battery start-up may be trading while insolvent, The Financial Times, 6 November 2023

68 The Faraday Institution (BEV0011)

69 AMTE Power plc (BEV0034)

70 Policy Exchange, The future of the UK auto industry: What role for Government? June 2023

71 Jaguar Land Rover to provide fleet of all electric vehicles for world leaders at COP 26, Jaguar Land Rover, 16 September 2021

72 Jaguar car brand to be all-electric by 2025, BBC News, 15 February 2021

73 Jaguar Land Rover pledges £15bn investment in electric vehicles, The Financial Times, 19 April 2023

electric vehicles.[74] Once built, the new gigafactory is due to have an initial capacity of 40GWh. Battery production is due to start in 2026.

Jaguar Land Rover is the gigafactory's anchor customer.[75] However, the Minister of State for Industry, Nusrat Ghani MP, informed the House of Commons that the gigafactory will "produce high-quality, high-performance, sustainable battery cells and packs for a variety of applications within the mobility and energy sectors."[76] The gigafactory could also supply other car manufacturers in future.[77] Minister Ghani added that "what is really exciting about this initiative is that it is about producing batteries not just for JLR but for the whole market, which is crucial."[78] The Government has not, however, specified how much capacity will be available for other customers.

The Tata Group's decision followed two years of negotiations with the UK Government.[79] During that time, the UK faced competition from other European countries, such as Spain and Hungary, in attracting Tata's investment. The Secretary of State for Business and Trade, Rt Hon. Kemi Badenoch MP, wrote to us on 20 July 2023 with details of Tata's investment. This letter noted that the Automotive Transformation Fund was "instrumental" at securing this deal.[80] The Government, however, has not yet disclosed details of the package offered to Tata.[81] We wrote to the Secretary of State in August to signal our preference for the relevant information to be in the public domain.[82]

The gigafactory is widely expected to be built at the Gravity site near Bridgewater in Somerset. Tata is due to confirm the location following a due diligence process.[83] The Gravity site, a brownfield site near Puriton, was once home to the Royal Ordnance Factory. The Gravity site is located approximately 15 miles (24km) from Hinkley Point C nuclear power station.[84] There is also good access to Bristol Port and the M5. Gravity is one of a number of Enterprise Zones in the South West.

Tata Sons'[85] new global battery company, Agratas, is due to design, develop and manufacture batteries at the new gigafactory. However, the necessary technology is still at an early stage. In August 2023, The Financial Times reported that Envision AESC's plant in Sunderland is due to provide batteries for Jaguar Land Rover from 2025 until Agratas' gigafactory comes online.[86] The newspaper added that the parties involved have not confirmed AESC's involvement and whether that Chinese company is set to receive any of the UK Government support offered to Tata.[87] The Secretary of State for Business and Trade has reportedly warned that the UK should avoid

74 Correspondence from Rt Hon. Kemi Badenoch Secretary of State for Business & Trade and President of the Board of Trade Minister for Women & Equalities on Tata Group gigafactory investment on 20 July 2023
75 HC Debate, 20 July 2023 col. 1029 [Commons Chamber]
76 HC Debate, 20 July 2023 col. 1029 [Commons Chamber]
77 Correspondence from Rt Hon. Kemi Badenoch Secretary of State for Business & Trade and President of the Board of Trade Minister for Women & Equalities on Tata Group gigafactory investment on 20 July 2023
78 HC Debate, 20 July 2023 col. 1029 [Commons Chamber]
79 Correspondence from Rt Hon. Kemi Badenoch Secretary of State for Business & Trade and President of the Board of Trade Minister for Women & Equalities on Tata Group gigafactory investment on 20 July 2023
80 Correspondence from Rt Hon. Kemi Badenoch Secretary of State for Business & Trade and President of the Board of Trade Minister for Women & Equalities on Tata Group gigafactory investment on 20 July 2023
81 PQ 196337 [Batteries: Factories] answered on 11 September 2023
82 Correspondence to the Rt Hon. Kemi Badenoch Secretary of State for Business & Trade and President of the Board of Trade Minister for Women & Equalities on Tata Group's gigafactory investment on 29 August 2023
83 Correspondence from Rt Hon. Kemi Badenoch Secretary of State for Business & Trade and President of the Board of Trade Minister for Women & Equalities on Tata Group gigafactory investment on 20 July 2023
84 Somerset residents react to plans for £4bn car battery factory, BBC News, 19 July 2023
85 Tata Sons is the principal holding company of the Tata group
86 Chinese-owned battery group involved in Tata UK gigafactory, The Financial Times, 4 August 2023
87 Chinese-owned battery group involved in Tata UK gigafactory, The Financial Times, 4 August 2023

becoming "overly reliant" on battery technology from "any specific country, whether it's China or somewhere else."[88]

Looking further ahead, the Secretary of State told us that Tata also plans to create two R&D hubs, one in the UK and another in India, which will focus on the next generation of battery technologies.[89] However, the location of the new UK facility has not been announced yet.

Tata Group's plans to build a gigafactory in the UK provide a much-needed boost to the UK's gigafactory pipeline, especially after Britishvolt's administration earlier this year. We congratulate the Department on its efforts to secure this investment, following close competition from other markets. However, we reiterate our preference that the scale and scope of support offered to Jaguar Land Rover should be in the public domain.

We are pleased that this new gigafactory will supply batteries to Jaguar Land Rover's suite of electric vehicles built in the UK. However, we would welcome more clarity on the extent to which this facility can be expanded to cater for other manufacturers, within and outside the automotive industry.

Developing battery manufacturing capacity in the UK

Battery manufacturers

19. The leading battery manufacturers globally are all based in Asia.[90] Those manufacturers include Korean and Japanese companies, such as Panasonic, LG Energy Solutions and Samsung, that have been producing batteries for consumer electronics for decades, along with Chinese companies, including CATL, BYD and many others, that have a significant share of the global battery market.[9192] Battery manufacturers from Europe and North America are relatively new entrants to the market.[93]

20. Leading battery manufacturers from Asia have expanded into the European market. Policy Exchange has suggested that the UK had hoped to entice one of the leading battery manufacturers from Asia, such as Samsung, to the UK following the introduction of the UK's Faraday Battery Challenge. However, they observed that these manufacturers have preferred to build gigafactories in the EU, partly to be close to the German car industry.[94] While many Asian battery manufacturers have gigafactories in operation or under development in Europe, Transport & Environment, an environmental campaign group, has pointed out that most (60%) of the batteries produced in Europe by 2030 will be made by European companies rather than by manufacturers from Asia.[95]

21. There are advantages and disadvantages to attracting both established manufacturers and new entrants to build gigafactories in the UK. Stellantis encouraged the UK to build

88 UK warned against being 'overly reliant' on Chinese EV batteries, The Financial Times, 19 June 2023
89 Correspondence from Rt Hon. Kemi Badenoch Secretary of State for Business & Trade and President of the Board of Trade Minister for Women & Equalities on Tata Group gigafactory investment on 20 July 2023
90 IEA, Global Supply Chains of EV Batteries, July 2022
91 Statista, Global market distribution of lithium-ion battery makers between January and August 2023, October 2023
92 CATL is the leading battery manufacturer globally, with nearly 40% of the market for electric vehicle battery cells International Energy Agency, Global EV Outlook 2023: Catching up with climate ambition, April 2023
93 IEA, Global Supply Chains of EV Batteries, July 2022
94 Policy Exchange, The future of the UK auto industry: What role for Government? June 2023
95 Transport &Environment, How not to lose it all Two-thirds of Europe's battery gigafactories at risk without further action, March 2023

gigafactories with "industry specialists."[96] Benchmark Mineral Intelligence told us that Hungary, as a result of gigafactory investments from Asian manufacturers such as CATL, is now a target for businesses specialising in other parts of the supply chain (e.g. cathode and anode production).[97] Given the targets UK OEMs need to meet, the SMMT stressed that the automotive industry needs any source of delivery that the UK can secure, regardless of whether the manufacturers are homegrown or not.[98] The advantage of encouraging homegrown battery start-ups is that such companies will develop intellectual property which, in turn, will help to retain manufacturing domestically.[99] Dr Andy Palmer, former Chief Executive of Aston Martin and Chair of InoBat, a European battery manufacturer, told us that it is

> much less risky to take a cell that has already been developed in the far east and is being localised than it is to take a cell from Northvolt, as an example, where you are developing a new cell and developing a manufacturing facility. You have to get a certain amount of the way down the investment cycle to be able to prove that you have a product that is good enough.[100]

22. Envision AESC, a Chinese company, is the main battery manufacturer in the UK. The Envision AESC has one gigafactory in operation in Sunderland, with another, larger, gigafactory due to begin production in 2024 (See Box 3). Agratas, a wholly owned subsidiary of Tata Sons, plans to build a UK gigafactory to serve Jaguar Land Rover and other potential customers (See Box 2). Agratas is a new entrant to the market. Envision AESC will reportedly supply battery cells to JLR, before Agratas's gigafactory comes online.[101] The Secretary of State for Business and Trade, while supportive of Envision, warned that the UK should not become overly reliant on battery technology from one country.[102]

23. **Encouraging a competitive mix of battery manufacturers to locate in the UK will help to build the supply chain while capturing intellectual property from new technologies.** ***The Advanced Manufacturing Plan and UK Battery Strategy must set out how the Government plans to attract established battery manufacturers as well as new entrants to the battery market to build gigafactories in the UK. Those plans could include a twin-track process for access to financial support to reflect the differences between firms at different stages of development.***

Business models

24. A variety of business models are being used to develop battery manufacturing capacity. Close partnership between OEMs and battery manufacturers, including joint ventures, has become a common model across Europe. BMW, Volkswagen and Stellantis are car manufacturers that have established partnerships or joint ventures with battery manufacturers in Europe.[103] OEMs are choosing to vertically integrate with battery manufacturers, and even further upstream in some cases, to gain greater control over the

96 Stellantis (BEV0001)
97 Benchmark Mineral Intelligence (BEV0010)
98 Q85 [Konstanze Scharring]
99 Q84 [Dr Palmer]
100 Q84 [Dr Palmer]
101 Chinese-owned battery group involved in Tata UK gigafactory, The Financial Times, 4 August 2023
102 UK warned against being 'overly reliant' on Chinese EV batteries, The Financial Times, 19 June 2023
103 The Faraday Institution (BEV0011); Stellantis (BEV0001);

supply chain.[104] Where such partnerships exist, Professor Ian Henry, an industry expert, told us OEMs will be less likely to use independent suppliers and will tend to use established ones, such as major Asian battery manufacturers, if they do. That preference could make it increasingly difficult for new entrants to the market.[105] Other battery manufacturers, such as Northvolt and Britishvolt, have chosen to create their own technologies.[106] The Faraday Institution told us that that model is the hardest to "execute successfully", because of the time needed to develop a new product.[107] Such investments are relatively risky, because such companies need to secure orders and to build a gigafactory before their technology is proven, as was the case with Britishvolt (See Annex 2). Other manufacturers, such as Freyr, have licensed technology, which helps to reduce the investment risk.[108]

25. The stand-out lesson from the companies that we examined in the UK and in Europe is the need to secure guaranteed orders from an anchor customer to finance the construction of a gigafactory. These orders typically come via offtake agreements.[109] To secure orders from OEMs, battery manufacturers need to prove they have a viable product that can be scaled-up and that they have funds to scale-up. The Green Alliance explained that this can lead to a "chicken and egg situation, whereby manufacturers must secure the funds to guarantee a customer, but they also need a customer to secure the funds."[110] The Government could potentially play a role in facilitating offtake agreements by connecting battery manufacturers with new customers, such as OEMs, and also by underwriting such agreements to help de-risk investments.[111]

26. **Having secure orders from an anchor customer is critical if battery manufacturers are going to raise sufficient funds to build a gigafactory. Offtake agreements between OEMs and battery manufacturers help signal to investors that there is demand for their product. *The Advanced Manufacturing Plan and UK Battery Strategy should set out ways in which the Government could help to facilitate offtake agreements between OEMs and battery manufacturers.***

104 Professor Ian Henry (Managing Director at AutoAnalysis) - (BEV0009)
105 Professor Ian Henry (Managing Director at AutoAnalysis) - (BEV0009)
106 The Faraday Institution (BEV0011)
107 The Faraday Institution (BEV0011)
108 The Faraday Institution (BEV0011)
109 An offtake agreement is an agreement between a producer (e.g. a battery manufacturer) and a purchaser (car manufacturer) of a product (e.g. batteries), whereby the purchaser agrees to buy the producers new product. These agreements can often used before a factory or facility (e.g. a gigafactory) has been built. These agreements are used to help the producer to secure private investment to build these facilities because they provide a signal of future demand for the product.
110 Green Alliance, Powering up the UK battery industry, September 2023
111 Green Alliance, Powering up the UK battery industry, September 2023

Box 3: Nissan and Envision

Nissan opened Europe's first gigafactory in Sunderland in 2012.[112] The factory was built by Automotive Energy Supply Corporation (AESC), a company partly owned by Nissan. AESC, together with the battery facility in Sunderland, was sold to Envision, a Chinese renewable energy group, in 2018.[113] Envision AESC's factory, which is co-located with Nissan's assembly plant, has a capacity of just under 2GW/h.

Nissan's successor to the Nissan Leaf car is due to enter production in 2026. In 2021, Nissan and Envision AESC announced plans to build a second gigafactory, located a short distance from Nissan's assembly plant, to produce batteries for Nissan's new model. This investment was achieved with collaboration from the UK Government, which Nissan told us helped build a "strong business case to manufacture EVs in Sunderland in the years to come."[114] For example, the investment has received funding from the Automotive Transformation Fund.[115] Nissan told us that the company's commitment to manufacture the successor to the Nissan Leaf in Sunderland will protect 5,000 jobs at the plant and more in the supply chain.[116]

Construction of the new gigafactory is underway. The gigafactory has a modular design which means that its capacity can be expanded. In 2024, the new gigafactory will have 11GWh of capacity at the new site. By 2030, the gigafactory's capacity is due to reach 25GWh.[117] However, we were informed that there is space at the site to accommodate up to 35GWh of capacity.[118]

Potential gigafactory sites

27. The UK contains other potential gigafactory sites that have yet to attract investment. The number of potential gigafactory sites is limited—but we have enough on which to build the gigafactories the nation needs. Jeff Pratt from the UK Industrialisation Centre, a national battery manufacturing scale-up facility, told us that some 50 sites in the UK could support a gigafactory. However, only twelve of those sites have planning permission.[119] One of these sites is near Coventry Airport. The Coventry Airport site, for example, could accommodate up to 60GWh of battery manufacturing capacity.[120] Fred Perry, Director of Advanced Manufacturing at the Department for Business and Trade, informed us that the Department is "in discussion with a number of potential investors across a number of sites", including the Coventry site.[121]

28. These potential sites are likely to benefit from targeted support to make them an attractive proposition for investment. The West Midlands Gigafactory—a joint venture between Coventry Airport and Coventry City Council—recommended that the Government should "engage with local partners in advance of an investor being secured to develop a framework package of support."[122] Targeted support could include providing a reliable supply of energy at the site, which would need investment from other bodies

112 Nissan Motors UK (BEV0045)
113 Policy Exchange, The future of the UK auto industry: What role for Government? June 2023
114 Nissan Motors UK (BEV0045)
115 PQ 185565[Automotive Transformation Fund: Electric Vehicles] answered on 24 May 2024
116 Nissan Motors UK (BEV0045)
117 Policy Exchange, The future of the UK auto industry: What role for Government? June 2023
118 The Faraday Institution (BEV0011); Advanced Propulsion Centre UK Limited (BEV0047)
119 Q95 [Jeff Pratt]
120 West Midlands Gigafactory (BEV0017)
121 Q168 [Fred Perry]
122 West Midlands Gigafactory (BEV0017)

to make sure this infrastructure is in place.[123] Linking special economic status, such as enterprise zones, freeports or investment zones, to such sites could also help attract investment.[124]

29. **There are limited number of potential gigafactory sites—but we have enough sites in the UK to meet the nation's needs, including sites in the UK's key automotive clusters.** ***These sites are strategic national assets and should be treated as such. The Government must designate gigafactory sites as strategically important sites and work with local partners to put together a targeted package of support, with a view to attracting investors and ensuring gigafactories can be built at pace. These sites should be given priority for improvements to energy and transport infrastructure. The Government should work with local partners to grant those areas special economic status.***

30. **Building a gigafactory will require support from central Government Departments, local authorities and private companies such as National Grid. The transaction cost of co-ordinating between these bodies should not fall on investors. A single project office integrating the full panoply of public support drawn from the various bodies involved is required, and the Department for Business and Trade should take on that lead role, as 'gold command'.**

Risks and opportunities for the UK

Automotive industry

31. Building gigafactories in the UK is critical to making sure the UK is an attractive place to manufacture electric vehicles. The SMMT has described battery manufacturing as the " single largest prize in future vehicle production where the UK can create a potential competitive advantage."[125] It observed that batteries are the most valuable component in an electric vehicle. Batteries comprise between 30% and 50% of the cost of an electric vehicle.[126] The SMMT argued that the

> scale and pace of support needed now to catalyse innovation and investment would be vastly outweighed by the long-term reward, whereby the industry can repay investment many times over, contributing back to the Exchequer and creating high skilled, high wage jobs in the UK, and products which can compete internationally.[127]

32. There are efficiencies to be gained from building gigafactories and assembly plants near each other.[128] Co-locating gigafactories with assembly plants is a common business model across Europe. Locating these factories close to each other avoids the costs and risks of transporting batteries long-distances, which is important because profit margins in the industry are thin.[129] Batteries are the heaviest component of an electric vehicle. Nissan pointed out that "removing the need to import them takes out a major cost contributor."[130]

123 West Midlands Gigafactory (BEV0017); Nyobolt (BEV0036); Q118 [Jeff Pratt]
124 West Midlands Gigafactory (BEV0017); Nyobolt (BEV0036)
125 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
126 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
127 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
128 Nissan Motors UK (BEV0045); The Faraday Institution (BEV0011);
129 The Faraday Institution (BEV0011); Nissan Motors UK (BEV0045); Stellantis (BEV0001); Green Alliance (BEV0021); AMTE Power plc (BEV0034); Balance Batteries (BEV0041); Stellantis (BEV0001)
130 Nissan Motors UK (BEV0045); UK Battery Industrialisation Centre (BEV0028)

The Faraday Institution told us that co-location has benefits such as "increased safety, greater control over production quality, potential avoidance of import tariffs and the flexibility to introduce new design iterations quickly."[131]

33. Professor Ian Henry told us that, while it is not ideal, vehicle assembly plants in the UK might remain viable if they had to rely on importing battery cells and battery modules.[132] However, other commentators held the view that importing batteries would have an adverse impact on the competitiveness of UK manufacturers.[133] Stellantis, a UK-based manufacturer, told us that its UK plants would be at a competitive disadvantage if they imported batteries from Europe and China.[134] The SMMT told us that, while vehicle manufacturers are likely to prefer source batteries locally (e.g. within the same country), it

> may not be critical to have battery production solely in the UK to maintain existing EV production volumes, given supplies could be imported and put into UK-built vehicles, as is already happening with several EV models currently built and planned to be built in the UK. Currently, this also happens with engines (noting in this scenario the UK is a net exporter of engines). However, there is a risk that EV production volumes may never reach at least one million units per annum if there is insufficient domestic cell production capacity and, by implication, offtake agreements with vehicle manufacturers.[135]

34. There is no guarantee that gigafactories in the UK will win contracts with car manufacturers based in the UK.[136] However, without sufficient battery manufacturing capacity, global automotive OEMs, which are foreign-owned with headquarters and factories in other countries, may choose to build new models of electric vehicles in countries containing a cluster of gigafactories.[137] The Faraday Institution told us that, in a worst-case scenario, UK automotive production could become focused on niche and high-value segments of the market, where the UK can retain a competitive advantage.[138] The decline would be gradual as OEMs, model by model, choose to build electric vehicles elsewhere. The UK Battery Industrialisation Centre explained that

> We are likely to start to see decisions being made for one or two particular new electric vehicle models to be made in a specific location as a response to an economic business case made within global HQs of the major manufacturers. Over time, as investments are made in upgrading particular electric vehicle plants, it will eventually become economically unviable to keep an older plant open which has not been upgraded and skilled for new technologies.[139]

131 The Faraday Institution (BEV0011)
132 Professor Ian Henry (Managing Director at AutoAnalysis) – (BEV0009)
133 Balance Batteries (BEV0041); Green Alliance (BEV0021); Stellantis (BEV0001)
134 Stellantis (BEV0001);
135 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
136 Professor Ian Henry (Managing Director at AutoAnalysis) – (BEV0009); Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
137 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043); UK Battery Industrialisation Centre (BEV0028)
138 The Faraday Institution (BEV0011)
139 UK Battery Industrialisation Centre (BEV0028)

35. The automotive sector directly employs around 160,000 people but supports hundreds of thousands more jobs in the wider economy.[140] Employment in this industry is concentrated outside of London and South East in the West Midlands, the North West and the North East.[141] The failure to build a battery industry in the UK could put many of these jobs at risk. The Faraday Institution estimated that in a worst-case scenario employment in the sector could fall to 30,000 by 2040.[142]

Strategic benefits

36. Beyond the automotive sector, building a domestic manufacturing base capable of producing batteries at scale has a variety of strategic benefits for the UK. Those benefits include economic growth and job creation, including in regions outside London and the South East.[143] The UK is likely to need a presence in the lithium-ion battery industry to capitalise on potential sources of competitive advantage in the next-generation of battery technologies (see Chapter 4).[144] Building batteries in the UK would enhance the UK's energy security and national security.[145] A domestic supply of batteries would confer environmental benefits by reducing emissions generated by shipping batteries in from overseas.[146] The UK Battery Industrialisation Centre stated:

> The establishment of gigafactories touches many important themes including the supply of critical materials, energy security, and the long-term sustainability of legacy industries, such as automotive manufacturing. Therefore, a key learning point is that the subject of establishing gigafactories is a matter of national security and it should be treated as such.[147]

140 House of Commons Library, UK automotive industry, 5 September 2023, CDP-0189; Department for Business and Trade (BEV0051)
141 UK Battery Industrialisation Centre (BEV0028)
142 The Faraday Institution (BEV0011)
143 Midlands Engine (BEV0022); Dr Andy Palmer (BEV0008);
144 Dr Andy Palmer (BEV0008); Green Alliance, Powering up the UK battery industry, September 2023
145 Danecca Ltd (BEV0031); Dr Andy Palmer (BEV0008); Midlands Engine (BEV0022); UK Battery Industrialisation Centre (BEV0028)
146 Dr Andy Palmer (BEV0008);
147 UK Battery Industrialisation Centre (BEV0028)

2 Battery supply chain

37. Gigafactories are only one part of the battery supply chain. Gigafactories need a supply chain around them to be successful.[148] Lithium-ion batteries are the dominant battery chemistry. Lithium, nickel, cobalt, manganese and graphite are the main raw minerals used to make these batteries, although other minerals are also used. Once these minerals have been mined, they need to be refined and processed to produce chemicals to make the key components of battery cells. Those components are cathodes, anodes, electrolytes and separators. Most of the cost of producing a battery cell comes from the raw materials, particularly the raw minerals used to manufacture cathodes, which comprise lithium, nickel and cobalt.[149] Refining raw minerals and manufacturing battery components make up the midstream of the battery supply chain. Once batteries reach end-of-life, they can be reused or recycled, whereby the raw materials are extracted and re-enter the supply chain.[150]

Raw minerals

38. The expansion of gigafactories is likely to make the UK a major consumer of raw minerals, according to the UK Critical Mineral Intelligence Centre, a specialist centre led by the British Geological Survey.[151] However, it is not certain that the UK will be able to secure a sufficient supply of raw minerals to meet increasing demand as the UK is competing with other economies to secure supplies of these minerals to support decarbonisation.[152]

39. It is not possible for the UK to have a self-sufficient supply of domestically produced batteries. Some of the minerals used to make lithium-ion batteries do not exist in the UK. The possibility of extracting lithium in Cornwall and the North-East is being explored by Cornish Lithium, British Lithium and others.[153] Nickel and cobalt are also found in the UK, but it is unclear whether those minerals can be extracted domestically at a commercial scale.[154]

40. Supply chains for raw minerals present challenges. The raw minerals used to produce lithium-ion batteries are heavily concentrated in a small number of countries.[155] Enough of these raw minerals are expected to exist to satisfy global demand for electric vehicles.[156] However, supply chain constraints in the short-term are likely, due to the long lead times required to bring new mines into operation and to establish recycling facilities.[157] Mineral

148 Green Alliance, Powering up the UK battery industry, September 2023
149 The Faraday Institution (BEV0011)
150 This includes being remanufactured or repurposed.
151 UK Critical Mineral Intelligence Centre, Study on future UK demand and supply of lithium, nickel, cobalt, manganese and graphite for electric vehicle batteries, July 2022
152 UK Critical Mineral Intelligence Centre, Study on future UK demand and supply of lithium, nickel, cobalt, manganese and graphite for electric vehicle batteries, July 2022; Q8 [Paul Lusty]
153 Cornish Lithium Limited (BEV0042); British Lithium Limited (BEV0016)
154 Cobalt minerals exists in variety of deposits across the UK, but often within polymetallic ores. This means that it is likely to be extracted as a by-product of other mining operations. Historical mining of cobalt in the UK has found the quality of these minerals to be low. However, the UK Critical Minerals Intelligence Centre suggested that there is the "potential for undiscovered cobalt in several areas of the UK." High concentrations of nickel and the presence of nickel-bearing minerals exist in the UK. There is exploration of nickel mineralisation in Scotland.
155 IEA, Global Supply Chains of EV Batteries, July 2022; UK Battery Industrialisation Centre (BEV0028)
156 Q110 [David Wong]
157 The Deparment told us that "global demand for electric vehicle battery minerals is projected to increase by between six and thirteen times by 2040,13 exceeding the rate at which new primary and secondary sources are currently being developed." See Department for Business and Trade (BEV0051

prices are often volatile.[158] The supply chains for these raw minerals are often opaque making it difficult to trace the source of these minerals from the mine to the finished product.[159] There are also adverse environmental and social impacts across those supply chains.[160]

41. The Government, through the Critical Minerals Strategy, is looking to secure sufficient supplies of raw minerals by accelerating the UK's domestic capabilities, collaborating internationally and enhancing international markets. The UK Government published a refresh of this strategy in March 2023 and launched a Task and Finish Group on Critical Minerals Resilience to assess "critical mineral dependencies and vulnerabilities" across sectors of the economy.[161]

42. To help secure a more resilient supply of critical minerals, the Government could:

- **support mining companies in the UK to bring domestic production online faster.**[162] This could include underwriting offtake agreements earlier in the supply chain and ensuring that mining companies can access an affordable supply of clean electricity.[163]
- **build a circular economy for batteries in the UK to mitigate demand for raw minerals,** including supporting recycling facilities in the UK. Recycling facilities have struggled to develop a sustainable economic model, due, in part, to a lack of supply of recyclable battery materials.[164] Government support for this industry may be necessary to ensure domestic facilities are in operation for when substantial levels of battery waste materialises.[165] The UK Government could also help to stimulate demand by introducing minimum levels of recycled content, assigning a guaranteed value, and owner, for end-of-life batteries via a Battery Value Guarantee and by introducing financial incentives to prevent battery waste from being exported to recycling facilities abroad.[166]
- **enter supply agreements with friendly countries**. Benchmark Mineral Intelligence, for example, suggested that the UK should aim to have "long term raw material supply agreements with friendly countries that are dominant in the upstream of this EV supply chain."[167] Others have made a similar suggestion.[168] The UK Government has already made progress on this front.[169] The Green Alliance added that the Government should progress ongoing conversations between UK-based businesses and mining operators in countries with strong environmental, social and governance (ESG) records and stable economies,

158 Benchmark Mineral Intelligence (BEV0010)
159 Critical Minerals Association (BEV0046)
160 Green Alliance, Powering up the UK battery industry, September 2023
161 In March 2023, the Government published the Critical Minerals Refresh, which provides an overview of how the strategy is being delivered, along with some upcoming milestones. For more information see Department for Business, Energy and Industrial Strategy, Critical Minerals Refresh: Delivering Resilience in a Changing Global Environment, March 2023
162 Green Alliance, Powering up the UK battery industry, September 2023; Critical Minerals Association (BEV0046)
163 Green Alliance, Powering up the UK battery industry, September 2023
164 UK Battery Industrialisation Centre (BEV0028); Green Finance Institute, Powering the Drive to Net Zero: Unlocking Public and Private Capital for the UK Battery Sector, May 2022
165 The Faraday Institution (BEV0011)
166 Green Finance Institute, Powering the Drive to Net Zero: Unlocking Public and Private Capital for the UK Battery Sector, May 2022; Green Alliance, Powering up the UK battery industry, September 2023
167 Benchmark Mineral Intelligence (BEV0010)
168 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
169 Department for Business, Energy and Industrial Strategy, Critical Minerals Refresh: Delivering Resilience in a Changing Global Environment, March 2023

such as Australia and Canada, which have sufficient nickel, cobalt and lithium reserves to meet UK production requirements.[170]

- **introduce a requirement for batteries to be sold in the UK to come with a battery passport containing information on the environmental, social and governance credentials of the supply chain and a guarantee that forced labour was not used at any stage of the battery's production.**[171] This would help improve the transparency of global battery supply chains for UK consumers, while also promoting the ESG credentials of batteries made in the UK.

Midstream processes: refining of raw minerals and the manufacture of battery components

43. Once raw minerals are mined, they need to be refined and processed before they can be used to manufacture battery components. Most of the raw minerals used to make lithium-ion batteries, except graphite, are mined outside China.[172] However, China dominates the midstream of the battery supply chain. The refining and processing of battery minerals is heavily concentrated in China. The International Energy Agency, for example, has pointed out that "over half of global raw material processing for lithium, cobalt and graphite also occurs in China."[173] China is also the main producer of cathodes and anodes - two key battery components. In 2022, China accounted for 78% of cathode production and 91% of anode production.[174] China's success at building midstream capacity means that raw materials flow into China from countries where they are mined.[175] This control over the midstream has helped China secure a lead position in downstream production of battery cells and electric vehicles. The UK's dependence on such supply chains creates a strategic vulnerability for the country, especially if China restricts exports of materials and components that the UK needs.[176]The Critical Minerals Association told us

> China's top legislature passed a law in December 2020 on export control, allowing their government to ban exports of strategic materials and advanced technology to specific foreign companies. Given that the 14th Five-Year Plan aims to facilitate China's transition from midstream dominance to downstream dominance, it is right to be wary over the UK's dependence on a foreign entity with the same downstream goals. The UK must develop an alternative supply chain to ensure long-term security of supply.[177]

44. The UK has some refining capabilities. For example, a large nickel refinery in South Wales.[178] However, this facility does not currently produce battery-grade materials. The Phillips66 Humber refinery produces synthetic graphite and anode-grade petroleum cokes, a precursor to anode production.[179] The UK has some lithium refining capabilities and there are plans to build new lithium refineries in the South West and North East.[180] British Lithium is planning to co-locate a refinery with a quarry and beneficiation plant

170 Green Alliance, Powering up the UK battery industry, September 2023
171 Green Alliance, Powering up the UK battery industry, September 2023
172 IEA, Global Supply Chains of EV Batteries, July 2022
173 IEA, Global Supply Chains of EV Batteries, July 2022
174 Benchmark Mineral Intelligence (BEV0010)
175 Q25 [Simon Moores]
176 Critical Minerals Association (BEV0046); Q26 [Jeff Townsend]
177 Critical Minerals Association (BEV0046)
178 CPI (BEV0024)
179 Phillips66, Humber Refinery [accessed on 7 November 2023]
180 Livent (DEV0049); British Lithium Limited (BEV0016); Green Lithium Refining Limited (BEV0014); Q7 [Paul Lusty]

in Cornwall; Green Lithium has plans to build a lithium refinery in Teesside.[181] There is an electrolyte factory in the Tees Valley.[182] There are, however, no manufacturers of cathodes or anodes in the UK.[183]

45. The Government is aiming to create an enabling environment for businesses that make up the midstream of the critical minerals value chain.[184] These businesses are eligible for support from the Automotive Transformation Fund. Onshoring the midstream of the battery supply chains has strategic benefits. The UK has a lot of value to add in these parts of the supply chain, especially given the strength of the UK's chemical industry and the UK's research into new cathode technologies.[185] The UK's high relative levels of access to low-carbon electricity would reduce the carbon-intensity of these processes.[186] The midstream includes some high value-added parts of the supply chain, which, if onshored, would help the UK to meet rules of origin requirements with the EU and other trading partners.[187] Onshoring cathode manufacturing, for example, is seen as strategically important in this respect, because most of the value of a battery cell comes from the materials and manufacturing used to produce cathodes.[188] Without these midstream processes, the UK would need to export recycled battery materials.[189]

Building an integrated battery supply chain

46. In addition to building gigafactories, the UK should aim to build an integrated battery supply chain, with a secure supply of raw minerals from the UK and overseas and domestic industrial capabilities in midstream processes that are strategically important and where the UK can add substantial value. The Department told us that it is not feasible or desirable for the UK to onshore all elements of the battery supply and that the UK is likely to rely on imports of raw minerals, materials and components.[190] Although we accept that observation, localising more of the supply chain, and particularly midstream processes, in the UK is strategically important.

47. Localising more of the supply chain would offer the UK a source of competitive advantage. The relatively high environmental, social and governance credentials of batteries made in the UK would help the UK to become a source of premium batteries that are produced more sustainably and ethically than those in some other countries.[191] Access to low-carbon electricity would help to reduce the carbon-intensity of processes throughout the battery supply chain.[192] The Faraday Institution estimated that batteries made in the UK would have emissions 12% lower than the EU average and 24% lower than

181 British Lithium Limited (BEV0016); Green Lithium Refining Limited (BEV0014)
182 CPI (BEV0024)
183 Benchmark Mineral Intelligence (BEV0010)
184 PQ 171391 [Minerals: supply chain] answered on 3 April 2023
185 Green Alliance, Powering up the UK battery industry, September 2023; The Faraday Institution (BEV0011)
186 Green Lithium Refining Limited (BEV0014)
187 The Faraday Institution (BEV0011)
188 The Faraday Institution (BEV0011)
189 Green Alliance, Powering up the UK battery industry, September 2023
190 Department for Business and Trade (BEV0051)
191 Green Alliance, Powering up the UK battery industry, September 2023; The Faraday Institution, The UK: A Low Carbon Location to Manufacture, Drive and Recycle Electric Vehicles, November 2021; Balance Batteries (BEV0041); Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
192 McKinsey, The race to decarbonize electric-vehicle batteries, February 2023; Green Alliance, Powering up the UK battery industry, September 2023; The Faraday Institution, The UK: A Low Carbon Location to Manufacture, Drive and Recycle Electric Vehicles, November 2021; Green Lithium Refining Limited (BEV0014);

batteries made in Germany.[193] However, those outcomes would depend on most of the midstream and recycling processes being localised.[194]

48. The UK could take a range of steps to promote the benefits of domestic production. Those measures include battery passports, requirements on carbon-footprint reporting, carbon footprint thresholds and minimum levels of recycled content.[195] A carbon border adjustment mechanism, which is a tax designed to tackle carbon leakage,[196] could also help to ensure that batteries produced domestically are not unfairly disadvantage by carbon-intensive imports.[197]

49. Although there are benefits to localising more of the battery supply chain, such an approach carries attendant risks. The processes used to produce electric vehicle batteries use substances that are hazardous to human health. British Occupational Hygiene Society, a scientific charity specialising in health protection in industry, told us that there needs to be a "proportionate, relevant and effective regulatory regime for the manufacture of EV batteries in the UK."[198]

50. **It is not feasible or desirable to onshore the end-to-end battery supply chain. The UK cannot have a self-sufficient supply of lithium-ion batteries and will continue to rely to some degree on imports of raw minerals, materials and components. However, building the UK's industrial capabilities across the battery supply chain, and especially in midstream processes such as the refining of raw minerals and the manufacture of cathodes and anodes, will confer strategic advantages. *The Government should specify the industrial capabilities within the UK battery supply chain that are strategically critical to onshore along with new interventions that will encourage relevant businesses to locate in the UK. Such specifications could be set out either in the forthcoming UK Battery Strategy or in response to this Report.***

51. **Global battery supply chains, and especially the upstream supply of critical minerals, have environmental, social and governance challenges. Those supply chains are concentrated in China. The UK's dependence on those supply chains poses risks to the UK and to the Government's strategic objectives, especially if China were to restrict exports of the materials and components that the UK needs. It is critical that the UK Government continues to collaborate internationally not only to diversify the battery supply chain, but to ensure that batteries are produced to high environmental and social standards.**

193 The Faraday Institution, The UK: A Low Carbon Location to Manufacture, Drive and Recycle Electric Vehicles, November 2021.

194 Green Alliance, Powering up the UK battery industry, September 2023

195 European Commission, Circular economy: New law on more sustainable, circular and safe batteries enters into force, August 2023

196 The London School of Economics explained that the "term 'carbon leakage' typically refers to the subset of 'trade embodied emissions' that are specifically caused by climate policy asymmetries. Leakage concerns arise when one country decides, ahead of others, to implement ambitious policies to encourage industries to transition to carbon-neutral production. Compliance costs are either passed through to consumers or absorbed by the regulated companies, raising the possibility of being undercut by imports that have not paid equivalent carbon prices, leading to leakage. Therefore, carbon pricing policies usually incorporate anti-leakage mechanisms to 'level the playing field'." See What is carbon leakage? Clarifying misconceptions for a better mitigation effort, London School of Economics, 8 December 2021

197 Green Finance Institute, Powering the Drive to Net Zero: Unlocking Public and Private Capital for the UK Battery Sector, May 2022

198 British Occupational Hygiene Society (BEV0048)

52. ***The UK Battery Strategy should set out how the Government plans to promote robust environmental, social and governance standards across the battery industry domestically and globally to promote transparency and a green and clean battery supply.***

53. **A battery supply chain in the UK would enable businesses based in this country to manufacture batteries sustainably and ethically. This offers the UK a competitive advantage over other markets, especially as consumers demand higher environmental, social and governance standards. The UK's access to low-carbon sources of electricity means that batteries produced in the UK will be produced more sustainably than those in China and many European countries. *The Government should empower UK consumers by requiring batteries available on the UK market to come with a battery passport containing information about how sustainably and ethically those batteries were produced.***

3 Encouraging investment into the battery supply chain in the UK

54. The UK has attributes that make it an attractive place to produce electric vehicles, batteries and other materials used in the battery supply. It has a rich automotive heritage with a highly productive workforce.[199] It also excels at innovation. The Automotive Sector Deal and the Faraday Battery Challenge has helped to build excellent research and development capabilities designed to support the industrialisation of battery technologies, such as the UK Battery Industrialisation Centre. Batteries made in the UK are likely to cost more than those manufactured in China. However, the UK could produce batteries at a price competitive with those made in Germany.[200] A domestic battery supply chain in the UK could also produce batteries more sustainably than those manufactured in China, Germany and other competitors.[201] OEMs, we heard, will increasingly compete to reduce the carbon-intensity of battery production in an effort to demonstrate the environmental credentials of their finished vehicles.[202] However, the UK also has barriers that are deterring investment.

Global competition for investment in the battery supply chain

55. The UK continues to face tough competition from other markets who are looking to boost domestic production of electric vehicles and to develop resilient supply chains for their automotive industries. China, for example, is far ahead of the rest of the world in developing an integrated supply chain for electric vehicle batteries. China dominates almost all aspects of the electric vehicle supply chain from the refining of raw minerals through to the manufacture of battery components and battery cells. China's position in today's electric vehicle and battery industry is the product of more than a decade of supply-side and demand-side policies that have supported domestic firms.[203] Growing overcapacity in electric vehicle manufacturing and battery production in China's domestic market means its manufacturers are increasingly looking to expand in Europe.[204][205]This creates a risk of flooding the UK market with cheap imports that jeopardise the development of the UK battery supply market.

56. Many other countries have industrial strategies that are seeking to increase domestic production of electric vehicles and batteries and to onshore associated supply chains.[206] The International Energy Agency, for example, has pointed out that, like the UK, countries with large automotive industries are also looking to secure access to "upstream supply and

199 Green Finance Institute, Powering the Drive to Net Zero: Unlocking Public and Private Capital for the UK Battery Sector, May 2022
200 The Faraday Institution (BEV0011)
201 The Faraday Institution, The UK: A Low Carbon Location to Manufacture, Drive and Recycle Electric Vehicles, November 2021.
202 Q46 [Ian Constance]
203 IEA, Global Supply Chains of EV Batteries, July 2022
204 European Parliament, EU anti-subsidy probe into electric vehicle imports from China EU companies warn China on EV overcapacity, October 2023; EU companies warn China on EV overcapacity, The Financial Times, 19 September 2023
205 The European Commission has recently launched an anti-subsidy investigation into electric vehicle from China, which The Financial Times suggest that European expansion may not be a viable option for Chinese firms. For more information see Chinese electric vehicle groups braced for wave of consolidation, The Financial Times, 17 October 2023
206 IEA, Global Supply Chains of EV Batteries, July 2022

refining capacity" of raw minerals and to develop a lead position in "high value-added" parts of the supply chain.[207]

57. Global competition for investment in electric vehicle supply chains, including gigafactories and upstream processes, has intensified since the US Inflation Reduction Act was introduced in August 2022. Tax credits, loans and grants are available in the US to help accelerate the adoption of electric vehicles and boost domestic production. Consumer tax credits for electric vehicles up to $7,500, for example, are designed to incentivise local production. To be eligible for the full tax credit, vehicles need to be manufactured or assembled in the US and be made from locally sourced minerals or those from a trading partner. There are also incentives directly for manufacturing. Battery manufacturers in the US can access production subsidies of $35 US dollars per kilowatt-hour (kWh) for battery cells,[208] equivalent to 30% of their production costs.[209] All battery manufacturers in the United States are eligible for this subsidy. Menon Economics, a research and advisory company, noted that this support incentivises mass production because the subsidy is set per kWh.[210] The firm has estimated that battery manufacturers in the United States will receive $150billion of financial support over the next decade as result of this subsidy, and other support, introduced under Inflation Reduction Act.[211]

58. In the first year since the Inflation Reduction Act was introduced, the United States attracted more than $70 billion of investment into its electric vehicle supply chain.[212]This investment has come at the expense of investment in Europe.[213] Economies have responded to the Inflation Reduction Act by increasing the amount of subsidies available to clean industries, including battery manufacturing, and by introducing reforms to de-risk investments.[214] The European Union has relaxed its state aid rules since the Inflation Reduction Act was introduced.[215] The EU Commission's Green Industrial Plan, published in February 2023, aims to provide a "supportive environment" for developing manufacturing capacity for green technologies and products in the EU. The EU's plan includes proposals to speed up access to funding, provide a "predictable and simplified regulatory environment", develop skills in the workforce and provide "open trade for resilient supply chains."[216] These measures build on the support that was already in place.[217]

59. The Advanced Manufacturing Plan, due to be published alongside the Autumn Statement, is meant to set out how the UK can continue to compete globally to attract

207 IEA, Global Supply Chains of EV Batteries, July 2022
208 Another $10 per kWh is available for battery modules.
209 The cost of manufacturing a complete battery in the UK in 2022 was USD 157 per kWh.
210 Menon Economics, Battery subsidies in the EU, Norway and the US, May 2023
211 Menon Economics, Battery subsidies in the EU, Norway and the US, May 2023
212 The White House, One Year In, President Biden's Inflation Reduction Act is Driving Historic Climate Action and Investing in America to Create Good Paying Jobs and Reduce Costs, 16 August 2023;
213 Transport &Environment, How not to lose it all Two-thirds of Europe's battery gigafactories at risk without further action, March 2023
214 Social Market Foundation, One year on from the Inflation Reduction Act: International responses to the IRA, August 2023
215 Social Market Foundation, One year on from the Inflation Reduction Act: International responses to the IRA, August 2023; Menon Economics, Battery subsidies in the EU, Norway and the US, May 2023
216 European Commission, A Green Deal Industrial Plan for the Net-Zero Age, February 2023
217 The Department for Business and Trade told us that support in the EU is provided by "different levels of government" including by local and national governments as well at intergovernmental and supranational levels. They added that the most notable intervention in the EU is the 'Important Project of Common European Interest' (IPCEI) scheme. This is funded by national contributions, but is administered at the EU-level. The scheme is focused on developing battery production in Europe and reducing reliance on imports. See Department for Business and Trade (BEV0051)

private capital into the UK's electric vehicle supply chain.[218] In March 2023, the Chancellor of the Exchequer hinted that the UK would not go "toe-to-toe" with other nations in a "distortive global subsidy race", but would target funding strategically to where the UK has a competitive advantage.[219]

60. The Faraday Battery Challenge, run by UK Research and Innovation, told us that the Inflation Reduction Act and other international policy interventions have "overshadowed" the amount of funding on offer in the UK.[220] Opinion is divided about the extent to which the UK needs to raise the amount of financial support available to match that on offer in other countries.[221] For example, the House of Lords Science and Technology Committee, in 2021, argued that the resources allocated to support the battery sector would need to be commensurate with those available in other countries.[222] The UK Battery Industrialisation Centre, in contrast, emphasised that the UK needs to sustain its investment, but does not need to "match the massive scale of subsidies" available internationally.[223] The SMMT said that the UK needs to

> carefully consider the UK's vision and position in the rapidly evolving international funding landscape, and adapt its approach to subsidy control, to ensure the UK has access to sufficient battery capacity as measures by competitor markets will be highly effective in attracting mobile capital and investment in future industrialisation and localisation towards these markets at the potential expense of the UK if left unanswered.[224]

61. Some increase in financial support is likely to be necessary. However, we heard it is of critical importance that the UK creates the right conditions that help to attract investment into gigafactories and the wider supply chain by creating a policy framework that couples subsidies, land availability, low cost power, high quality skills, de-risked supply of critical minerals and supply chains, tariff free trade and research and development. This must come with a long-term commitment and stable business environment for the electric vehicle supply chain, alongside a package of policies that radically speeds up the time required to craft support packages, and helps to de-risk investments.[225]

62. **Global competition for the electric vehicle supply chain has intensified following the passing of the Inflation Reduction Act in the United States. The Inflation Reduction Act has seen investment flow into the electric vehicle supply chain, especially gigafactories, in the United States at the expense of Europe. *The UK Government must urgently respond to this intensified global competition with an internationally competitive package of long-term support to attract private investment into gigafactories and the wider battery supply chain within the UK.***

218 Q147 [Fred Perry]
219 Jeremy Hunt: We're powering up Britain's green industrial revolution (thetimes.co.uk) 30 March 2023
220 UKRI Faraday Battery Challenge (BEV0032)
221 Balance Batteries (BEV0041); UKRI Faraday Battery Challenge (BEV0032); House of Lords Science and Technology Committee, Battery strategy goes flat: Net-zero target at risk, 1st Report of Session 2021–22 - published 27 July 2021 - HL Paper 53; UK Battery Industrialisation Centre (BEV0028)
222 House of Lords Science and Technology Committee, Battery strategy goes flat: Net-zero target at risk, 1st Report of Session 2021–22 - published 27 July 2021 - HL Paper 53
223 UK Battery Industrialisation Centre (BEV0028)
224 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)
225 Society of Motor Manufacturers and Traders (SMMT) (BEV0043); UK Battery Industrialisation Centre (BEV0028); Nissan Motors UK (BEV0045); Nyobolt (BEV0036); Advanced Propulsion Centre UK Limited (BEV0047); Faraday Battery Challenge, part of UK Research and Innovation (BEV0032).

63. **The UK is competing against other large markets that are offering large subsidies to boost domestic production of electric vehicles and batteries and onshore businesses in the supply chain. The UK Government does not necessarily need to match the scale of subsidies on offer in these markets if the UK's overall package is internationally competitive. However, *the UK Government must provide a long-term stable business environment, with a clear framework of support that de-risks investments in the UK's battery supply chain.***

Barriers to investment in the battery supply chain

Industrial strategy

64. Many countries have identified electric vehicles and batteries as strategic industries and are implementing industrial strategies designed to increase domestic production and build resilient, integrated supply chains.[226] The Automotive Sector Deal and the Faraday Battery Challenge, which were introduced as part of the Government's Industrial Strategy in 2017, helped to establish a battery ecosystem in the UK. The Department told us that the UK has

> deployed a highly structured framework, composed of a set of interventions that work together to accelerate technologies from the early stages of innovation through to industrialisation. The UK framework is aimed at unlocking an industry-led transition to Net Zero, prioritising investment where there is a strong case for government intervention, whilst leveraging additional funding from industry.[227]

65. Some witnesses told us that the UK has suffered from an absence of industrial strategy designed to support the automotive industry's transition to zero emission vehicles and build a domestic battery industry.[228] The Chancellor of the Exchequer has identified advanced manufacturing, which includes automotive manufacturing, as one of five growth sectors for the UK. We were told that the Government plans to publish an Advanced Manufacturing Plan alongside the Autumn Statement.[229] The UK Government is also developing a UK Battery Strategy.[230]

66. **The absence of a clear and visible industrial strategy for the UK's automotive sector had deterred investment in the UK. The forthcoming publication of the Government's Advanced Manufacturing Plan and UK Battery Strategy should help to address that lack of investment. *The Government should adopt an integrated approach, with measures to develop industrial capabilities across the battery value chain and to collaborate internationally with friends and partners with rich sources of battery minerals. The Advanced Manufacturing Plan and UK Battery Strategy must set out how the Government plans to capitalise on the UK's sources of competitive advantage and also to address structural barriers that are deterring investment in the UK's battery supply chain.***

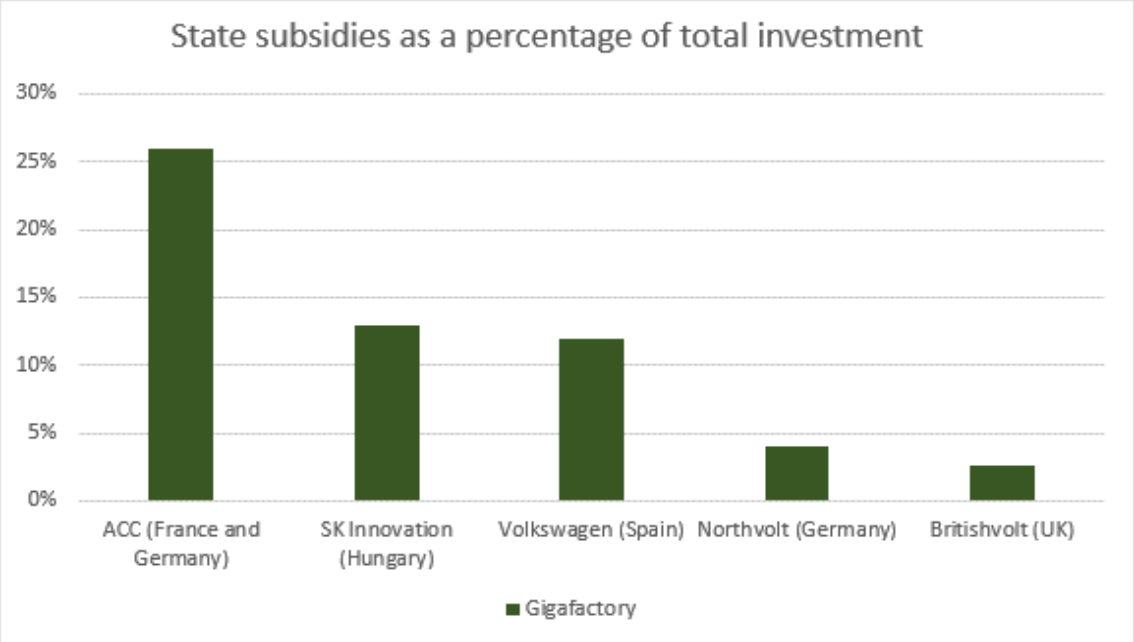
226 IEA, Global Supply Chains of EV Batteries, July 2022
227 Department for Business and Trade (BEV0051)
228 Q85 [David Wong], Q87 [Dr Palmer]
229 Q147 [Fred Perry]
230 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023

Financial support

67. The UK Government provides direct grants for capital investments in the electric vehicle supply chain through the Automotive Transformation Fund. This fund is designed to unlock private investment into gigafactories and other businesses in the supply chain. The Government uses the fund to prioritise investments that help to anchor other parts of the supply chain in the UK and to secure further investment.[231] The fund uses a portfolio approach that aims to balance risk across a range of projects.[232] The amount granted varies between projects, but is designed to be the minimum amount needed to secure a sustainable investment.[233] The Government has allocated £850 million to the ATF since 2020 (£136 million of which was reprioritised for the Sizewell C nuclear power station); the total value of offers made under the fund stood at £550 million in September 2023.[234]

68. These funds have helped to attract investment into gigafactories and other parts of the electric vehicle supply chain. These funds are, however, thinly spread, designed to support not only batteries, but fuel cells, electric drives and motors and powertrains.[235] The limited amount of funding available through the Automotive Transformation Fund has meant that some battery manufacturers have been offered substantially less support than is available in other countries, whereas others have been forced to look elsewhere.[236] The chart below from the Green Alliance shows how the amount of financial support offered to Britishvolt[237] compares with other investments in gigafactories in Europe.[238] The Important Project of Common European Interest' (IPCEI) scheme in the EU has provided funding for gigafactories. Under this scheme, some battery manufacturers in the EU have received subsidies of up to 25 % of the total investment cost.[239] Matching the amount of funding for gigafactories in Hungary and Spain would cost £1.3billion by 2030, according to estimates by the Green Alliance.[240]

231 Automotive Transformation Fund, GOV.UK [accessed on 7 November 2023]
232 Q153 [Fred Perry]
233 Automotive Transformation Fund, GOV.UK [accessed on 7 November 2023]
234 PQ 199465 [Automotive Transformation Fund] answered on 22 September 2023
235 Automotive Transformation Fund, GOV.UK [accessed on 7 November 2023]
236 Green Alliance, Powering up the UK battery industry, September 2023; Q87 [Dr Palmer]
237 The amount of funding allocated via the Automotive Transformation Fund varies depending on the project. The Government (as noted in Box 2) has noted provided information on the scale of financial support offered to Tata to help fund its UK gigafactory.
238 Green Alliance, Powering up the UK battery industry, September 2023
239 Menon Economics, Battery subsidies in the EU, Norway and the US, May 2023
240 Green Alliance, Powering up the UK battery industry, September 2023



Source: Green Alliance

69. There have also been problems with how the fund is administered. For example, the Green Alliance noted that it can take a long time for the funds to be made available, which can deter investments.[241] The Automotive Transformation Fund is directed at the automotive sector, which has disadvantaged manufacturers who are looking to supply non-automotive markets.[242]

70. Direct grants are one way of unlocking private capital, but other sources of financial support might be effective. The Green Finance Institute has proposed the use of a Battery Investment Facility that would use public money to de-risk private investment for firms in the earlier stages of their development, which can struggle to access finance from banks and private equity who have a lower risk-appetite.[243] This could include a public-private, or blended, fund where public money is used to bring in funding from private investors.[244] Alternatively, the Green Alliance proposed that the UK Government could underwrite offtake agreements between businesses at different points in the supply chain to give investors greater confidence or by allowing institutions such as the UK Infrastructure Bank to take on more risk by, for example, issuing loan guarantees.[245]

71. **The Automotive Transformation Fund has helped to unlock private investment into the UK, including in gigafactories and businesses further up the supply chain. However, now global competition has intensified, the UK Government needs to**

241 Green Alliance, Powering up the UK battery industry, September 2023
242 Q87 [Dr Palmer]
243 Venture capital and government grants are often used to fund firms at research and development and proof-of-concept stage. The finance for these businesses to scale-up then comes from banks and private equity firms, who tend to have longer timelines for investment, but are more risk averse. The gap between these stages is know as the 'valley of death' where firms struggle to attract the investment they need to scale-up. This is a particular problem for firms in the battery supply chain that, due to high upfront costs, can be out of the scope of traditional investors. For more information see Green Alliance, Powering up the UK battery industry, September 2023
244 Green Finance Institute, Powering the Drive to Net Zero: Unlocking Public and Private Capital for the UK Battery Sector, May 2022
245 Green Alliance, Powering up the UK battery industry, September 2023

ensure that financial support on offer in the UK is internationally competitive. ***The Government should conduct a benchmarking review to determine how the financial support on offer compares with that available in competitor countries. It should publish this review and use the findings to inform a new offer of support for the UK's battery industry in its forthcoming UK Battery Strategy.***

Energy costs

72. High industrial energy prices in the UK compared with international competitors are a major barrier for investors across the electric vehicle supply chain.[246] Processes throughout the battery supply chain are extremely energy-intensive. A single large gigafactory could consume more than 2 TWh of electricity per annum, or around 0.7% of the total current UK annual electricity consumption.[247] Energy prices make up a significant proportion of the operating costs of gigafactories. Energy prices are also a major cost for automotive manufacturers and businesses further upstream.[248] Energy costs for energy-intensive businesses, such as battery manufacturers, were 26% higher than the EU average in 2022.[249]

73. The Department told us that battery manufacturing is included in measures designed to support Energy Intensive Industries from 2024.[250] The Energy Intensive Industries Exemption Scheme cuts levies on eligible businesses. The Green Alliance suggested that the Government should "guarantee access to the exemption scheme for businesses in the battery supply chain."[251] The exemptions available to energy-intensive industries do not address the high wholesale price of energy. Investors would benefit from greater long-term certainty over future energy costs. Long-term contracts between energy suppliers and businesses, known as Purchase Power Agreements, in the battery supply chain could help, but these are difficult for businesses to come by.[252] The Government could help by underwriting these agreements to guarantee businesses in the battery supply chain secure access to affordable electricity.[253]

74. **High energy prices in the UK are deterring investment in the battery supply chain. The Government has taken steps to support energy-intensive industries. However, investors still need more certainty that UK energy prices will remain internationally competitive.** ***The Advanced Manufacturing Plan and UK Battery Strategy should set out further interventions that will provide investors with more long-term certainty that the UK's energy prices will be competitive with other markets.***

Skills shortages

75. Access to a skilled and productive workforce is a major factor for businesses in choosing where to locate. The electrification of the automotive industry will require a

246 InoBat (BEV0037); Green Alliance (BEV0021); Green Alliance, Powering up the UK battery industry, September 2023; Green Finance Institute, Powering the Drive to Net Zero: Unlocking Public and Private Capital for the UK Battery Sector, May 2022; Midlands Engine (BEV0022); Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)

247 Advanced Propulsion Centre UK Limited (BEV0047)

248 Nissan Motors UK (BEV0045); Society of Motor Manufacturers and Traders (SMMT) – (BEV0043)

249 Green Alliance, Powering up the UK battery industry, September 2023

250 Department for Business and Trade (BEV0051)

251 Green Alliance, Powering up the UK battery industry, September 2023

252 Green Alliance, Powering up the UK battery industry, September 2023

253 Green Alliance, Powering up the UK battery industry, September 2023

substantial shift in skills.[254] Thousands of jobs in gigafactories and the wider battery supply chain are likely to be needed by 2030. The UK faces skills gaps across the battery supply chain. However, the UK Battery Industrialisation Centre told us that the "same is true across Europe generally where this industry is growing from the ground up."[255] There is, however, plenty of scope to upskill and reskill employees in the automotive sector and other industries to perform roles in the battery supply chain.[256] Some firms have already made progress on this front. AMTE, a battery manufacturer based in Scotland, has worked to upskill staff from a decommissioned nuclear power station in Dounreay.[257] The Faraday Battery Challenge is looking to address gaps in the training provision for the battery sector.[258] The Faraday Institution told us that:

> Comprehensive training programmes in dedicated centres will need to be offered in regions where battery production is most likely to be cited, noting that skills shortages may be more acute in certain UK regions such as the North East.[259]

76. **The UK faces skills shortages across the battery supply chain.** ***The Advanced Manufacturing Plan and UK Battery Strategy should set out:***

a) ***the forecast labour market involved in reaching its targets for UK-supplied batteries***

b) ***the forecast training cost for this workforce; and***

c) ***how they plan to train and reskill professionals in the automotive sector to support domestic production of electric vehicles, batteries and other processes in the battery supply chain, including through devolution of the requisite training budgets to local areas.***

77. ***The Government should ensure that mayoral combined authorities or local councils—especially those that govern strategically important sites where gigafactories could be built—have adequate and flexible funding to tailor support local training programmes. Offers of financial support to businesses in the battery supply chain should be conditional on these companies investing in upskilling and reskilling employees from the automotive industry and other sectors.***

Export opportunities

78. Some 80% of vehicles made in the UK are exported. Vehicles made in the UK are sold in more than 130 countries around the world.[260] The EU is the UK's largest export market. Around 60% of vehicles made in the UK are exported to the EU. The United States and

254 The High Value Manufacturing Catapult has suggested that 63% of jobs in automotive manufacturing could be subject to significant change. For more information see The High Value Manufacturing Catapult, The Opportunity for a National Electrification Skills Framework and Forum, September 2021

255 By 2040, the Faraday Institution has estimated that 35,000 people could be employed in gigafactories. A gigafactory, with a capacity of between 30–40GWh, could directly employ over 3,000 people.

256 Green Lithium Refining Limited (BEV0014);

257 CPI (BEV0024)

258 UKRI Faraday Battery Challenge (BEV0032)

259 The Faraday Institution (BEV0011)

260 Society of Motor Manufacturers and Traders, Manifesto 2030: Automotive Growth for a Zero Emission Future, June 2023

China are the UK's other largest export markets.[261] China, the United States and Europe are the three largest markets for electric vehicles globally. However, electric vehicle sales have also be rising in emerging markets, such as India, Indonesia and Thailand.[262] InoBat, a European battery manufacturer, emphasised that it is important to ensure trade routes are protected and developed. This is because gigafactories represent a significant investment and, therefore, need to be "underpinned by sustainable offtake demand."[263] It added that opportunities available in export markets form part of the investment case for battery manufacturers, when they choose where to locate.[264] It suggested that the UK could "do more to incorporate, develop and promote the export trade routes for cell manufacture, and not just limit focus to how a UK gigafactory can support UK customers."[265] The SMMT has called on the Government to:

> Position automotive and advanced manufacturing supply chains at the core of UK trade policy and market access. Secure access to global markets for tariff-free export of British-made vehicles, batteries and green technologies, and deliver export support services that allow businesses of all sizes to succeed.[266]

79. ***The UK Government's trade policy should aim to secure tariff-free access to global markets for electric vehicles and batteries manufactured in the UK.***

261 SMMT, Manufacturing Data [accessed on 7 November 2023]
262 International Energy Agency, Global EV Outlook 2023: Catching up with climate ambition, April 2023
263 InoBat (BEV0037)
264 InoBat (BEV0037)
265 InoBat (BEV0037)
266 Society of Motor Manufacturers and Traders, Manifesto 2030: Automotive Growth for a Zero Emission Future, June 2023

4 Commercialising the next generation of battery technologies

80. Lithium-ion batteries are expected to remain the most popular battery chemistry for the next decade, partly due to the challenges involved in commercialising alternatives.[267] Lithium-ion batteries have been incrementally improved over several decades to optimise their performance.[268] Research into this family of battery technologies continues. However, the Department has noted that the lithium-ion battery may be reaching its limits for improvement.[269]

Next generation of battery technologies

81. Lithium-ion batteries are not without challenges. New battery technologies are on the horizon that offer potential benefits over lithium-ion batteries on the market. Table 2 provides a summary of some of the next-generation of battery technologies along with their characteristics and potential uses. These technologies are at different stages of development. Different battery technologies are likely to be better suited for certain applications than others.[270] The Department told us that it expects "a range of battery technologies to play a part" across different segments of the battery market.[271] Sodium-ion batteries, for example, are likely to be more suited for energy storage.[272] Solid-state batteries offer the potential to improve the range of electric vehicles substantially, while addressing safety concerns such as the risk of fire. The Department noted that the degree to which different battery technologies are adopted will also depend on other factors, such as health and safety and sustainability.[273] It stated that its forthcoming UK Battery Strategy will focus on batteries for mobility, energy storage and industrial applications.[274]

Table 2: Next-generation battery technologies

Type	Benefits	Potential applications
Sodium-ion	Less expensive, due to abundant and easily accessible materials	Sodium-ion batteries have a lower energy density than lithium-ion batteries. These batteries are expected to be well suited to energy and grid-level storage and possibly a range of other applications.

267 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023
268 House of Lords Science and Technology Committee, Battery strategy goes flat: Net-zero target at risk, 1st Report of Session 2021–22 - published 27 July 2021 - HL Paper 53
269 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023
270 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023
271 Department for Business and Trade (BEV0051)
272 Department for Business and Trade (BEV0051); AMTE Power plc (BEV0034)
273 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023
274 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023

Type	Benefits	Potential applications
Solid-state	Safer, less risk of fires Longer lifespan High energy density Faster charging times	Solid-state batteries offer a substantial improvement in energy-density (45%) over lithium-ion batteries. These batteries could improve the safety of electric vehicles and substantially improve the range of an EV. These could also be used in short-rage aircraft, including aircraft with vertical take-off and landing.
Lithium-sulphur batteries	Lighter, safer and more sustainable.	Where range and weight considerations are more important than cost considerations, lithium-sulphur batteries could be used. The Department told us that these batteries might initially be adopted in high altitude pseudo satellites, drones and unmanned aerial vehicles (including military and civilian). These batteries could, however, be suitable for large vehicles.
Metal-air batteries	Lighter with a higher energy density.	This technology is still being developed. However, the technology could be used across a range of applications.
Redox flow batteries	These batteries are less material-intensive to produce, are safer (e.g. less risk of fires) and experience less degradation over time	Redox flow batteries are particularly suited to stationary storage applications (e.g., grid storage) due to their large size, weight, and suitability for long term storage (long lifetime and minimal degradation).

Sources: Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023; Department for Business and Trade (BEV0051); The Faraday Institution, High-energy battery technologies, January 2020

Commercialising the next generation of battery technologies

82. The UK already has firms that are developing next-generation battery technologies. AMTE, a battery manufacturer based in Scotland, is developing sodium-ion cells for the energy storage market.[275] Faradion is another well-established company specialising in sodium-ion batteries.[276] Ilka Technologies, which is based in Hampshire and originated from the University of Southampton, specialises in solid-state batteries.[277] The Department suggested that the UK has a "significant strategic advantage" in certain new battery technologies, where it could be a frontrunner in commercialisation.[278] The Green Alliance suggested that the UK has an opportunity to develop the next-generation of batteries, especially with its expertise in niche, high-performance vehicles that could be an early-adopter of such technologies.[279] It added that developing intellectual property in these new technologies would help the industry to retain battery manufacturers and grow.[280] However, we heard that although the UK excels at innovation, it struggles to ensure that new technologies are commercialised in the UK.[281] Benchmark Mineral Intelligence told us:

275 AMTE Power plc (BEV0034)
276 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023
277 Ilika Technologies Ltd (BEV0030)
278 Department for Business and Trade, UK Battery Strategy: Call for evidence on the scope and priorities for the UK Battery Strategy, August 2023
279 Green Alliance, Powering up the UK battery industry, September 2023
280 Green Alliance, Powering up the UK battery industry, September 2023
281 Benchmark Mineral Intelligence (BEV0010)

> The UK is one of the world's leading educational and research centres of battery technology, yet there is a significant gap between this educational excellence and wide-spread commercialisation. In short we are missing the middle: we are very good at education, research and creating start up companies in the UK, but have a lack of larger companies and corporations that can industrialise this opportunity.[282]

83. **The UK has potential competitive advantages in new battery technologies. However, despite excelling in innovation, it struggles to ensure that new technologies developed in the UK are commercialised domestically. *The UK Battery Strategy must set out how the Government plans to ensure that new battery technologies, where the UK has a competitive advantage, are commercialised in the UK.***

84. The UK has a battery ecosystem that supports the research, innovation and industrialisation of battery technologies in the UK.[283] That ecosystem includes institutions such as the Faraday Institution, the UK Battery Industrialisation Centre and the Advanced Propulsion Centre as well as schemes such as the Faraday Battery Challenge. In 2021, the House of Lords Science and Technology Committee recommended that funding for the research and development of batteries should be "increased and put on a long-term footing" to ensure that the UK remains globally competitive.[284] The Lords Committee added that "proposals for additional funding for research and development in the UK should be seen in the context of the Government's ambition for the UK to be a 'science superpower'."[285]

85. ***The UK Battery Strategy should include long-term support for research and development of new battery technologies in the UK to ensure the UK remains at the cutting-edge of battery technologies.***

86. Some witnesses argued that the UK could leapfrog competitors by focusing on the next-generation of battery technologies.[286] However, such a development could be difficult to achieve without first establishing a domestic industrial base for lithium-ion batteries.[287] Jeff Pratt from the UK Industrialisation Centre told us:

> If you look at where the technology is at the moment, it is evolutionary, not revolutionary….the sunk cost in the gigafactory is absolutely massive, so the manufacturers do not want to scrap the asset. The asset has a massive value, so they want to change the asset gradually over time. A rule of thumb we used to use is that there is about a 20% change for the next-generation battery in terms of investment. I do not think it is a massive risk now—and you have to put a stake in the ground and go at some time.[288]

282 Benchmark Mineral Intelligence (BEV0010)
283 UK Battery Industrialisation Centre (BEV0028); Department for Business and Trade (BEV0051)
284 House of Lords Science and Technology Committee, Battery strategy goes flat: Net-zero target at risk, 1st Report of Session 2021–22 - published 27 July 2021 - HL Paper 53
285 House of Lords Science and Technology Committee, Battery strategy goes flat: Net-zero target at risk, 1st Report of Session 2021–22 - published 27 July 2021 - HL Paper 53
286 House of Lords Science and Technology Committee, Battery strategy goes flat: Net-zero target at risk, 1st Report of Session 2021–22 - published 27 July 2021 - HL Paper 53
287 Green Alliance, Powering up the UK battery industry, September 2023
288 Q119 [Jeff Pratt]

87. **The UK may not be able to simply leapfrog into new technologies without first establishing itself in the lithium-ion battery industry. That conclusion reinforces the importance of acting at pace now to develop a battery supply chain in the UK.**

Annex 1: EU-UK Rules of Origin requirements

From 1st January 2024, automotive manufacturers in the UK and the EU need to comply with stricter rules of origin requirements for electric vehicles to continue to benefit from tariff-free trade between these markets. For example, under the Trade and Cooperation agreement, electric cars that fail to meet these requirements will be subject to a 10% tariff.[289] These rules are due to tighten again from 1st January 2027.

The rules of origin requirements stipulate the value of content for electric vehicles, but also battery packs and battery cells, that must be sourced from the UK and/or EU for electric vehicles to be traded tariff-free. Up to 31 December 2023, 60% of the value of electric vehicles, including hybrids, sold between the UK and the EU can come from non-originating materials. The maximum value of non-originating content is due to fall to 55% from 1st January 2024 and then to 45% from 1st January 2027.[290] This means that from 2027 the majority of the value of an electric vehicle needs to be sourced within the UK and/or the EU to be eligible for tariff-free trade.

The Trade and Cooperation Agreement also includes rules of origin requirements for batteries used in electric vehicles, including battery packs and battery cells.[291] From 1st January 2024, only 50% of the value of battery cells can be sourced from outside the UK and/or the EU. From 1st January 2027 onwards, just 35% of the value of a battery cells can be derived from non-originating content.[292] Battery packs need to have 60% of originating content from 1st January 2024. By 2027, just 30% of the value of battery packs can be sourced from non-originating content.[293]

The rules of origin requirements are designed to localise more of the supply chain for electric vehicles, including batteries, in Europe. However, to allow enough time for a supply chain to develop, the EU and the UK decided to phase-in these requirements over several years. The then Parliamentary Under Secretary of State for Business, Energy and Industrial Strategy, Nadhim Zahawi MP, informed the House in March 2021 that "the phased approach to rules of origin for batteries" would give "industry time to localise supply chains for electrified vehicles."[294] These phase-in dates were informed by policy advice given to ministers during the negotiations and were developed in consultation with stakeholders to account for the needs of supply chains in the UK and EU.[295] Representatives from the UK's automotive industry, however, told us that the sector called for a longer timeframe given the length of time it takes value chains to develop.[296] They added that much of such development is outside of the automotive industry's ability to control.[297]

Tighter rules of origin requirements have prompted some car manufacturers to localise their supply chain. Nissan, for example, told us that the tighter rules of origin were "a

289 Different vehicles are subject to different levels of tariff.
290 Green Alliance, Powering up the UK's battery industry: Annexes, September 2023
291 Green Alliance, Powering up the UK's battery industry: Annexes, September 2023
292 Green Alliance, Powering up the UK's battery industry: Annexes, September 2023
293 Green Alliance, Powering up the UK's battery industry: Annexes, September 2023
294 PQ 160801 [Electric vehicles: UK trade with the EU], answered on 9 March 2021
295 PQ 156034 [UK-EU Trade and Cooperation Agreement] answered on 7 March 2023; Q25
296 Q81 [Konstanze Scharring];
297 Q101 [[Konstanze Scharring]; Q83 [David Wong]

driving consideration behind Nissan's partnership with Envision to build the gigafactory in Sunderland."[298] However, many OEMs, in the UK and the EU, will not meet the stricter requirements that are due to be phased-in from January 2024.[299] Stricter requirements for batteries, for example, are affecting the ability of OEMs to comply with the rules at the electric vehicle level.[300] The automotive sector has raised concerns about its ability to meet these requirements for some time. told us that this has been a key issue at the Automotive Council—a joint industry and government council—for the last year and a half.[301]

Part of the problem is that the supply chain for electric vehicle batteries across Europe has not developed fast enough to allow many OEMs to comply.[302] The supply chain, for example, remains heavily concentrated in Asia (See Chapter 2).[303] David Wong from the SMMT explained that "quite a lot of the early stages of cell production and, even before cell production, the midstream refining of materials, are almost non-existent in the EU (and UK). They are ramping up, but just not quickly enough."[304] The European Automobile Manufacturers' Association (ACEA) told the European Commission that the industry only had three-years after the Trade and Cooperation Agreement was signed before restrictive rules of origin for batteries were introduced. This, they argued, is "simply too short for all players in complex and capital-intensive supply chain to be able to plan and execute investments."[305] External factors, such as spikes in the cost of raw materials, have made it harder for OEMs to meet the 2024 requirements.[306] Stellantis, for example, told us:

> When we decided on our footprint for 2024 production (decision confirmed in 2021), we had planned on meeting the Regional Value Content of the vehicles at 45% to avoid import duties on trade flows between the EU and UK. Due to the various external headwinds, the prices of raw materials which is all none originating increases substantially, that we are now unable to meet these Rules of Origin.[307]

The introduction of a tariff on electric vehicles will negatively affect trade in both directions across the Channel, at an estimated cost of £4.3billion.[308] UK-based OEMs will suffer to varying degrees due to a range of factors, such as the extent of their trade with the EU. However, on average, the SMMT has estimated that the price of battery electric vehicles made in the UK and sold in Europe would increase by £3,600, whereas vehicles made in Europe and sold in the UK would increase in price by an average of £3,400.[309] Production of electric vehicles could also suffer from a 10% tariff too.[310] The SMMT point out that

298 Nissan Motors UK (BEV0045)
299 Ford, Vauxhall owner and JLR call for UK to renegotiate Brexit deal, The Guardian, 17 May 2023; Stellantis (BEV0001); ACEA, ACEA response to European Commission questionnaire on battery rules of origin, June 2023;
300 ACEA, ACEA response to European Commission questionnaire on battery rules of origin, June 2023
301 Q129 [Fred Perry]
302 Q49 [Ian Constance], 49 [Alan Hollis], Got Brexit done? Now sort electric car 'cliff-edge,' UK and EU told, Politico, 2 May 2023
303 Q49 [Ian Constance]
304 Q82 [David Wong]
305 ACEA, ACEA response to European Commission questionnaire on battery rules of origin, June 2023
306 Society of Motor Manufacturers and Traders (SMMT) – (BEV0043); Q51 [Stephen Gifford], Q81 [Konstanze Scharring]
307 Stellantis (BEV0001)
308 SMMT, Agreement with Europe needed to avoid £3,400 electric vehicle tax hike, October 2023
309 SMMT, Agreement with Europe needed to avoid £3,400 electric vehicle tax hike, October 2023
310 The European Automobile Manufacturers Association (ACEA), for example, has projected that in a worst-case scenario production of electric vehicles in the EU could fall by almost 480,000 units over a three-year period.

uncompetitive vehicles could leave the market, thereby reducing consumer choice.[311]

Unlike electric vehicles, petrol and diesel vehicles sold between the UK and the EU will not face a tariff.[312] Therefore, proceeding with stricter rules of origin requirements raises the cost of electric vehicles relative to petrol and diesel cars and vans at a time when the UK, together with governments across Europe, want to encourage consumers to buy zero emission vehicles.[313] Another unintended consequence of these stricter rules of origin is that UK and EU manufacturers risk losing market share to cheaper electric vehicles exported from China. The Minister of State told us that China would be the greatest beneficiary if the EU and UK fail to agree a change to the rules.[314]

Automotive manufacturers in the UK and the EU have called for an extension of the current rules of origin requirements until 2027.[315] The UK Government is reportedly in favour of a 3-year extension of the existing rules—a position shared by Germany and other Member States.[316] The European Commission has previously resisted calls to extend the deadline in order to continue to encourage investment into Europe.[317] Vice-President of the European Commission, Maroš Šefčovič, recently told The Financial Times that rules of origin would be loosely applied in 2024.[318] Negotiations between the UK and the EU are ongoing. The Minister of State told us she does not expect these negotiations to be concluded until shortly before the deadline.[319]

We fully support the intention behind the rules of origin requirements to localise more of the electric vehicle supply chain across Europe. However, the UK Government and the European Commission have under-estimated the timeframe required for these supply chains to develop. Introducing stricter rules of origin requirements from 1st January 2024 could lead to serious unintended consequences for the UK and the EU. Placing a 10% tariff on electric cars, but not on petrol and diesel cars, would send the wrong message to consumers who should be encouraged to buy zero emission vehicles. Manufacturers, in the UK and the EU, are also at risk of losing market share to cheaper electric vehicles imported from China. *We strongly recommend that the UK and the EU agree at least a three-year extension of the current rules of origin requirements to allow more time for a supply chain in Europe to develop.*

311 SMMT, Agreement with Europe needed to avoid £3,400 electric vehicle tax hike, October 2023
312 SMMT, Agreement with Europe needed to avoid £3,400 electric vehicle tax hike, October 2023
313 Q101 [Konstanze Scharring]; Q120 [Nusrat Ghani]
314 Q123 [Minister Ghani]
315 Ford, Vauxhall owner and JLR call for UK to renegotiate Brexit deal, The Guardian, 17 May 2023; Ford statement on the Rules of Origin from Tim Slatter, Ford Britain Chair, Ford, 18 May 2023; Delay EU tariffs to help sales of electric cars, says UK car industry, The Guardian, 18 October 2023
316 EU to loosen new rules on EV sales in attempt to defuse row with UK, The Financial Times, 6 October 2023
317 Michel Barnier calls for post-Brexit UK-EU defense treaty, Politico, 1 August 2023; Brussels to stick with plan for post-Brexit tariffs on UK EV imports from 2024, The Financial Times, 5 July 2023
318 EU to loosen new rules on EV sales in attempt to defuse row with UK, The Financial Times, 6 October 2023
319 Q133 [Minister Ghani]

Annex 2: Britishvolt

Britishvolt, a UK battery startup, was formed in 2019, with the aim of developing and manufacturing high-performance, sustainable battery cells in the UK.[320] The company had started developing prototype battery cells and was in the process of building a 30GWh gigafactory near Blyth in Northumberland. Britishvolt had some initial success. The company achieved unicorn status in September 2021[321], with a £800 million valuation.[322] Britishvolt, received a final offer of government support through the Automotive Transformation Fund in July 2022. However, after struggling to raise investment, the company entered administration in January 2023.

Britishvolt's strategy and management

EY, the company's administrators, explained that Britishvolt's management had decided to pursue a dual track strategy. This entailed attracting equity investment at the same time as developing prototype batteries and building a gigafactory and research and development facilities.[323] Britishvolt needed to raise substantial amounts of funding to finance the development of the business. Britishvolt's management, for example, had planned to raise £800m of equity in 2022, followed by a further £1.7bn in future years.[324]

We heard that Britishvolt had assembled a credible team of battery specialists who made a lot of progress, within in a relatively short space of time, to develop a viable product.[325] Britishvolt had, for example, shared samples and prototypes with OEMs in order to try to secure commitments from them.[326] OEMs showed some interest. The company had signed memorandums of understanding with Lotus and Aston Martin and was in discussion with other OEMs.[327] The memorandums of understanding with Lotus and Aston Martin, however, did not guarantee any orders. At the time Britishvolt entered administration, EY confirmed that the company had no registered intellectual property and was not expecting to generate revenue in the short-term.[328]

Gigafactory site and construction

Britishvolt's gigafactory site in Cambois, near Blyth in Northumberland, is thought to be one of the best locations for a gigafactory in Europe. The 93-hectre site was once home

320 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023

321 Unicorn status refers to a privately held startup company that is valued over $1billion. For more information see Unicorn: What It Means in Investing, With Examples, Investopedia, 29 April 2023

322 Britishvolt joins unicorns, The Times, 16 September 2021

323 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023

324 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023

325 Q84 [Jeff Pratt] Q69 [Ian Constance]

326 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023

327 Britishvolt & Lotus Sign Mou to Collaborate on Next Generation Battery Cells Specific to Lotus Requirements, Batteries News, 28 January 2022; Aston Martin inks deal to develop EV batteries with UK start-up Britishvolt, CNBC, 7 March 2022; EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023

328 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023

to a power station and has good access to energy through an undersea interconnector.[329] The site also has good rail links and is close to a deep-sea port. Britishvolt selected the Cambois site in December 2020, before purchasing the site for around £4million in April 2021.[330] Construction of the gigafactory started in summer 2021, shortly after the company received planning permission. However, in August 2022, The Guardian reported that construction of the gigafactory would be "severely limited" until February 2023 to "minimise spending" while the company focused on "unlocking its next round of funding and critical power supply infrastructure."[331]

Government support

On 21 January 2022, the Government announced an in principle offer of government funding for Britishvolt via the Automotive Transformation Fund. Britishvolt was offered £100m through the fund. After this announcement, the Government carried out a due diligence process before a final grant offer was made on 27 July 2022.[332] The Government has explained that the due diligence process is used for all ATF applications to "test key assumptions" such as those which "underpin the value for money analysis, viability, compliance with subsidy control and wider legal requirements," which is necessary to ensure "awards are robust and protect taxpayers' interests."[333]

The Government stated that this funding would "help to unlock a significant amount of further support from private investors."[334] The ATF funding was due to be paid in instalments, subject to certain milestones and conditions being met. The Government, however, has not published the milestones that Britishvolt needed to meet. The Minister of State, Nusrat Ghani MP, told the House of Commons it would "not be appropriate to go further into the details of this matter" because there are "significant commercial sensitivities related to funding arrangements for potential future grant awards."[335] EY noted that Britishvolt was "unlikely to be able to meet the spending milestones required to release the first grant instalment without first obtaining significant additional third-party investment."[336]

Financial difficulties

After struggling to attract investment, Britishvolt experienced financial difficulties towards the end of the summer and early autumn last year. The company had managed to raise £167.5m of equity investment, along with a further £33.8m in unsecured debt finance, which consisted of loans and convertible loan notes.[337] However, numerous funding targets were missed. Britishvolt entered emergency fundraising talks in October 2022, with a view raising enough money to help fund the company until it could secure orders from

329 Britishvolt in emergency funding talks to avoid pre-Christmas collapse, The Financial Times, 14 October 2022
330 Britishvolt in emergency funding talks to avoid pre-Christmas collapse, The Financial Times, 14 October 2022.
331 Huge UK electric car battery factory on 'life support' to cut costs, The Guardian, 12 August 2022
332 Department for Business, Energy and Industrial Strategy, Final grant offer provided to Britishvolt, 27 July 2022; PQ HL4929 [Britishvolt: Insolvency] answered on 2 February 2023
333 PQ 149460 [Britishvolt: Insolvency] answered on 24 February 2023
334 Department for Business, Energy and Industrial Strategy, Government backs Britishvolt plans for Blyth gigafactory to build electric vehicle batteries, 21 January 2022
335 PQ 149460 [Britishvolt: Insolvency] answered on 24 February 2023
336 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023
337 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023

OEMs. Specifically, reports suggested that Britishvolt needed to raise around £200million to fund the company until the summer of 2023, when it was expecting to receive its first orders.[338] EY explained that the company encountered a series of pinch points towards the end of 2022, but managed to secure "relatively small amounts of additional equity investment and other financing" to enable it to continue.[339]

Rescue bids were put forward to seek to prevent the company from going into administration. However, these risked significantly diluting existing shareholders. Britishvolt reportedly requested advances on the government support that was offered via the Automotive Transformation Fund.[340] However, as already noted, the Government required the company to meet certain milestones to access this funding. Graham Stuart, the then Minister for Energy and Climate, told the House of Commons that no funds had been paid to Britishvolt. In response to an Urgent Question, he explained that:

> […] we offered significant support to Britishvolt through the automotive transformation fund on the condition that key milestones, including private sector investment commitments, were met. Unfortunately, the company was unable to meet these conditions and as a result no ATF funds were paid out. Throughout the process, we have always remained hopeful that Britishvolt would find a suitable investor and we are disappointed that this has not been possible. We want to ensure the best outcome for the site, and we will work closely with the local authority and potential investors to achieve this.[341]

Britishvolt's financial difficulties coincided with a challenging period for the UK economy. Dr Graham Hoare, the then Chief Executive of Britishvolt, told The Financial Times that "market conditions" in the UK had "radically changed," which led potential investors to pull out "at the last minute."[342] More specifically, EY added Britishvolt's management found that:

> the geopolitical crises, spiking energy prices and general macroeconomic instability had closed equity markets to the opportunity offered by BV, given the significant investment required and the time needed for the business to generate its first material revenue.[343]

Britishvolt eventually entered administration on 17 January 2023. Britishvolt was sold to Recharge Production UK Limited, a newly incorporated subsidiary of Scale Facilitation, a financial services firm, for under £8.6m on 26 February 2023.[344]

338 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023
339 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023
340 Battery maker Britishvolt falls into administration, The Times, 18 January 2023
341 HC Deb Wednesday 18 January 2023, col 367 [Commons Chamber]
342 Britishvolt in emergency funding talks to avoid pre-Christmas collapse, The Financial Times, 14 October 2022
343 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023
344 EY, Power by Britishvolt Limited (in Administration) ("the Company") Administrators' statement of proposals, 13 March 2023

Conclusions and recommendations

Gigafactories in the UK

1. *In the forthcoming UK Battery Strategy, the Government should specify the extent to which future demand for batteries in the UK should be supplied by domestic sources in 2030 and 2040, along with a 10-year plan for scaling-up this capacity and an estimate of the public money required to do so. To match our competitors, the UK Government should consider targeting at least 90% of the UK's annual demand for batteries to be met from domestic supplies by 2030.* (Paragraph 16)

2. *The UK needs gigafactories that can cater for the diverse array of vehicles, including luxury cars, public transport and commercial vehicles, manufactured in this country. Retaining niche segments of the automotive market in the UK is strategically important, because the highly specialised nature of these vehicles provides an opportunity to encourage innovative battery manufacturers into the UK. The UK also has an opportunity to take the lead in supplying forms of transport (rail, maritime, aviation and micro-mobility) and sectors of the economy (e.g. energy storage and military applications), which are expected to see demand for batteries rise, especially from 2030 onwards. To capitalise on these opportunities, the Government should:*

    - *outline, in the Advanced Manufacturing Plan, what UK battery manufacturing capacity will be needed to cater for the diverse needs of niche segments of the automotive industry, and by when, together with the measures required to secure this.*

    - *support battery manufacturers looking to supply batteries to non-automotive sectors by stimulating demand for batteries in these industries and ensuring government support is available to manufacturers targeting these market segments.* (Paragraph 17)

3. Encouraging a competitive mix of battery manufacturers to locate in the UK will help to build the supply chain while capturing intellectual property from new technologies. *The Advanced Manufacturing Plan and UK Battery Strategy must set out how the Government plans to attract established battery manufacturers as well as new entrants to the battery market to build gigafactories in the UK. Those plans could include a twin-track process for access to financial support to reflect the differences between firms at different stages of development.* (Paragraph 23)

4. Having secure orders from an anchor customer is critical if battery manufacturers are going to raise sufficient funds to build a gigafactory. Offtake agreements between OEMs and battery manufacturers help signal to investors that there is demand for their product. *The Advanced Manufacturing Plan and UK Battery Strategy should set out ways in which the Government could help to facilitate offtake agreements between OEMs and battery manufacturers.* (Paragraph 26)

5. There are limited number of potential gigafactory sites—but we have enough sites in the UK to meet the nation's needs, including sites in the UK's key automotive clusters. *These sites are strategic national assets and should be treated as such. The Government must designate gigafactory sites as strategically important sites and*

work with local partners to put together a targeted package of support, with a view to attracting investors and ensuring gigafactories can be built at pace. These sites should be given priority for improvements to energy and transport infrastructure. The Government should work with local partners to grant those areas special economic status. (Paragraph 29)

6. Building a gigafactory will require support from central Government Departments, local authorities and private companies such as National Grid. The transaction cost of co-ordinating between these bodies should not fall on investors. A single project office integrating the full panoply of public support drawn from the various bodies involved is required, and the Department for Business and Trade should take on that lead role, as 'gold command'. (Paragraph 30)

Tata Group, Agratas and Jaguar Land Rover (Box 2)

7. Tata Group's plans to build a gigafactory in the UK provide a much-needed boost to the UK's gigafactory pipeline, especially after Britishvolt's administration earlier this year. We congratulate the Department on its efforts to secure this investment, following close competition from other markets. However, we reiterate our preference that the scale and scope of support offered to Jaguar Land Rover should be in the public domain.

8. We are pleased that this new gigafactory will supply batteries to Jaguar Land Rover's suite of electric vehicles built in the UK. However, we would welcome more clarity on the extent to which this facility can be expanded to cater for other manufacturers, within and outside the automotive industry.

Battery supply chain

9. It is not feasible or desirable to onshore the end-to-end battery supply chain. The UK cannot have a self-sufficient supply of lithium-ion batteries and will continue to rely to some degree on imports of raw minerals, materials and components. However, building the UK's industrial capabilities across the battery supply chain, and especially in midstream processes such as the refining of raw minerals and the manufacture of cathodes and anodes, will confer strategic advantages. *The Government should specify the industrial capabilities within the UK battery supply chain that are strategically critical to onshore along with new interventions that will encourage relevant businesses to locate in the UK. Such specifications could be set out either in the forthcoming UK Battery Strategy or in response to this Report.* (Paragraph 50)

10. Global battery supply chains, and especially the upstream supply of critical minerals, have environmental, social and governance challenges. Those supply chains are concentrated in China. The UK's dependence on those supply chains poses risks to the UK and to the Government's strategic objectives, especially if China were to restrict exports of the materials and components that the UK needs. It is critical that the UK Government continues to collaborate internationally not only to diversify the battery supply chain, but to ensure that batteries are produced to high environmental and social standards. (Paragraph 51)

11. The UK Battery Strategy should set out how the Government plans to promote robust environmental, social and governance standards across the battery industry domestically and globally to promote transparency and a green and clean battery supply. (Paragraph 52)

12. A battery supply chain in the UK would enable businesses based in this country to manufacture batteries sustainably and ethically. This offers the UK a competitive advantage over other markets, especially as consumers demand higher environmental, social and governance standards. The UK's access to low-carbon sources of electricity means that batteries produced in the UK will be produced more sustainably than those in China and many European countries. *The Government should empower UK consumers by requiring batteries available on the UK market to come with a battery passport containing information about how sustainably and ethically those batteries were produced.* (Paragraph 53)

Encouraging investment into the battery supply chain in the UK

13. Global competition for the electric vehicle supply chain has intensified following the passing of the Inflation Reduction Act in the United States. The Inflation Reduction Act has seen investment flow into the electric vehicle supply chain, especially gigafactories, in the United States at the expense of Europe. *The UK Government must urgently respond to this intensified global competition with an internationally competitive package of long-term support to attract private investment into gigafactories and the wider battery supply chain within the UK.* (Paragraph 62)

14. The UK is competing against other large markets that are offering large subsidies to boost domestic production of electric vehicles and batteries and onshore businesses in the supply chain. The UK Government does not necessarily need to match the scale of subsidies on offer in these markets if the UK's overall package is internationally competitive. However, *the UK Government must provide a long-term stable business environment, with a clear framework of support that de-risks investments in the UK's battery supply chain.* (Paragraph 63)

15. The absence of a clear and visible industrial strategy for the UK's automotive sector had deterred investment in the UK. The forthcoming publication of the Government's Advanced Manufacturing Plan and UK Battery Strategy should help to address that lack of investment. *The Government should adopt an integrated approach, with measures to develop industrial capabilities across the battery value chain and to collaborate internationally with friends and partners with rich sources of battery minerals. The Advanced Manufacturing Plan and UK Battery Strategy must set out how the Government plans to capitalise on the UK's sources of competitive advantage and also to address structural barriers that are deterring investment in the UK's battery supply chain.* (Paragraph 66)

16. The Automotive Transformation Fund has helped to unlock private investment into the UK, including in gigafactories and businesses further up the supply chain. However, now global competition has intensified, the UK Government needs to ensure that financial support on offer in the UK is internationally competitive. *The Government should conduct a benchmarking review to determine how the financial*

support on offer compares with that available in competitor countries. It should publish this review and use the findings to inform a new offer of support for the UK's battery industry in its forthcoming UK Battery Strategy. (Paragraph 71)

17. High energy prices in the UK are deterring investment in the battery supply chain. The Government has taken steps to support energy-intensive industries. However, investors still need more certainty that UK energy prices will remain internationally competitive. *The Advanced Manufacturing Plan and UK Battery Strategy should set out further interventions that will provide investors with more long-term certainty that the UK's energy prices will be competitive with other markets.* (Paragraph 74)

18. The UK faces skills shortages across the battery supply chain. *The Advanced Manufacturing Plan and UK Battery Strategy should set out:*

    a) *the forecast labour market involved in reaching its targets for UK-supplied batteries*

    b) *the forecast training cost for this workforce; and*

    c) *how they plan to train and reskill professionals in the automotive sector to support domestic production of electric vehicles, batteries and other processes in the battery supply chain, including through devolution of the requisite training budgets to local areas.* (Paragraph 76)

19. *The Government should ensure that mayoral combined authorities or local councils—especially those that govern strategically important sites where gigafactories could be built—have adequate and flexible funding to tailor support local training programmes. Offers of financial support to businesses in the battery supply chain should be conditional on these companies investing in upskilling and reskilling employees from the automotive industry and other sectors.* (Paragraph 77)

20. The UK Government's trade policy should aim to secure tariff-free access to global markets for electric vehicles and batteries manufactured in the UK. (Paragraph 79)

Commercialising the next generation of battery technologies

21. The UK has potential competitive advantages in new battery technologies. However, despite excelling in innovation, it struggles to ensure that new technologies developed in the UK are commercialised domestically. *The UK Battery Strategy must set out how the Government plans to ensure that new battery technologies, where the UK has a competitive advantage, are commercialised in the UK.* (Paragraph 83)

22. *The UK Battery Strategy should include long-term support for research and development of new battery technologies in the UK to ensure the UK remains at the cutting-edge of battery technologies.* (Paragraph 85)

23. The UK may not be able to simply leapfrog into new technologies without first establishing itself in the lithium-ion battery industry. That conclusion reinforces the importance of acting at pace now to develop a battery supply chain in the UK. (Paragraph 87)

Formal Minutes

Tuesday 14 November 2023

Members present:

Liam Byrne, in the Chair

Ian Lavery

Andy McDonald

Mark Pawsey

Draft Report (*Batteries for electric vehicle manufacturing*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 87 read and agreed to.

Summary agreed to.

Annex agreed to.

Resolved, That the Report be the First Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

[Adjourned till Tuesday 14 November at 9:45am]

Witnesses

The following witnesses gave evidence. Transcripts can be viewed on the inquiry publications page of the Committee's website.

Tuesday 9 May 2023

Simon Moores, Chief Executive, Benchmark Mineral Intelligence; **Jeff Townsend**, Founder, Critical Minerals Association; **Jeremy Wrathall**, Founder and Chief Executive, Cornish Lithium Limited; **Paul Lusty**, Director, UK Critical Minerals Intelligence Centre — Q1–34

Stephen Gifford, Chief Economist, The Faraday Institution; **Alan Hollis**, Chief Executive, AMTE Power plc; **Ian Constance**, Chief Executive, Advanced Propulsion Centre UK — Q35–76

Tuesday 23 May 2023

David Wong, Senior Technology and Innovation Manager, Society of Motor Manufacturers and Traders (SMMT); **Konstanze Scharring**, Director of Policy, Society of Motor Manufacturers and Traders (SMMT); **Jeff Pratt**, Managing Director, UK Battery Industrialisation Centre; **Andy Palmer**, Former Chief Executive Officer at Aston Martin, Former Chief Operations Officer at Nissan and Chairman of InoBat — Q77–119

Tuesday 12 September 2023

Ms Nusrat Ghani MP, Minister for Industry and Economic Security, Department for Business and Trade; **Fred Perry**, Director, Advanced Manufacturing, Department for Business and Trade; **Edmund Ward**, Deputy Director, Industrial Decarbonisation, Department for Energy Security and Net Zero — Q120–172

Published written evidence

The following written evidence was received and can be viewed on the inquiry publications page of the Committee's website.

BEV numbers are generated by the evidence processing system and so may not be complete.

1 AMTE Power plc (BEV0053)

2 AMTE Power plc (BEV0034)

3 Advanced Propulsion Centre UK Limited (BEV0047)

4 Allan, Mr Peter (Business Consultant, Guernsey Scientific and Electrical Ltd.); and Tostevin, Ms Lorraine (Company Secretary, Guernsey Scientific and Electrical Ltd.) (BEV0006)

5 Anti-slavery International (BEV0015)

6 Balance Batteries Ltd (BEV0041)

7 Benchmark Mineral Intelligence (BEV0010)

8 British Occupational Hygiene Society (BEV0048)

9 CPI (BEV0024)

10 Cornish Lithium Limited (BEV0042)

11 Critical Minerals Association (BEV0046)

12 Cross Sector Battery Systems Innovation Network Advisory Board (BEV0025)

13 Danecca Ltd (BEV0031)

14 Department for Business and Trade (BEV0051)

15 Dobson, Professor Peter (Professor Emeritus of Engineering Science, Oxford University) (BEV0004)

16 Faraday Battery Challenge, part of UK Research and Innovation (BEV0032)

17 Finch, Professor Adrian (Professor of Geology, University of St Andrews) (BEV0019)

18 Green Alliance (BEV0021)

19 Green Lithium Refining Limited (BEV0014)

20 Henry, Professor Ian (Managing Director, AutoAnalysis) (BEV0009)

21 Ilika Technologies Ltd (BEV0030)

22 InoBat (BEV0037)

23 Intelligent Energy (BEV0020)

24 Livent (BEV0049)

25 Midlands Engine (BEV0022)

26 myenergi (BEV0013)

27 Newcastle University (BEV0026)

28 Nissan Motors UK (BEV0045)

29 Nordberg, Mr Anthony (Consultant, EWAY.DIRECT LTD; and Consultant, EWAY.DIRECT LTD) (BEV0027)

30 Nyobolt (BEV0036)

31 Palmer, Dr Andy (Former Chief Executive and Chief Operations Officer, Aston Martin, Nissan) (BEV0008)

32 Pestell, Karl (Director, RGJ Consulting) (BEV0039)

33 Research by British Lithium Limited (BEV0016)

34 Society of Motor Manufacturers and Traders (SMMT) (BEV0043)

35 Srinivasan, Mr Vignesh (PhD Research Scholar, UMPEDAC, Universiti Malaya) (BEV0005)

36 Stellantis (BEV0001)

37 The Faraday Institution (BEV0011)

38 The MTC (BEV0029)

39 The Trades Union Congress (BEV0003)

40 Trackwise Designs plc (BEV0002)

41 Transport & Environment (BEV0012)

42 UGB Ltd (BEV0038)

43 UK Battery Industrialisation Centre (BEV0028)

44 Venegas, Mrs Melissa (PhD candidate, Aston University); Matopoulos, Dr Aristides (Professor of Supply Chain Design, Cranfield University); and Greasley, Dr Andrew (Lecturer, Aston University) (BEV0018)

45 Vertical Aerospace (BEV0023)

46 WAE Technologies Limited (BEV0035)

47 Watercycle Technologies Ltd (BEV0040)

48 West Midlands Combined Authority (BEV0033)

49 West Midlands Gigafactory (BEV0017)

50 ZPN Energy Limited (BEV0007)

List of Reports from the Committee during the current Parliament

All publications from the Committee are available on the publications page of the Committee's website.

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Number	Title	Reference
1st	Pre-appointment hearing with the Government's preferred candidate for Chair of the Competition and Markets Authority	HC 523
2nd	Draft Legislative Reform (Provision of Information etc. relating to disabilities) Order 2022	HC 522
3rd	Energy pricing and the future of the Energy Market	HC 236
4th	Post-pandemic economic growth: state aid and post-Brexit competition policy	HC 759
5th	The semiconductor industry in the UK	HC 291
6th	The semiconductor industry in the UK: Government response	HC 1115
7th	Royal Mail	HC 1045
8th	Memorandum of Understanding on scrutiny of the Investment Security Unit	HC 1235
9th	UK plc	HC 1120
10th	Post-pandemic economic growth: UK labour markets	HC 306
11th	Decarbonisation of the power sector	HC 283
1st Special	Decarbonising heat in homes: Government Response to the Committee's Seventh Report of 2021–22	HC 208
2nd Special	Energy pricing and the future of the energy market: Responses to the Committee's Third Report of Session 2022–23	HC 761
3rd Special	Post pandemic economic growth: State aid and post-Brexit competition policy: Responses to the Committee's Fourth Report of Session 2022–23	HC 1078
4th Special	Revised (Draft) National Policy Statement for Energy: Government response to the Committee's Ninth Report of Session 2021–22	HC 1299
5th Special	State aid and post-Brexit competition policy: Office for the Internal Market response to the Committee's Fourth Report	HC 1302
6th Special	The semiconductor industry in the UK: Further Government response to the BEIS Committee's Fifth Report of Session 2022–23	HC 1404
7th Special	Royal Mail: Responses to the BEIS Committee's Seventh Report of Session 2022–23	HC 1391

Number	Title	Reference
8th Special	UK trade negotiations: Agreement with India: Government response to the International Trade Committee's Fifth Report	HC 1584
9th Special	CPTPP: opportunities and challenges for the UK: Government response to the International Trade Committee's Sixth Report	HC 1614
10th Special	Free Trade Agreement Negotiations with the Gulf Cooperation Council: Government response to the International Trade Committee's Seventh Report	HC 1626

Session 2021–22

Number	Title	Reference
1st	Post-pandemic economic growth: Industrial policy in the UK	HC 385
2nd	Climate Assembly UK: where are we now?	HC 546
3rd	Post-pandemic economic growth: Levelling up	HC 566
4th	Liberty Steel and the future of the UK steel Industry	HC 821
5th	Pre-legislative scrutiny: draft Downstream Oil Resilience Bill	HC 820
6th	Pre-appointment hearing of the Government's preferred candidate for Chair of the Financial Reporting Council	HC 1079
7th	Decarbonising heat in homes	HC 1038
8th	Post Office and Horizon - Compensation: interim report	HC 1129
9th	Revised (Draft) National Policy Statement for Energy	HC 1151
10th	Draft Legislative Reform (Renewal of National Radio Multiplex Licences) Order 2022	HC 1199
1st Special	Decarbonising heat in homes: Government Response to the Committee's Seventh Report of 2021–22	HC 208
2nd Special	Net Zero and UN Climate Summits: Scrutiny of Preparations for COP26—interim report: Government Response to the Committee's Third Report of Session 2019–21	HC 120
3rd Special	Uyghur forced labour in Xinjiang and UK value chains: Government Response to the Committee's Fifth Report of Session 2019–21	HC 241
4th Special	Mineworkers' Pension Scheme: Government Response to the Committee's Sixth Report of Session 2019–21	HC 386
5th Special	Climate Assembly UK: where are we now?: Government Response to the Committee's Second Report	HC 680
6th Special	Post-pandemic economic growth: Industrial policy in the UK: Government Response to the Committee's First Report	HC 71
7th Special	Post-pandemic economic growth: Levelling up: Government Response to the Committee's Third Report	HC 924
8th Special	Liberty Steel and the Future of the UK Steel Industry: Government Response to the Committee's Fourth Report	HC 1123

Number	Title	Reference
9th Special	Pre-legislative scrutiny: draft Downstream Oil Resilience Bill. Government Response to the Committee's Fifth Report	HC 1177
10th Special	Post Office and Horizon – Compensation: interim report. Government Response to the Committee's Eighth Report	HC 1267

Session 2019–21

Number	Title	Reference
1st	My BEIS inquiry: proposals from the public	HC 612
2nd	The impact of Coronavirus on businesses and workers: interim pre-Budget report	HC 1264
3rd	Net Zero and UN Climate Summits: Scrutiny of Preparations for COP26 – interim report	HC 1265
4th	Pre-appointment hearing with the Government's preferred candidate for the Chair of the Regulatory Policy Committe	HC 1271
5th	Uyghur forced labour in Xinjiang and UK value chains	HC 1272
6th	Mineworkers' Pension Scheme	HC 1346
1st Special	Automation and the future of work: Government Response to the Committee's Twenty-third Report of Session 2017–19	HC 240
2nd Special	Future of the Post Office Network: Government Response to the Committee's First Report of Session 2019	HC 382
3rd Special	Safety of Electrical Goods in the UK: follow-up: Government Response to the Committee's second report of Session 2019	HC 494
4th Special	COP26: Principles and priorities—a POST survey of expert views	HC 1000