Call for Evidence: Batteries for electric vehicle manufacturing

Response: UK Battery Industrialisation Centre (UKBIC), Rowley Road, Coventry

Submitted by:

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1. The £130 million UK Battery Industrialisation Centre is a key component of the Faraday Battery Challenge, an Industrial Strategy Challenge Fund (ISCF) programme funded and co-ordinated through Innovate UK (UKRI). The Faraday Battery Challenge focus is to fast track the UK development and commercialisation of cost-effective, high-performance, durable, safe, low-weight and recyclable battery technologies.
2. The investment in UKBIC arose from a recognition that there is a significant cost and risk gap that exists between the early-stage design and development of battery technologies in small demonstration quantities, and the development of large-scale private battery manufacturing facilities, which require very high levels of up-front and continued operational business funding. UKBIC is an open access and independent 'learning factory' for the UK. It fills a strategic gap between R&D of products and technologies on a smaller development scale, and the full-scale manufacture of commercial products in industrial factories. It enables small, medium and large sized organisations to access equipment and capabilities which would be difficult to access otherwise without significant up-front capital investment.
3. UKBIC's delivery funding was awarded in 2017 following a competition led by the Advanced Propulsion Centre and Innovate UK. The facility was officially opened by the Prime Minister and commenced work with customers in July 2021.

4. Is there enough UK vehicle manufacturing demand in the UK to support gigafactories?

a) The latest industry forecasts show UK automotive battery demand at ~96 Gigawatt hours per year (GWh/yr) by 2030[1]. The vast majority of this comes from passenger car production demand (~80GWh/yr) with the remainder from light commercial vehicles and heavy goods vehicles.

b) An average gigafactory being designed and developed today would have an output capacity of ~30GWh/yr; however, they could operate on a much smaller scale for niche or premium products, or some are being planned as large as 50GWh/yr. These forecasts clearly show there is enough vehicle manufacturing demand being planned in the UK to support multiple gigafactories.

c) Today, the UK manufactures more than 850,000 cars and ~73,000 commercial vehicles, as well as 1.6 million engines[2]. These numbers have fallen in recent years; prior to the Covid-19 pandemic, the UK produced 1.5m cars and 2.7m engines[3].

[1] Advanced Propulsion Centre: Q3 2022 Automotive industry demand forecast (Dec 2022)

[2] SMMT Motor Industry Facts 2022

d) It is essential that the UK automotive industry is supported to transition this vital and valuable industry over to electrified powertrains as we move towards zero emissions targets in 2030 and 2035.

5. Will the UK have sufficient battery production supplies by 2025 and 2030 respectively to meet the government phase-out plans for petrol and diesel vehicles?

e) Currently, the UK will not have sufficient battery production supplies by 2030 to meet, not only the government phase-out plans for petrol and diesel vehicles, but also to meet the growth in demand for batteries from UK automotive manufacturers (outlined above).

f) It generally takes around 2-3 years to construct a new gigafactory from scratch. This includes around 24 months for the physical construction of the building and site infrastructure. Additional time required is dependent on the preparedness of the site (planning and permitting) and whether the new plant is being designed from scratch or copy-and-pasted from an existing plant layout in another location.

g) Clearly, this means that to support increased battery demand by 2025, new plant construction would already need to have commenced today. To meet the automotive demand forecast of ~96GWh/yr by 2030, a significant launch and ramp-up of activity would be required over the next few years.

h) Indeed, Envision AESC has already started construction of its new gigafactory near the Nissan plant in the North East of England. This gigafactory has announced capacity of 12GWh/yr[4].

i) At the time of writing, the future of Britishvolt's proposed 30GWh/yr plant in Blyth, Northumberland, is unclear. This would clearly have significantly increased the potential supply capacity of UK produced batteries by 2030.

j) AMTE Power has announced plans to build a 0.5GWh/yr plant (Megafactory) in Dundee, Scotland to produce high value, differentiated battery cells for automotive and energy storage markets[5].

k) At present, there are no other gigafactory announcements confirmed for UK investment. If forecast automotive demand for batteries cannot be met by localised supply, automotive OEMs will have no choice but to meet this demand from overseas suppliers.

6. Is UK-based battery production necessary to support the manufacture of electric vehicles in the UK?

l) Yes. There are a number of reasons for this.

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[3] SMMT Motor Industry Facts 2019

[4] First pillar ceremony unveils start of construction on Envision AESC's second UK gigafactory - Envision (envision-aesc.co.uk)

[5] AMTE Power selects Dundee as preferred site for battery cell factory in boost for Scottish net zero jobs – AMTE Power

m) Batteries will be a defining feature of the electric vehicle architecture, and they represent a significant proportion of the value of the full vehicle. Ability to manage the supply of batteries will be critical for automotive OEMs' control of their vehicle production in future.

n) Supply of batteries from overseas may be an acceptable position in the short-term. However, as a general position, demand for batteries will grow exponentially over the next decade and will outstrip supply. For this reason, security of supply will become a paramount concern to OEMs.

o) Countries and regions across the globe are now adopting minimum sourcing requirements legislation. For example:

i. The Rules of Origin requirements resulting from the Trade and Cooperation Agreement between the UK and the European Union[6]:
   - By 2027, electric vehicles must have 55% UK/EU content and must have an originating battery pack
   - An originating battery pack must have either 65% UK/EU content for the cell or 70% for the battery pack
   - Transitional rules of origin apply before 2027

ii. Inflation Reduction Act in the USA:
   - Clean vehicles will be required to increase the percentage of minerals extracted and processed in the USA or a country the US has a free trade agreement with, or recycled in North America
   - Rises to 80% by 2026
   - Similar requirement applies to battery components – e.g. 100% must be manufactured and assembled in North America by 2028 to be eligible for clean vehicle tax credit

p) These increasingly stringent localisation policies will impact automotive OEMs differently, depending on their major vehicle export markets and the nature of the UK's trading relationships with those countries.

q) If UK automotive OEMs are using batteries produced outside of the UK, we run the risk that this highly valuable part of the electric vehicle componentry would not be classed as originating content in certain markets depending on our trade agreements. This has the potential to put the UK at a significant competitive disadvantage as a place to manufacture electric vehicles for export. To ensure the sustainability of our national automotive manufacturing industry, it is essential that local supply is encouraged into the UK now, while early plant investment decisions are still being made.

r) Vehicle OEMs will want localised supply of batteries in order to closely manage this critical supply chain source. A point that is central to vehicle production is that component supply should be planned against vehicle sales volume demand and production schedules over a period of months. This supply and demand match is made much more difficult to forecast and manage when lengthy logistics timescales need to be factored into the battery supply schedule. Additionally, if battery

[6] Brexit-TCA-Rules-of-Origin-for-Batteries-press-briefing-FINAL-5March-2021.pdf (faraday.ac.uk)

components, such as cells, are being shipped from overseas, a considerable amount of very expensive capital can be tied up in lengthy transit at any one time which creates additional risk and cost.

s) From the supplier perspective, this is also complicated by the time-limited 'shelf life' of some battery materials and components which must be used by a certain date in order to maintain the necessary quality threshold. Therefore, the longer the logistics timescales, the more difficult this supply and demand forecasting is made.

t) These are some of the commercial reasons that we can expect automotive OEMs to gravitate production close to the supply of batteries (and vice versa). It significantly reduces supply chain risk and enables their close control of one of their key suppliers.

7. What are the risks to the UK automotive industry of not establishing sufficient battery manufacturing capacity in the UK?

u) The automotive industry's requirement for a local secure supply batteries is urgent and important. This is due to both the impending legislative targets on new vehicle products, and the growth of minimum sourcing requirements being adopted in major markets across the world, as mentioned previously.

v) An example: Vehicle models will typically run on a ~10 year production cycle. Therefore, an automotive OEM thinking about launching a new car model in 2026 will need that model to still be available on the market up to 2036 (which, in this case, would be after the ban on the sale of new hybrid and petrol/diesel cars). Pre-launch development cycles for new vehicles are typically around 4 years, which means that OEMs looking at models for production between 2026-2036 will have already started development of those models now (2022), and the initial technology R&D will have been undertaken many years before that.

w) Automotive OEMs have already committed to many of these product decisions for the next decade. Decisions about localised production and sourcing for the medium to long-term are being made now.

x) The risk is that once these major production investment decisions are made and sited for upcoming models, they will be significantly more difficult to dislodge later. If we do not succeed in attracting a sustainable cluster of electric vehicle manufacturing to have confidence in investing in the UK now, it will be near impossible to reverse this trend later.

y) *Please see the previous answer to Q3 for further context on the reasons why localised (UK-based) battery supply is necessary to support electric vehicle manufacturers.*
It is important to be clear that we would not witness a mass exodus of automotive manufacturing from the UK at a particular date, but the gradual regional clustering of gigafactories will have a major influencing factor on future electric vehicle assembly line investment decisions. 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 with 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. The grave risks to UK employment, export opportunity, and GDP, if we do not attract investment during this decision-making window, are clear.

z) The die is not yet cast.
Investment decisions are still being made and, regionally, across Europe, there is still a huge amount of learning and scaling of battery capacity and capability needed in order to meet the forecasts of demand. The UK has significant strengths on which to build, including:

iii. Through Envision AESC and Nissan operating in Sunderland, the UK was home to the first giga-scale production facility in Europe, opened in 2012. Envision AESC have already announced their plans to considerably expand this capacity in the UK.

iv. The UK maintains a strong and vital R&D, academic and innovation community in batteries and energy storage, linked closely to our highly valuable specialist and premium automotive OEMs for new technology adoption

v. High volume automotive OEMs in the UK who are yet to announce full investment plans for electric vehicle production

aa) There is something of a chicken-and-egg situation where automotive OEMs will want confidence in localised supply of batteries in order to be able to make secure vehicle plant investment decisions. Battery suppliers will require demand signals from customers in order to make their investment decisions in a particular area, alongside economically-driven priorities (such as availability of suitable land, skilled labour, clean / cost effective energy, etc).

bb) Once 2-3 battery production plant investment decisions are made in the UK's favour, this would bring enough stability and security to the industry to attract a clustering in growth from customers, as well as the valuable upstream supply chain.

8. What other domestic end uses for batteries would provide a market for UK battery production?

cc) There are a number of other end users of batteries that would provide an equally valuable market for UK battery production. A number of companies from other sectors are already in discussions or active projects with us at UKBIC in order to develop battery technologies for their particular market applications. This includes aerospace (another hugely valuable and important sector for the UK), marine, off-highway and commercial vehicles, rail, and static energy storage for domestic, commercial and grid scale uses.

dd) The main current distinction between the volume automotive industry and many of these other sectors is that there are currently not the same legislative targets pushing low/zero carbon technology implementation or rules of origin designation of batteries today. Societal pressure and longer-term objectives to meet net zero targets may ultimately drive some of these sectors towards implementation of battery technologies into their energy systems, but without legislation focusing on rules of origin or embedded carbon footprint for production, there will be little

incentive for these industries to demonstrate the same focus on localised improvement of supply chains for their future electrified products.

ee) The legislative drive to net zero will push these industries towards batteries and other low carbon technologies over the coming decades. The question will be whether the UK will prosper from this transition through investment, jobs, economic opportunities from localised supply.

9. Does the UK have a sufficient supply of critical materials to support vehicle battery production?

ff) For all suppliers, wherever they are based, this will be a question of how they are able to get hold of critical materials by the 2030s when demand will grow exponentially.

gg) The various materials required for batteries are sourced from all over the world.

hh) Today some of the most important materials in lithium-ion batteries for electric vehicles include:

Material	Significant Source Examples
Nickel	Indonesia, Australia, Brazil, Russia, Cuba, Philippines
Manganese	South Africa, Australia, China, Gabon, Brazil
Cobalt	DRC, Russia, Australia, Indonesia, Philippines, Cuba
Lithium	Bolivia, Argentina, Chile, USA, Australia, China
Graphite	China, Brazil, Mozambique

ii) There is much data available on the natural sources (current and potential) and largest processors of these materials but it is important to note that it can take as long as 10-15 years to bring a new mining source online to increase the opportunity for increased supply to match demand. Therefore, we can expect to see some constraints on certain critical material supplies, such as those listed above, over the next decade as demand grows rapidly.

jj) Because of this, we are seeing trends towards increasing vertical integration up the supply chain, as battery producers and OEM users aim to increase the security of their own supply as demand forecast grows.

kk) There are two important points to remember in the discussion about supply of critical materials:

vi. First is increasing concerns over the transparency and sustainability of supply chains. ESG compliance will become of increasing importance in the future as issues become clear about the consequences of mining and primary processing and embedded carbon in the upstream supply chain, and issues around ethical mining practices in some parts of the world. The Global Battery Alliance and others are promoting the need to introduce ‘Battery Passports’; initiatives to provide transparency in practices and impacts of battery components right through the value chain. As a legislative and social drive, this will have a significant impact on the sourcing and supply of these materials over time and how demand is satisfied.

vii. Second is the increasing importance of recycling and re-use of battery materials. Until now, though material extraction from end-of-life batteries has been possible, a sustainable economic model has been difficult to develop. To date, recycled materials have struggled to meet the quality threshold required for re-use in place of new virgin material feedstock, in the quantities required for production. However, R&D continues to push forward in this area and much demonstrated progress is being made and scaled-up.

ll) In summary, there will be a global challenge in security of supply of critical materials over the next decade and the above factors along with global market dynamics will impact how this is directed.

10. How ready are UK vehicle producers for the EU–UK Trade and Cooperation Agreement (TCA) rules of origin (ROO) phasing in from 2024?

mm) As mentioned in an earlier answer, vehicles generally tend to run in 10-year production cycles so vehicle models in the market from 2024-2027 (during the phase in of Rules of Origin) will have been in development for a number of years before this.

nn) Localised sourcing of content is likely to be a challenge in the coming years. Automotive OEMs are tending to create partnerships with cell producers establishing themselves across Europe and sharing the responsibility for the regulations with these suppliers. As a rule, over 50% of the value of a battery lies within the materials inside the cells (the anodes and cathodes). Establishing more capacity in the upstream materials supply chain will be imperative for ensuring compliance with the rules in the longer-term. This will represent a challenge across the EU and the UK within the timescales.

11. What can the UK learn from investment in other countries in the establishment of gigafactories?

oo) 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.

pp) There is clear evidence of the importance placed on the development of gigafactories and a supporting supply chain in different parts of the world. In the USA, the Inflation Reduction Act has directed significant levels of federal funding towards reduction of carbon emissions with a focus on batteries and electric vehicles, including critical materials and recycling incentives. For many years, batteries have been considered to be an Important Project of Common European Interest (IPCEI) by the European Union and have, as a result, been apportioned several billion euros of public funding across the EU. In January 2023, the EU has also

announced the Green Deal Industrial Plan for the bloc to sharpen its competitive edge in clean-tech investment with additional tranches of funding.

qq) The UK must sustain its investment but does not necessarily need to match the massive scale of the above regional funds. What industry needs as a priority is a clear, long-term and stable commitment to industrial policy and provision of a secure and stable business environment for production and international trade. We need to be able to respond to and compete appropriately with those incentives being offered by other governments with agility, speed and flexibility.

rr) Through the Industrial Strategy, a UK ecosystem was established around batteries in 2017 – co-ordinating research, development, scale-up and industrial investment - supported by the Faraday Battery Challenge and the Advanced Propulsion Centre (APC). UKBIC was conceived and developed as part of this funded ecosystem.

ss) UKBIC can share anecdotally that this co-ordinated ecosystem to support industry growth has been envied by others visiting from all over the world. We have welcomed numerous government, industry and research visitors from countries including the USA, Germany, Japan, Singapore and Canada. Without exception, there has been praise for the uniquely joined-up approach we have developed in the UK and the foresight of the development of an open access industrialisation facility like UKBIC, which is a model not seen elsewhere today. We have laid these foundations for UK success through the co-ordinated oversight and consensus-driven objective of an industrial strategy. The most important focus from here is demonstrating sustained commitment to supporting this new industry as it rapidly grows in scale and matures over time.

12. Do we have the skills in the workforce required for the production of batteries? If not what needs to be done?

tt) The skills required are not in place today – not at the scale and speed needed for the forecast growth in production capacity. However, the same is true across Europe generally where this industry is growing from the ground up. The UK does currently have some pockets of knowledge and experience from existing company operations (Envision AESC, AMTE Power, etc) and UKBIC itself is growing a national capability for battery production growth.

uu) It is estimated that a new battery manufacturing plant with the capacity of 30-40GWh/yr could directly create around 3,200 jobs – a similar number could be added indirectly through the supply chain[7]. If we consider the scale of the demand growth for UK produced batteries (<90GWh/yr by 2030), the need for committed growth in production must be supported by sustained growth in the skills pipeline.

vv) Investment in appropriate interventions at the right qualification and skill levels is absolutely imperative to support the growth of this industry. No one company will be able to cope with the scale of the increase whilst ensuring an appropriate level of

[7] Electric vehicle battery value chain opportunity | McKinsey

quality assurance and co-ordination of activities across the UK nationally, and regionally at the point where local interventions are required.

ww) A nationally co-ordinated activity must be convened and supported by government, industry and the education community. Alongside this, regionally focused interventions must be supported by regional and local authorities, local employers and education providers to ensure that demand and supply of talent are well matched and interventions focus on the critical gaps. Access to skills is a critical success factor named among the top decision-making criteria for those making battery investments and is a common reason for problems and delay in the development of new production facilities.

13. Will the cost of UK batteries be competitive compared with batteries produced elsewhere?

xx) The material costs for batteries will be comparable wherever they are made, and will be subject to the same issues of supply constraint and demand growth. The variables which are dependent upon the country of production will be costs such as energy, capital utilisation and the effect of any local subsidies.

yy) Direct subsidies being offered by particular regions and countries for manufacturers to set up production are substantial. This reflects the highly competitive nature of the race to secure battery production clustering as investment decisions are being made. In addition to upfront subsidies, investors must also have sight of the cost effectiveness of long-term operational costs.

zz) In UKBIC discussions with potential gigafactory investors, there are a couple of well-repeated factors that they always state as influencing their gigafactory investment decisions:

viii. Proximity to customers (a clear demand signal)
ix. Investment incentives – comparable to those being offered by other countries
x. Timely site planning and permitting arrangements
xi. Cheap and clean energy
xii. Skilled and productive workforce availability

aaa) These factors, along with a clear and consistent industrial policy, have the power to make the UK competitive with other battery producing nations.

14. What impact will the European Union's proposed Carbon Border Adjustment Mechanism have on UK production?

bbb) The Carbon Border Adjustment Mechanism aims to level the playing field to ensure a fair price has been paid for the embedded carbon emissions of goods imported into the EU, so that climate objectives are not undermined through imported goods and components.

ccc) This is another example of the increasingly tight legislation which will enforce a level of localisation or supply chain transparency that is an emerging trend across the world.

ddd) 80% of cars made in the UK are exported out of the country to other markets. Over 50% of these are imported into the EU. If the UK continues to export cars into the EU, this is a further potential restriction on trade which has not existed previously. However, its aims should be entirely conducive with those objectives being pursued through the UK's net zero legislation. The big challenge will be the tight timescales for compliance in the short-term while battery sourcing decisions and development of new localised battery production are still in progress.