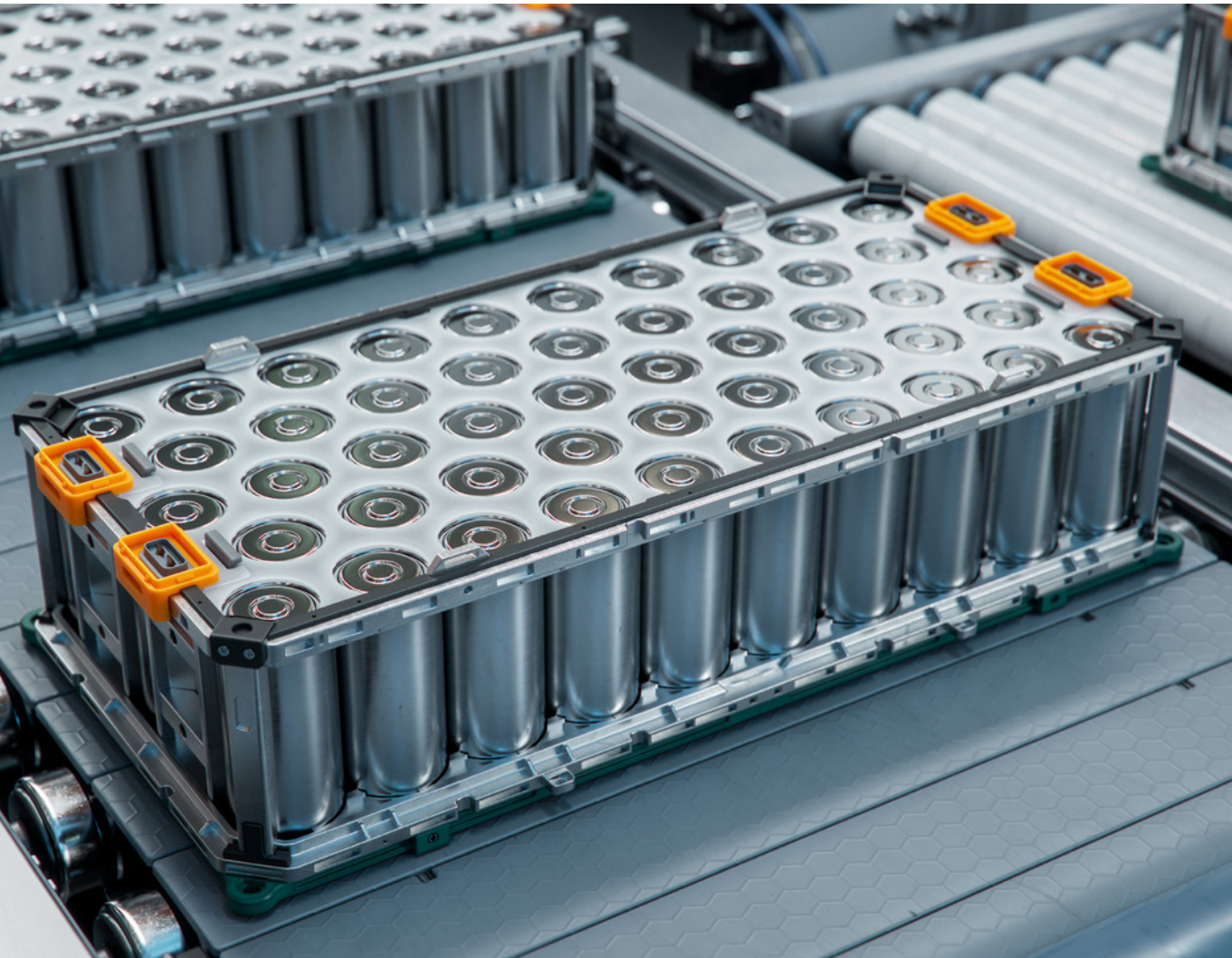
green alliance...

Powering up the UK battery industry



Powering up the UK battery industry

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by Emma Mckelvie and Helena Bennett

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Green Alliance
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Summary

> “The one thing the industry needs more than anything is some certainty from government. A clear strategy will give confidence to developers that the historic British automotive industry is a sound investment choice.”
>
> **Des Quinn, Unite the Union**

This report is one of a series in which Green Alliance is looking in depth at important sectors to determine how the UK can take a lead in the global transition to net zero and improve the country’s economic resilience and sustainability in a rapidly decarbonising world.

The UK’s ambition to increase electric vehicle (EV) uptake has not yet led to a diverse, competitive battery industry. Despite the prospect of domestic sales of new petrol and diesel cars and vans ending in 2030, and global markets shifting quickly towards EVs, the UK still has a cautious approach to investment in EV manufacturing and the battery supply chain that underpins it.

The UK has one operational gigafactory and several more in the pipeline. In contrast, across the EU there are 35 gigafactories, either in development or operation.[1] Recent announcements that the Tata and Jaguar Land Rover gigafactory will be developed in the UK is good news and there is still potential for the Britishvolt site in Blyth to be built.

Attracting investment to scale up the UK’s battery supply chain has become more challenging due to the impact of the US Inflation Reduction Act (IRA) and the EU’s subsequent response, both drawing new investment to their industries. Additionally, forthcoming trade regulations (the Rules of Origin) and the multi-year lead time for investment decisions by vehicle manufacturers are setting a

time limit on the UK's ability to secure its place in this growing global sector.

To build sustainable vehicle manufacturing, the UK will need a broad reaching strategy, covering the entire supply chain, from extracting raw materials to recycling. Certainty, of the kind provided by the US IRA, is critical to attract private investment, even if the scale of subsidy differs, and rapid action is essential for market confidence.

To secure the Jaguar Land Rover gigafactory, the government has reportedly provided a one off, relatively large scale subsidy.[2] Such direct financial incentive is unavoidable given the competitive global market for investment, but subsidies must be accompanied by policy interventions which create an attractive investment environment for potential developers. According to the industry stakeholders we spoke to, these should include measures which address energy costs, secure access to critical raw materials and reduce risks to investors.

A nationwide strategy, encompassing the entire supply chain and all the businesses within it, will lay the groundwork for a successful UK EV industry. It will also lead to lower levels of direct subsidy being needed in the future to retain vehicle manufacturing, and it will reduce decision times for developers and investors, stimulating the industry to scale up more rapidly.

The government should consider where the UK could have a specific advantage, such as new technologies, niche end uses, low carbon, circular production and responsible material sourcing for battery makers, to meet the environmental, social and governance (ESG) concerns of the car industry.

We consulted a variety of industry stakeholders to identify the main barriers to a robust battery industry supply chain in the UK. Success in doing this will bring high skilled jobs, boost the economy, secure the country's automotive sector and support the transition to net zero.

We conclude that a UK battery strategy is required imminently. It should aim to:

1. **Develop a robust UK supply chain through an integrated approach**, ensuring security of critical raw material supply, and introducing stringent standards for mined materials and recycling.
2. **Create a more welcoming environment for developers and investors** through, for example, lower energy costs.
3. **Mobilise public capital to secure private investment**, including faster deployment of government funds through the state sharing the risk of agreements and creating facilities that bridge the investment gap.

Introduction

> “A growing domestic battery industry will provide jobs across the country and increase resilience against geopolitical shocks to the supply chain.”

Despite the UK’s world leading commitment to phase out new petrol and diesel cars and vans by 2030, there is still no coherent strategy to manage the transition away from manufacturing petrol and diesel vehicles towards manufacturing electric vehicles (EVs) and the batteries that power them.

Critical to the production of an EV is a reliable supply of batteries. The UK has not yet entered the battery production market in a significant way, unlike China, the US and the EU. And while the UK could source its batteries from anywhere abroad, this could raise costs significantly due to the forthcoming UK-EU Rules of Origin trade requirements and the cost and difficulty of transporting batteries long distances.

The UK’s piecemeal approach to developing its battery industry so far has also had negative consequences for the sector, such as driving original equipment manufacturers (OEMs) to look abroad for opportunities to produce batteries, shaking the confidence of the private sector and investors in the UK industry’s future.

A growing domestic battery industry will provide jobs across the country, create widespread economic benefits and increase resilience against geopolitical shocks to the supply chain.

The government has alluded to an upcoming strategy for battery production, which will help increase confidence that the UK will become an appealing market for this technology of the future. However, as this has not yet been published and the subsequent uncertainty is making the UK unattractive for investors in the industry.

> **Strong government leadership is needed to show commitment to securing battery production in the UK.”**

Strong government leadership is needed to show commitment to securing battery production in the UK, and a strategy must lay out a series of measures to support development right across the supply chain.

We have gathered evidence from a range of industry experts to discover what is holding the UK back and here we present our conclusions with recommendations for a national battery strategy.

The picture today

“With 780,000 people employed in the automotive sector, a jobs crisis looms.”

Every role in the UK car industry supports another 2.2 jobs in adjacent sectors.[3] If the industry founders, job losses will disproportionately impact some regions; the West Midlands is the location of over a third of UK automotive industry jobs and the source of 41 per cent of gross value added (GVA) from vehicle manufacturing.[4] With 780,000 people employed in the automotive sector and 3,480 businesses directly involved in vehicle and vehicle parts manufacturing, a jobs crisis looms unless the government can secure a sustainable future for the industry.[5]

Eighty per cent of the cars manufactured in the UK are exported. Failing to retain production could see EU exports contract by £10.9 billion and those to China fall by £1.45 billion.[6,7] The value of vehicle manufacturing to the UK is well documented, the sector estimates it could be worth £106 billion in 2030 if the UK establishes EV manufacturing, and that potential value does not include the broader economic advantages associated with the supply chain.[8]

Because transporting batteries is costly and hazardous, more localised production is preferable to reduce risks and costs. Without its own battery manufacturing, the UK could face the slow decline of its car industry as production moves closer to where batteries are made.

Forthcoming Rules of Origin requirements between the UK and EU also mean that, to avoid tariffs, batteries must be made either in the UK or the EU. (More details about the impacts of the Rules of Origin are in the online annexes to this report at bit.ly/45QmhWT).

> “Ensuring the supply of critical raw materials for batteries is vital to support EV manufacturing in the UK”

Battery production will enable security of supply

The war in Ukraine has severely disrupted the global raw materials market, exposing vulnerabilities in the supply chain. The EU and UK have previously relied on Russian nickel and other material imports to produce batteries. The cost of critical raw materials (CRMs) used to make batteries jumped by 50 per cent in the four months after the invasion of Ukraine.[9]

In 2021, China produced 75 per cent of the world’s lithium-ion batteries. It continues to dominate both CRM extraction and processing, accounting for 35 per cent of all nickel processing and 50 to 70 per cent of lithium and cobalt processing.[10,11]

Ensuring the supply of these materials, both domestically and through trade deals, is vital to support EV manufacturing in the UK. It will also allow for more stringent ethical, social and environmental standards to be applied to the materials used.

The rest of the world is getting started

The development of long term, coherent national strategies in other countries, to attract battery and EV manufacturing, is increasing pressure on the UK to follow suit. The most notable is the US Inflation Reduction Act (IRA), which offers financial incentives to US based battery manufacturers and tax credits to purchase EVs with batteries assembled in North America.[12] These incentives are guaranteed until 2032, providing long term policy certainty. And IRA has gone beyond just battery manufacturing, providing incentives in the areas of mining, refining and recycling. One element of the tax credits available is conditional on half a battery’s CRM content being sourced in the US or from a country with which the US has a free trade agreement.[13] Although the UK is, in theory, eligible for this IRA credit, it is currently limited by domestic extraction, refining and recycling capacity.

The EU’s response to IRA has been to set its own targets for domestically produced batteries, as well as for material extraction and processing.[14] State aid rules have been

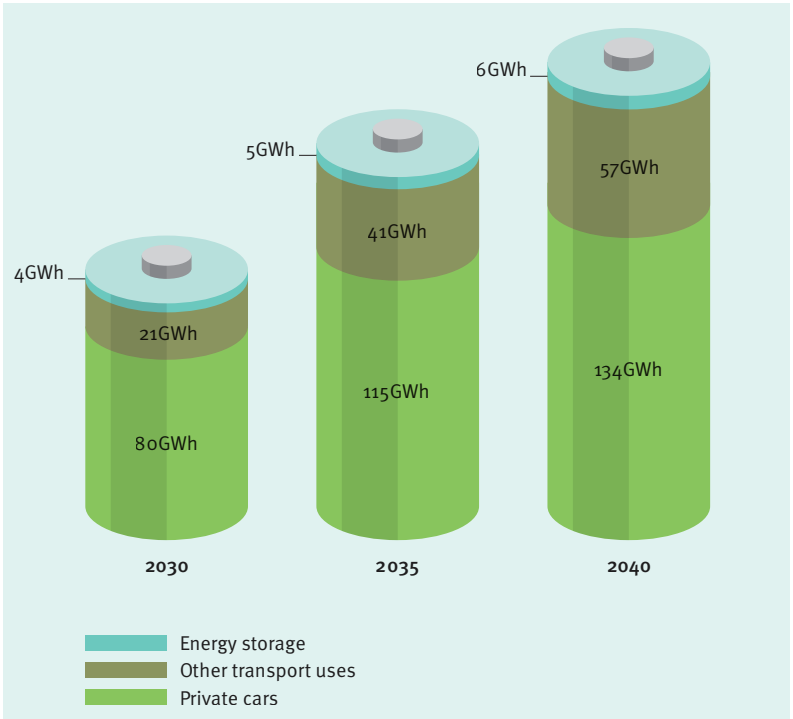
relaxed to improve competitiveness and reduce the EU's reliance on Chinese imports.

The UK lacks equivalent measures and is already feeling the effects, with smaller startups, like Arrival, relocating to more attractive environments.[15]

The UK's place in the race is uncertain

Projections from the Faraday Institution estimate the UK needs 80 GWh of battery production by 2030 to sustain pre-pandemic levels of car manufacturing, increasing to just over 90 GWh when vans are included. This then increases to over 100GWh when other uses, such as grid storage, are included.[16]

Projected UK battery demand[17]



The UK has one operational gigafactory, the Envision Automotive Energy Supply Corporation (AESC) plant in Sunderland, supplying 2GWh of battery capacity, and there are smaller factories, including AMTE Power's site in Thurso. A second Envision AESC plant has been announced for Sunderland, aiming to produce 11GWh in 2025, increasing to

> “Long lead times mean that two or three gigafactories must be confirmed within the next two to three years.”

25GWh in 2030. Jaguar Land Rover has confirmed its new gigafactory in Somerset aims to produce 40GWh. If these plans all begin production on time, progress will be made towards the 100GWh target, but there is still uncertainty about how remaining production needs will be met.[18,19]

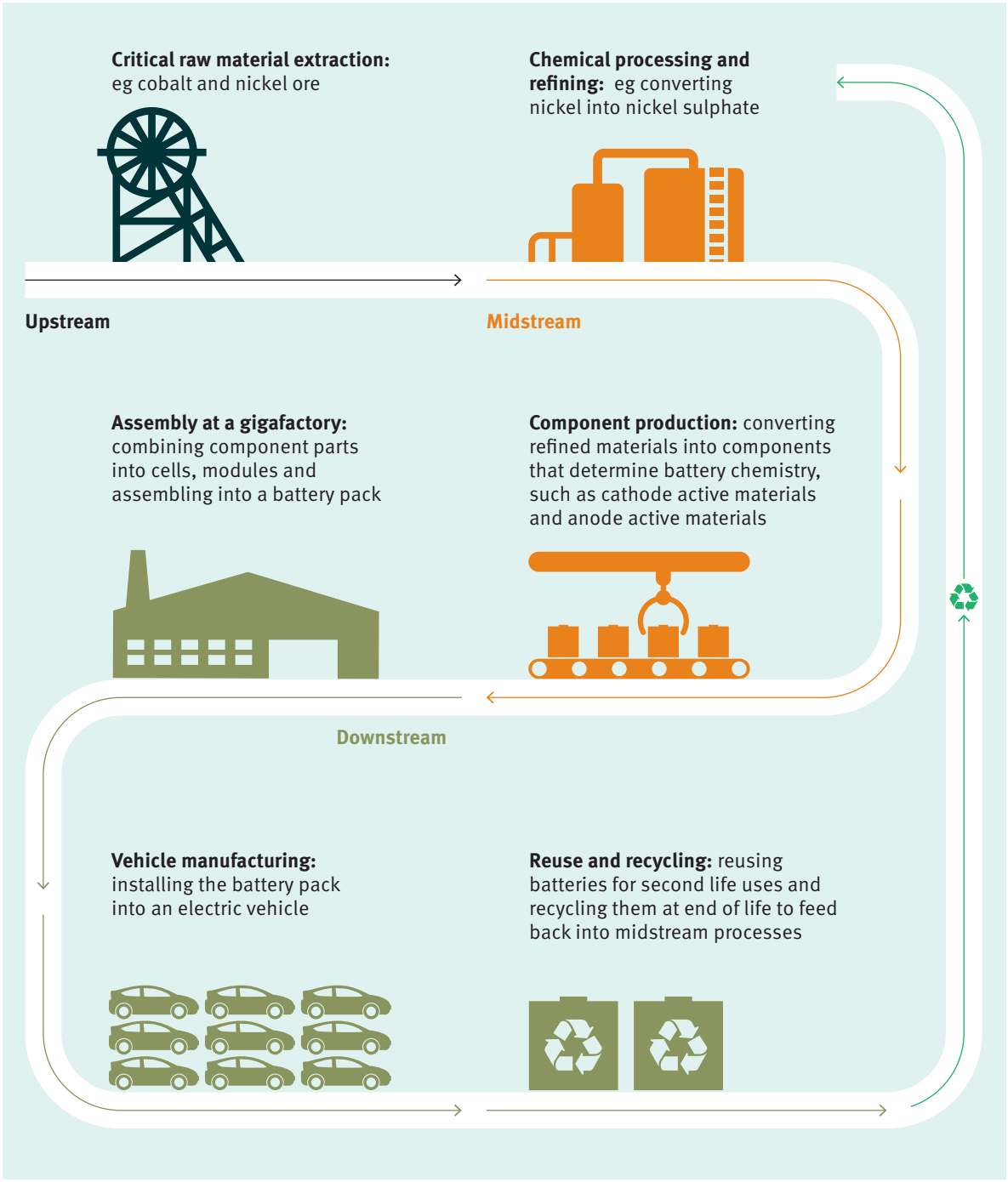
Britishvolt, the UK’s much hyped flagship gigafactory in Blyth, went into administration at the beginning of 2023 after failing to secure private investment and a lack of offtake agreements with vehicle manufacturers. It has subsequently been purchased by Recharge Industries, who still intend to build a facility on the site.[20] However, this episode has shaken confidence in the UK’s battery industry at a time when other countries are forging ahead.

The impact of past car factory closures in the UK have demonstrated the damage that could be inflicted on communities if the car industry cannot move fast enough to EV production. The sudden closure of MG Rover’s factory in 2005 led to the loss of nearly 6,000 well paid jobs.[21] Interviews with workers following the closure found that they experienced a significant drop in income as they were forced to change jobs, with those in new full time employment losing around £3,500 a year in earnings on average, and those in part time work suffering staggering drops in income of around £10,500.[22]

The window is closing for the UK to secure battery production. Long lead times mean that two or three gigafactories must be confirmed within the next two to three years to stay on track. Businesses in the battery supply chain have raised concerns that they cannot meet the UK-EU Rules of Origin requirements, previously mentioned, which come into force in January 2024.[23]

The UK has a competitive advantage in battery manufacturing and specific regions are more suited to scaling up the supply chain. For example, the UK has the highest projected lithium refining capacity in Europe and many research centres of excellence and academic institutions specialising in battery innovation.[24] (For more details see the online annexes to this report at bit.ly/45QmhWT).

The battery industry supply chain



Beyond gigafactories

> “Scaling up recycling would assist in meeting demand for essential components.”

Some domestic extraction of CRMs and scaling up recycling would assist in meeting demand for essential components of battery production.

Unless refining is developed in the UK, preferably close to battery recycling facilities, recovered materials will be shipped abroad to be refined and remanufactured before being reimported, adding considerable cost and extending lead times.

Looking at the whole supply chain is crucial to be able to take advantage of this opportunity; it could maximise the industry’s chances of success by ensuring better integration of gigafactories with other supply chain elements.

Gigafactories as a linchpin

Gigafactories are often seen as the anchors for building out the wider battery supply chain, as they often supply battery packs directly to car manufacturers and are quicker than other elements to build, with a development timescale of two to three years. They provide an important demand signal to other businesses in the supply chain but will not themselves succeed if there is no chain in place around them.

Processes taking place within a gigafactory account for only 24 per cent of the value of a finished battery.[25] Attracting the big players involved in midstream processes is seen by many in the battery industry as a necessary strategic move. It would help to secure the supply of CRMs, refined materials and cathode active materials (CAMs) for gigafactories. These components take longer to develop, so preparing now would set the UK up well to meet future demand.

> **Securing investment in midstream processes will be critical to building a competitive battery industry in the UK."**
> **Julian Hetherington, Advanced Propulsion Centre**

Supply chain integration

Car manufacturers are increasingly looking for the reassurance of 'locked in' supply chain relationships that give gigafactories a secure supply from midstream and upstream processes. This reduces the risks associated with volatile markets and geopolitical trade barriers and helps to speed up production times.[26] China already does this and has seen the benefit, with record production levels and accelerating sales of both batteries and electric vehicles.[27]

The UK could also achieve this with a more strategic approach to integrated supply chains, by exploiting its existing strengths and rapidly addressing its weaknesses.

Playing to UK strengths

> **“Continued large scale government support for research must continue to ensure UK innovation progresses.”**

The UK has value to add across the battery supply chain, such as existing industrial clusters with potential for carbon capture and storage (CCS) and hydrogen, which can be used in refining processes (see the online annexes to this report for more details of the UK’s competitive advantage at bit.ly/45QmhWT). It also has the distinct advantage of excellent research institutions exploring future opportunities and alternative markets for battery use, which may help attract international investment. However, interventions like the Faraday Battery Challenge are only funded until 2025; continued large scale government support for research must continue to ensure UK innovation progresses.

Developing next generation technologies

The UK has an opportunity to develop advanced battery technologies, such as solid state and sodium-ion batteries. Nissan, for example, is working with the University of Oxford to develop solid state batteries for commercial production by 2028.[28] Such technologies are likely to enter the high performance and niche vehicle sectors before reaching the mass market, which the UK is well placed to take advantage of.

The industry experts we spoke to believed that creating the intellectual property around new technologies would develop an inviting environment to keep battery manufacturers in the UK and grow the industry into the 2030s. But, to harness that potential, investment in gigafactories must be secured now. And the UK cannot easily leapfrog to new technologies without first being embedded in current lithium-ion battery production.

Retaining niche markets

The UK has existing strengths in low volume premium and niche vehicle manufacturing, with some of the most recognisable automotive brand names, including Aston Martin, Bentley and Lotus. Individually, these companies may not provide significant demand for the development of a gigafactory. Yet their aggregated demand could. Britishvolt attempted to capitalise on this by signing memorandums of understanding with five smaller OEMs.[29] Unfortunately, this never translated into secure orders, suggesting aggregation could be challenging.

> “Expanding the remit of a battery strategy to explore end uses other than cars will lead to higher levels of investment.”

Other battery uses

Other types of battery use, such as those for heavy goods vehicles, e-scooters or aircraft, are opportunities the UK should consider exploring, as there are not yet standout leaders exploiting them. These markets will grow later than cars, so planning for them now will enable the UK to move faster in the future.

Although starting from a low base, the number of commercial vehicles manufactured in the UK was up 30 per cent in 2022 compared to 2019 levels.[30] These are not subject to the domestic battery manufacturing requirements under the US IRA, meaning there is less incentive to relocate production away from the UK.[31]

Expanding the remit of a battery strategy to explore end uses other than cars will lead to higher levels of investment that will also benefit the EV market. Government support for battery development should not be ringfenced only for the automotive industry as all kinds of development will have spillover effects to other sectors, given the integrated nature of the supply chain.

> **"There are non-financial policies that could help to create a more attractive investment environment."**

The UK economy is not in a position to enable commitment to the level of direct subsidy that has come from the US. Green Alliance analysis found a level of investment like the US IRA's for EVs would cost the UK around £64 billion between 2023 and 2030.[32]

Some direct government investment will be necessary to encourage private investors in the supply chain; however, there are non-financial policies that could help to create a more attractive investment environment.

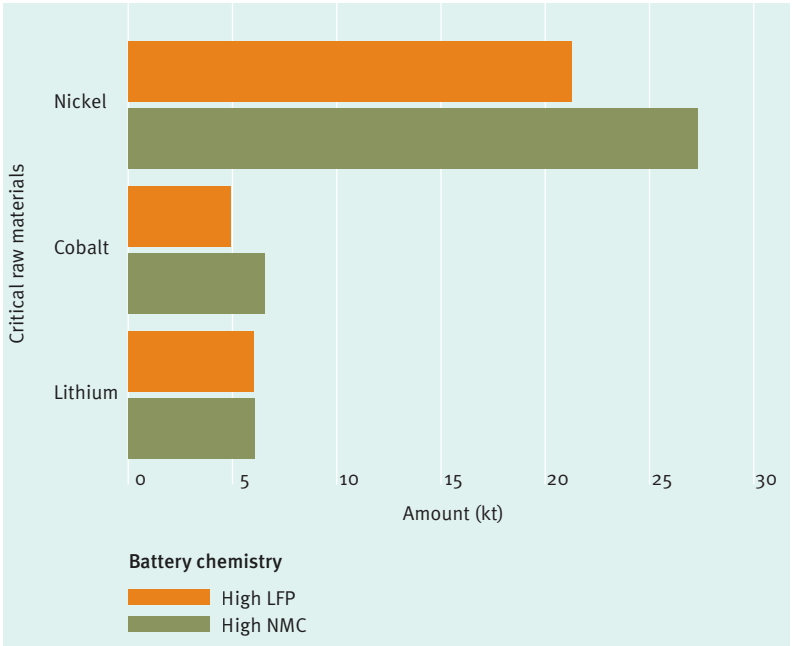
Critical raw material supply

The Faraday Institution estimates the UK will require 80GWh of battery production by 2030 to sustain pre-pandemic levels of car manufacturing.[33] Our calculations suggest that, in a scenario where lithium-ion batteries remain the dominant battery chemistry, this will require six kilotonnes of lithium and cobalt per year and over 20 kilotonnes of nickel.

The exact amount of CRMs required will depend on the types of lithium-ion battery produced. The two primary types used in EVs today are nickel manganese cobalt (NMC) and lithium iron phosphate (LFP), but this may vary significantly in the future if some CRMs become more or less available than others. It will also vary depending on investment decisions made by car manufacturers years in advance of production starting.

> “The Advanced Propulsion Centre estimates that 50% of UK lithium demand could be met through domestic extraction by 2030.”

Critical raw material demand in 2030 will vary depending on the battery chemistries of EVs



Guaranteeing CRM supplies will help to attract investment in midstream battery production processes. This can be done by exploiting the UK’s domestic reserves, as well as by securing supply from abroad.

While no mining is without environmental impacts, the use of CRMs in low carbon technologies is necessary. The best strategy is to carry out UK-based mining with strict environmental and social standards, and import from the highest ESG mining operations elsewhere, as well as push to improve ESG standards internationally.

Although the UK has limited mining potential, compared to many other states, securing domestic sources of mined lithium could be promising and is likely to be necessary, regardless of the future type of battery chemistry commonly used.[34] The Advanced Propulsion Centre estimates that at least half of UK lithium demand could be met by domestic extraction by 2030, although this depends on a range of variables, including whether or not there is local opposition to mining.[35] Plans should be accelerated by identifying possible extraction sites and providing incentives for the mining industry.

> “Sourcing raw materials in the UK should lead to higher environmental and social standards.”

The experts we consulted expressed concern that the government was not taking this need seriously enough. China has a firm grip on CRM mining and processing due to its long history of investment in resource rich countries. Given China’s history of curbing exports of valuable materials, the UK should ensure it has identified potential alternative sources from abroad.

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, such as Australia and Canada, which have sufficient nickel, cobalt and lithium reserves to meet UK production requirements (see the online annexes to this report at bit.ly/45QmhWT for further information).[36]

The government’s Critical Minerals Strategy has ambition on both the intention to explore the UK’s extraction potential and to secure CRMs from abroad, however there is little corresponding policy to deliver on it.

The environmental and social impacts of batteries

Extracting raw materials can result in biodiversity loss and severe water and air pollution when not conducted according to stringent standards. Producing a tonne of lithium requires an alarming 330m^3 of water and 75 per cent of all lithium mining is estimated to take place in areas experiencing high water scarcity.[37] In addition, 65 new allegations of human rights abuses related to mining were recorded in 2022.[38] Child labour, high levels of injury and long term health impacts associated with cobalt mining in the Democratic Republic of Congo are well documented, and mining related conflict has been reported across the spectrum of materials required for batteries.[39]

Sourcing raw materials in the UK should lead to better environmental and social outcomes if strict standards are adhered to. Actions to reduce pollution could also result in lower carbon emissions.

For imports, the government should introduce verification systems to ensure they meet sustainability expectations. The EU is introducing battery passports, which include

information on carbon footprint and supply chain due diligence.[40] The UK should replicate this to ensure transparency around the production and export of batteries.

Making batteries in the UK would produce an estimated 12 per cent lower greenhouse gas emissions compared to the EU average in 2025. This is largely due to the lower carbon intensity of the UK's power system.[41] But these estimates assume 80 per cent of all midstream activities and 100 per cent of recycling could take place in the UK, which is not currently the case.[42]

> "Recycling CRMs could supply at least 10% of EV battery requirements in 2035, increasing to 43% in 2040."

With an integrated battery supply chain the UK could become an industry leader, able to claim low embodied carbon and high social standards. The industry experts we consulted said this would capitalise on the emerging trend where western vehicle manufacturers want batteries with good ESG credentials and are willing to pay a premium for them.

Recycling regulations need an update

At the end of their first life in an EV, batteries can be reused in secondary applications, such as for storing and distributing electricity back to the grid or they can be remanufactured back into an EV battery. If a battery is not suitable for reuse, it must be recycled. The UK currently exports end of life car batteries to recycling facilities such as Umicore in Belgium.[43] Manufacturers pay between £3 and £8 per kilogramme to recycle lithium-ion batteries abroad and then pay again to import the recycled products.[44]

We found that recycling CRMs could supply at least ten per cent of EV battery requirements in 2035, increasing to 43 per cent in 2040. Our estimates suggest the economic value of lithium contained in all UK EV batteries that reach end of life in 2040 will be £146 million: £63 million for cobalt and £536 million for nickel.[45] Locally recycling batteries keeps costs down as transporting battery packs is 29 per cent of a recycling plant's costs.[46]

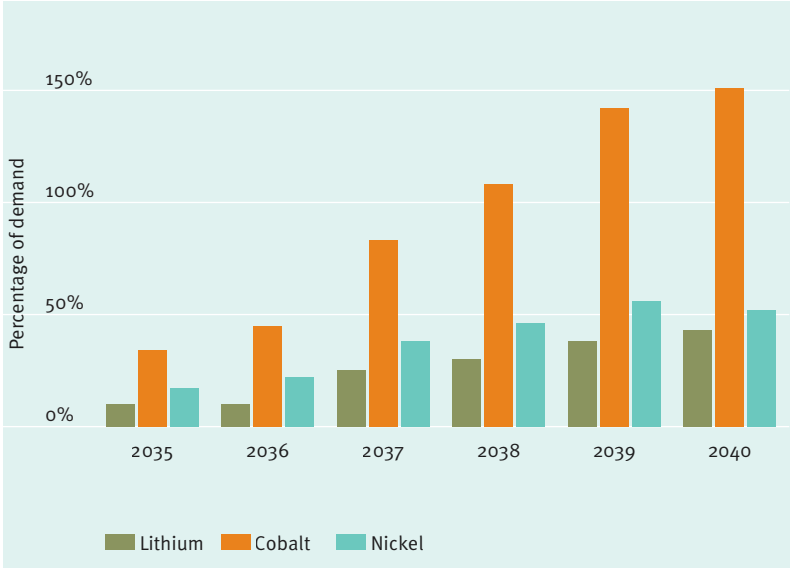
Relevant UK legislation predates EV rollout and should be updated. The Waste Batteries and Accumulators Regulation

makes producers responsible for battery recycling at the end of life, but lithium-ion batteries are classed as 'other' and are not subject to specific obligations in relation to CRM recovery.[47] A separate set of producer responsibility rules, around vehicle end of life, count reuse as sufficient, leaving a question around who takes responsibility for the battery at the end of its second life.[48] At present, it is unclear which rules apply to which circumstances.

An EV-specific individual extended producer responsibility (EPR) scheme would make battery manufacturers liable for what happens at the end of their product's life. This would be an incentive for better design for disassembly. The government must progress its plans to consult on an EPR scheme and ensure its scope extends to batteries.

> "The UK is the biggest market in Europe for end of life vehicles, making it the perfect location to establish a battery recycling industry."
> **Dr Anwar Sattar, University of Warwick**

Potential to meet critical raw material demand through recycling



Energy costs

Energy costs are a significant factor in investment decisions; a single gigafactory can consume over 2TWh of electricity per year.[49] Alan Hollis, CEO of AMTE Power, warned MPs at a select committee hearing in May 2023 that energy costs are the biggest challenge to remaining competitive.[50] UK energy costs for businesses with high electricity consumption, which is the case for gigafactories,

was 26 per cent higher compared to the EU average in 2022.[51] Wholesale energy prices, even with the Review of Electricity Market Arrangements which is underway and which will resolve the issue in the long term, are not predicted to drop significantly in the next couple of years. If investment is to be secured in the next two to three years, a shorter term solution is needed.

> “Addressing energy costs is vital to attracting investment in these industries.”
> Sam Quinn,
> Tees Valley Lithium

The Energy Intensive Industries Exemption Scheme, which cuts levies for some businesses and has been expanded to include battery manufacturing, does not address wholesale prices.[52] The exemption applies only to businesses with electricity costs over 20 per cent of their GVA. The problem with the exemption limit, as industry experts told us, is that high capital expenditure costs for businesses in the battery supply chain transfer to debt during operation, meaning electricity costs may be lower than 20 per cent of GVA, despite them often being over 20 per cent of operational expenditure. To counter this, the government should guarantee access to the exemption scheme for businesses in the battery supply chain, with qualification thresholds for intensity that acknowledge the cost of capital for new plant and equipment. This would have the effect of not favouring established industries over new investments.

Power purchase agreements (PPAs), a direct agreement between a large scale energy consumer and an electricity generator, can be an immediate solution to high energy costs, enabling the direct supply of cheaper clean energy. However, the competition to access them is fierce. Nascent industries, such as those in the battery supply chain, are at a disadvantage in agreeing favourable terms due to their lack of proven revenue.

To mitigate these challenges, the government could underwrite PPA contracts between renewable generators and battery manufacturers, through a scheme such as the ‘green power pool’, proposed by UCL, or at least they should work with industry to develop standardised, tradeable PPA contracts.[53, 54]

> **“The government should consider underwriting offtake agreements between battery supply chain stakeholders.”**

Underwriting offtake agreements

Investors are looking for long term certainty across the supply chain. This can come from policy incentives, such as through the US IRA, but also from having a guaranteed customer, through the signing of an offtake agreement. However, large capital expenditure projects in the battery supply chain often struggle to secure a guaranteed customer unless they can demonstrate they have funds to scale up. This was one of Britishvolt’s failures.[55] This is 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.

To counter this, the government should consider underwriting offtake agreements between battery supply chain stakeholders, offering security to both the producers and customers.

Investing to grow

> **Attracting investment is one of the biggest barriers to rapidly scaling up the battery industry in the UK."**
> Suzanna Hinson, Green Finance Institute

High upfront capital expenditure is required by gigafactories and other parts of the battery supply chain to build infrastructure. However, these assets are also considered high risk for a variety of reasons, such as when start ups have no track record. High funding requirements and high risk mean assets often fall outside the traditional areas for investors to consider.

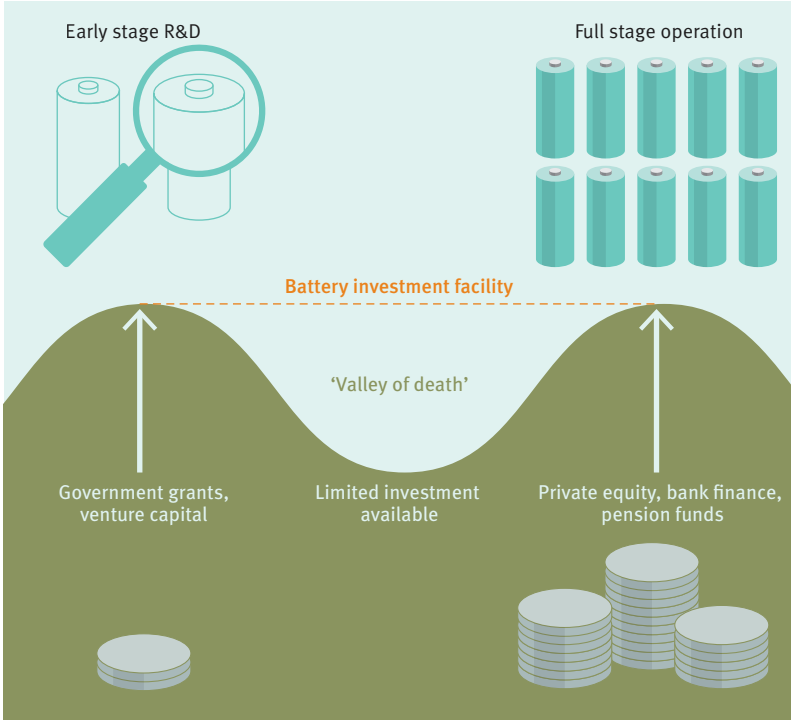
To overcome these barriers, the government must introduce measures which derisk investments, allowing mobilisation of capital into the supply chain.

Bridging the 'valley of death'

The so called 'valley of death' between early stage research and development (R&D) in the battery supply chain and production at scale is difficult to bridge. The R&D and proof of concept stages are typically financed through government grants (such as through the Advanced Propulsion Centre and Faraday Battery Challenge) and venture capital, while later stage finance for manufacturing at scale comes from private equity firms and banks with longer investment timelines and a lower appetite for risk.

To bridge the funding gap, the Green Finance Institute proposes a Battery Investment Facility. This would use public money to attract private investors that would otherwise view battery companies within the 'valley of death' as too high risk to allow them to invest. This would enable businesses to access both public and private funding at the same point, so there is no absence of a lead investor.[56] The Green Finance Institute is developing options for the operation of this facility, ranging from public and private investment being on equal terms, to public capital taking a stronger risk sharing position.

Where companies struggle to find investment to scale up



Loan guarantees

One of the specific products that either the Battery Investment Facility or the government could directly offer are loan guarantees. These can make investment less risky; they are already being used alongside direct grant funding across Europe to support the industry.

> “The UK Infrastructure Bank could be a central player in supporting the battery supply chain.”

Swedish battery developer, Northvolt, received a grant from the Swedish government of €58.8 million. This can be compared with £100 million subsidy Britishvolt received from the UK government, which was equivalent to around €116 million.[57, 58] Northvolt, however, also received €961.5 million in debt financing and loan guarantees through the European Investment Bank and the German government to establish two gigafactories.[59]

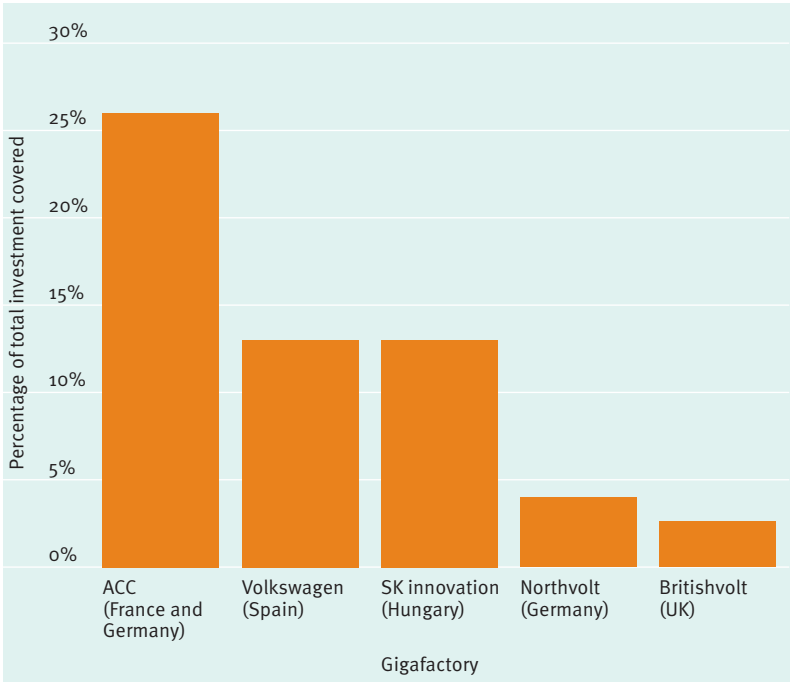
The UK Infrastructure Bank (UKIB) could be a central player in supporting the battery supply chain. The recent announcement of its investment in Cornish Lithium is an encouraging sign that there is ambition to support the development of a supply chain.[60] Yet UKIB’s other green investments to date suggest a low risk appetite, focusing on solar and offshore wind. Its 2022 strategic plan suggests gigafactories will form part of its Clean Energy priority, but this has not been followed up in public discussions around gigafactories and their wider supply chain. To help kickstart the industry, the UKIB should be open to taking on more risk across both equity and debt, including loan guarantees.

Direct support

The government has invested significantly in the EV supply chain, through a £1 billion investment in the Automotive Transformation Fund; £541 million of funding since 2017 for the Faraday Battery Challenge; and, it has recently been reported, a £500 million investment in the Jaguar Land Rover gigafactory in Somerset.[61] Despite this, more public investment is needed for the UK to remain globally competitive.

As the graph on page 26 demonstrates, public investment in Britishvolt was considerably lower than national funding provided for comparable projects in other countries.

State subsidies as share of total investment



In the US, total subsidies given to battery producers through the IRA and other state support are estimated to be even higher than those in Europe, equal to over 200 per cent of initial investment costs.[62] We estimate the cost of implementing subsidies at an equivalent level in the UK could be £14.8 billion between now and 2030 for battery manufacturers.[63] If tax incentives for EV consumers were included along the lines of those offered in the US, the figure could rise to £64 billion.[64]

Bringing capital expenditure funding in line with levels given in Hungary and Spain would mean UK investment of £1.3 billion in gigafactories alone by 2030.[65] This does not include the funding required to support other endeavours to develop the supply chain.

Given these estimates are greater than the Automotive Transformation Fund's entire budget, which exists to fund projects across the battery supply chain, it is clear more funding is needed to establish a competitive UK industry.

In March 2023, the Labour Party committed to spend £2 billion on eight gigafactories.[66] This equates to

£250 million per operation, which is not insignificant. But this does not encompass the wider supply chain. Commitments of this magnitude should be maximised by ringfencing spending to scale up and integrate the supply chain and using innovative blended finance structures to crowd in private finance.

The Automotive Transformation Fund is the obvious and logical vehicle for expanding support for the industry. However, the stakeholders we consulted told us that securing support through the fund can be long and cumbersome. Even if significant subsidies are offered, the slow speed of deployment can be offputting enough to make relocating to other countries preferable. The government should address this by accelerating the timeline to deploy funds.

> “The barrier of releasing government funds in a timely manner is starting to become detrimental to the battery industry.”
> Sam Quinn,
> Tees Valley Lithium

How to create a strong UK battery industry

> **“A UK battery strategy is needed to give the industry clarity and direction.”**

The UK has a window of opportunity to be a significant player in the EV transition and battery revolution. But it is closing fast as other countries gear up their automotive sectors for the future. Losing out to this competition risks losing the UK automotive industry and, with it, thousands of existing and future jobs.

A UK battery strategy is needed to give the industry clarity and direction, to drive research, technology development and investment in growth throughout the supply chain.

From our analysis and expert consultation, we conclude that a successful strategy should include action in the following three areas:

1. Develop a robust UK battery supply chain

Adopt an integrated approach, considering all aspects, from extraction to recycling, extending policy and financial measures beyond gigafactories, to prioritise projects which simultaneously develop multiple aspects of the production cycle.

Accelerate domestic mining of battery materials by identifying possible extraction sites, alongside the introduction of stringent environmental and social standards.

Create an EV-specific individual extended producer responsibility scheme to give manufacturers responsibility for what happens to a battery at the end of life.

Introduce UK ‘battery passports’, like those in the EU, to provide clear information on carbon footprint, supply chain due diligence and contents.

Facilitate trade discussions to secure CRMs between UK-based businesses and mining operations in countries with a strong environmental, social and governance record and stable economies.

2. Create a more welcoming environment for investors

Guarantee access to the Energy Intensive Industries Exemption scheme, with qualification thresholds that acknowledge the cost of capital for new plant and equipment.

Underwrite power purchase agreements between renewable energy generators and battery manufacturers to guarantee industry access to cheap, clean energy.

Identify and develop new battery technologies and niche markets for end uses that set the UK apart from global competition and attract a new wave of investment, including non-automotive end uses for batteries.

3. Mobilise public capital to secure private investment

Underwrite offtake agreements between different parts of the battery supply chain to increase investor confidence and accelerate the development of necessary infrastructure.

Bridge the gap between public and private capital through a provision like the Battery Investment Facility, proposed by the Green Finance Institute, to maximise the impact of public funding.

Facilitate the UK Infrastructure Bank to take on risk across both equity and debt, including loan guarantees.

Increase direct public funding to attract initial investors and developers across the supply chain, and strengthen the Automotive Transformation Fund's ability to deploy funds more rapidly, extending its remit to non-automotive end uses.

Endnotes

1 D Bailey, 19 January 2023, 'The race for electric vehicle battery making is well underway, and the UK is barely off the starting grid', UK in a Changing Europe

2 G Parker et al, 18 July 2023, 'Tata Motors set to announce plans to build UK battery factory', *Financial Times*

3 Society of Motor Manufacturers and Traders (SMMT), June 2023, *Manifesto 2030: automotive growth for a zero emission future*

4 A de Ruyter, et al, 2022, *Enabling a just transition in automotive: evidence from the West Midlands and South Australia*, The British Academy

5 D Bailey, et al, 2023, 'Shocks, resilience and regional industry policy: Brexit and the automotive sector in two Midlands regions', *Regional Studies*, vol 57 (6), pp 1,141 – 1,155

6 SMMT, 2023, 'Motor industry facts 2023'

7 Energy and Climate Intelligence Unit, 2023, *UK car exports on a cliff edge*

8 SMMT, 2023, op cit

9 P Hockenos, 16 June 2022, 'How Russia's war is putting green tech progress in jeopardy', Yale Environment 360

10 International Energy Agency, 2021, *The role of critical minerals in clean energy transitions*

11 D Iaconangelo, 20 January 2023, 'U.S. strikes at China with EV battery deal', *E&E News by Politico*

12 117th Congress, 2022, *The Inflation Reduction Act of 2022*

13 Ibid

14 The European Commission, 2023, 'Critical Raw Materials Act'

15 See, for example: P Campbell, 20 October 2022, 'EV start up Arrival to cut UK jobs in production to shift to US', *Financial Times*; and S Taaffe-Maguire, 20 March 2023, 'Ford job cuts: More than a thousand jobs go in the UK', Sky News

16 Ibid

17 The Faraday Institution, 2022, *UK electric vehicle and battery production potential to 2040*

18 Ibid

19 *Inside EVs*, 19 July 2023, 'JLR parent company to build 40-GWh battery cell gigafactory in UK'

20 D Jordan, 6 February 2023, 'Britishvolt: UK battery start-up set to be bought by Australian firm', BBC News

21 K Armstrong, et al, 2008, 'Auto plant closures, policy responses and labour market outcomes: a comparison of MG Rover in the UK and Mitsibushi in Australia', *Policy Studies*, vol 29 (3) pp 343-355

22 C Chapain and A Murie, 2008, 'The impact of factory closure on local communities and economies: the case of MG Rover Longbridge closure in Birmingham', *Policy Studies*, vol 29 (3), pp 305-317

23 House of Commons, Business and Trade Committee, 2023, 'Oral evidence: batteries for electric vehicle manufacturing', HC 1070

24 Transport & Environment, 2023, *A European response to US IRA: how Europe can use its soft and financial powers to build a successful electric vehicle value chain*

25 Bloomberg NEF, 30 November 2021, 'Battery pack prices fall to an average of $132/kWh, but rising commodity prices start to bite'

26 G Evans, 31 October 2022, 'A reckoning for EV battery raw materials', S&P Global Mobility

27 Dezan Shira and Associates, 10 August 2023, 'China's electric vehicle supply chain and its future prospects', *China Briefing*

28 I Dnistran, 6 February 2023, 'Nissan to launch EV with solid-state batteries in five years', *Inside EVs*

29 Britishvolt, 7 September 2022, 'Britishvolt passes battery safety test UN38.3 – next step shipping cells to customers for testing'. Our analysis uses Faraday Institute projections but other battery demand projections may differ and are regularly being updated.

30 SMMT, 2023, op cit

31 M Donath, 18 August 2022, 'Breaking it down: what does the IRA mean for fleet electrification?', Edison Energy

32 Green Alliance briefing, March 2023, 'The cost of implementing the IRA's electric vehicle policies in the UK'

33 The Faraday Institution, 2022, *UK electric vehicle and battery production potential to 2040*

34 E Deady, et al, 2023, *Potential for critical raw material prospectivity in the UK,* UK Critical Minerals Intelligence Centre

35 APC, 2022, 'Q4 2022 Automotive industry demand forecast'

36 Reserves do not equate to mined material; a variety of barriers could lead to reserves being inaccessible for several years. This also does not account for other countries' critical raw material demands.

37 International Energy Agency (IEA), 2023, *Energy technology perspectives*

38 Business and Human Rights Resource Centre, 2023, 'Transition minerals tracker: 2022 analysis'

39 Amnesty International, 19 January 2016, 'Exposed: child labour behind smart phone and electric car batteries'

40 Battery Pass, 2023, 'Battery passport content guidance'

41 S Gifford, 2021, *The UK: a low carbon location to manufacture, drive and recycle electric vehicle,* The Faraday Institution

42 Ibid

43 The Faraday Institution, 2020, *The importance of coherent regulatory and policy strategies for the recycling of EV batteries*

44 WMG, 2020, *Automotive lithium ion battery recycling in the UK*, University of Warwick

45 These values may go up as global demand rises and it becomes less economical to exploit existing reserves.

46 WMG, 2020, University of Warwick, op cit

47 J Malinauskaite, et al, 2021, 'Circular waste management of electric vehicle batteries: legal and technical perspectives from the EU and the UK post Brexit', *International Journal of Thermofluids*, vol 10

48 Ibid

49 Written evidence submitted to the Committee on Business and Trade by the Advanced Propulsion Centre, 2023

50 House of Commons, Business and Trade Committee, 2023, op cit

51 Department for Energy Security and Net Zero, 2023, 'Quarterly: Industrial electricity prices in the EU for small, medium, large and extra large consumers'

52 Department for Business, Energy and Industrial Strategy, 29 April 2022, 'High energy usage businesses to benefit from further government support'

53 V Viisainen et al, 2022, *Building the future: a faster route to clean steel*, Green Alliance

54 M Grubb et al, 2022, working paper, 'Separating electricity from gas prices through Green Power Pools: design options and evolution', UCL Institute for Sustainable Resources

55 S Keating, 2 November 2022, 'Northvolt versus Britishvolt: a tale of two deals', TXF

56 The Green Finance Institute, 2022, *Powering the drive to net zero*

57 J Erraia, et al, 2023, *Battery subsidies in the EU, Norway and the US*, Menon Economics

58 J Jolly, 21 January 2022, 'Britishvolt gets £100m boost to build UK's first large-scale gigafactory', *The Guardian*

59 J Erraia, et al, 2023, op cit

60 UK Infrastructure Bank, 8 August 2023, 'Bank invests to strengthen domestic lithium supply chain and boost Cornish economy'

61 See, for example: APC, 'Advanced Propulsion Centre proud of role in gigafactory announcement'; and The Faraday Institution, 'Faraday battery challenge'

62 J Erraia, et al, 2023, op cit

63 Green Alliance briefing, March 2023, op cit

64 Ibid

65 This assumes a total demand for batteries of 104GWh in 2030, as it includes demand for all battery end uses and is not limited to private car use.

66 E Miligan, 9 March 2023, 'Keir Starmer's UK Labour Party pledges £2 billion for eight battery plants', Bloomberg

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