

AUTOMOTIVE BATTERIES

A £4.8bn a year supply chain opportunity by 2030 for UK chemical and material companies



REPORT SUMMARY: APRIL 2019

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£4.8bn

A YEAR SUPPLY CHAIN OPPORTUNITY BY 2030

Introduction



Nissan Leaf battery pack

At the United Nations Framework Convention on Climate Change in Paris, 2016, the world's nations committed to a dramatic reduction in global greenhouse gas emissions in order to limit the global temperature rise to 2 degrees by 2050.

This has resulted in the EU (and the UK) to aim for 80% GHG reductions by 2050 relative to a 1990 baseline. To enact these reductions the UK has committed to carbon budgets.

As part of our response, the UK Government established an Industrial Strategy and Road to Zero ambition to ensure that by 2040 the majority of vehicles sold in the UK would have a significant electrical range and therefore a battery.

This trend has already started due to European legislation and it is predicted that by 2030 nearly all new European vehicles will incorporate a degree of battery power – either as part of a hybrid system or to power a completely electric vehicle.

Lithium-ion batteries are set to play a major part in the future of the automotive industry

The UK chemical industry is in a strong position to capitalise on the rapidly growing market for Lithium-ion (Li-ion) batteries in the UK and Europe – but we need to act now or risk losing production and revenue to our international competitors.

Today, we have a developing battery industry, but to turn this into a fully connected supply chain will require cooperation between the chemical industry, the automotive industry and the UK Government.

We are not starting from scratch as the UK is home to world leading chemical companies who currently supply the foundation materials used in battery cell manufacture. The automotive industry has also been active in developing new and innovative battery technologies here in the UK – through the Faraday Battery Challenge (FBC), Advanced Propulsion Centre (APC) and the UK Battery Industrialisation Centre (UKBIC).

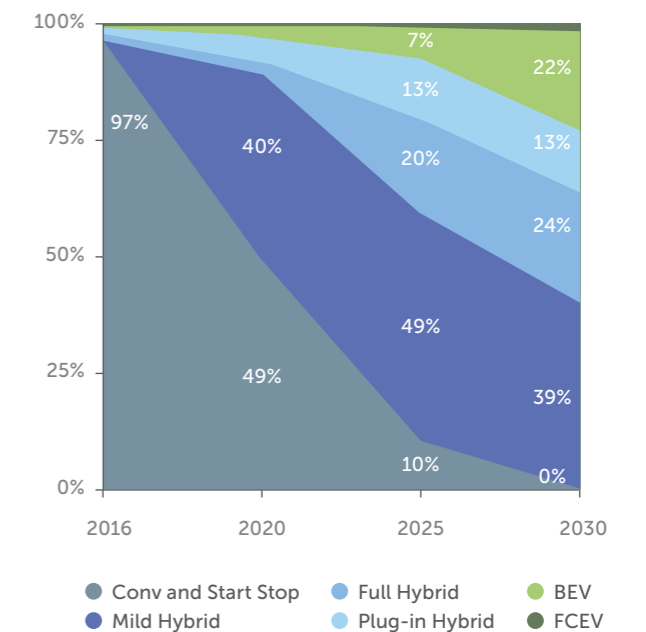
Building on strong foundations

This document is a summary of a report commissioned by Innovate UK and the Advanced Propulsion Centre. Authored by E4tech and supported by the Knowledge Transfer Network and WMG, University of Warwick.

The main report consulted companies in the UK chemical industry to establish what actions need to be taken to capitalise on the opportunities that lie before us.

If we work together, we can have a major impact in shaping not only the future of vehicle production in the UK but also anchor highly skilled jobs and manufacturing capability throughout the battery and chemical supply chain that support the UK in its path to clean growth and prosperity.

EU Light Duty Vehicle Production to 2030



UK-made Electric Vehicle (EV) batteries offer a highly profitable growth opportunity for the UK chemical industry

In 2018 we built approximately 1.6 million vehicles and 2.7 million engines in the UK, the vast majority of which were exported, benefiting the wider UK economy.

For the UK to maintain its automotive industry in a more electrified future, we need to improve our ability to build electric vehicles and have a competitive battery supply chain here in the UK.

The map opposite illustrates how the Electric Vehicle (EV) battery cell manufacturing industry is expanding around the world. As shown, most EV battery cells are currently manufactured in Asia. To continue importing batteries from such a distance for vehicle manufacturing is not commercially competitive or environmentally sustainable. As a result, battery cells will be increasingly manufactured across Europe, including here in the UK.

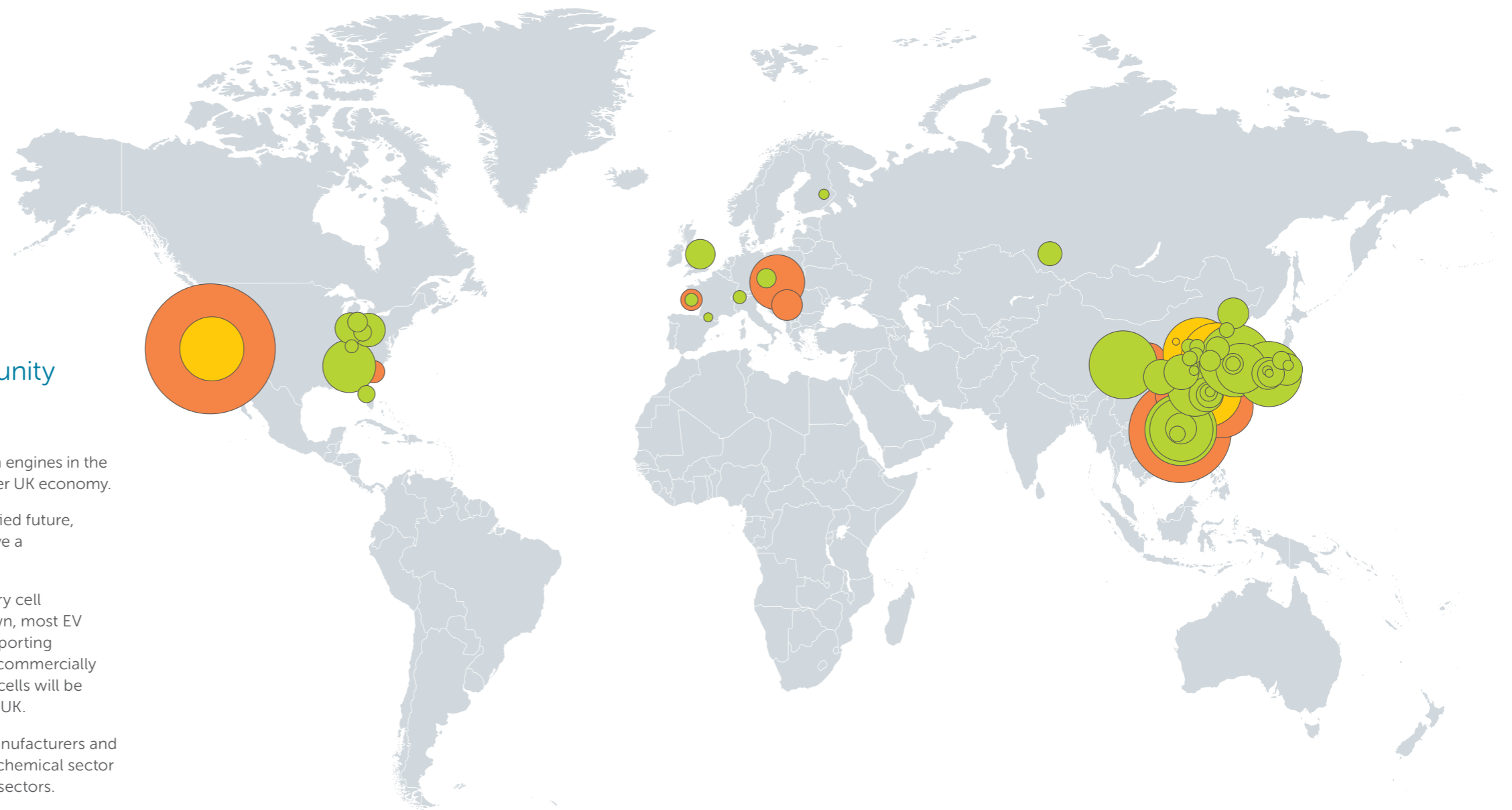
Large scale battery cell manufacturing would benefit UK car manufacturers and provide a strategic link to the UK chemical sector, enabling the chemical sector to unlock new opportunities and offer further benefits to other sectors.

UK-based chemical processing companies already have strong positions in the global battery supply chain

The UK has a strong chemical sector which directly employs 140,000 people in highly skilled jobs, exporting more than £50bn in products and services a year. The UK chemical sector features some of the world's largest and most capable battery supply companies, providing chemicals to the Asian battery market and often holding significant market shares. For example:

- The world's largest producer of speciality graphite cokes, already indirectly supplying battery producers in Asia
- Europe's second largest nickel refinery, also supplying battery producers in Asia
- One of Europe's largest automotive Li-ion battery production plants
- Europe's largest automotive Li-ion battery electrolyte plant and main producer of battery electric vehicles
- R&D and pilot manufacturing for one of the world's leading cathode materials suppliers

However, these individual companies are not a fully integrated supply chain.



Connecting the dots

For the UK to benefit most from this rapidly growing market, we need to connect these individual companies to create a fully functioning UK supply chain. As a result, we would:

- Add more value in the UK, which would benefit our domestic GDP and balance of trade
- Make cell manufacture in the UK more competitive, as the largest cost of battery cells is in their constituent materials
- Increase collaboration and development throughout the supply chain to maintain and strengthen our competitive advantage
- Be more responsive to new emerging battery materials and technologies, offering further exploitation into global markets

Li-ion Battery Manufacturing Asset Map

- Fully commissioned
- Under construction
- Announced

TOTAL CAPACITY
272,597 MWh

Source: BNEF Li-ion battery costs and market July 2017

Most of the value of the battery pack is in its chemical components

Most of the value in a battery pack is in the cells and its chemical components – the majority of the value lies in the chemicals used for anodes, cathodes and electrolyte.



- **25%**
Cell and pack manufacturing
- **56%**
Cell materials
- **19%**
Other pack components



A £4.8bn a year supply opportunity in 2030

Currently Europe imports most cell components from Asia. As volumes rise there will be a necessity for the battery supply chain to be localised – ideally in the UK.

The study gauged the interest of automotive manufacturers and the chemical industry in establishing a stronger UK-based EV supply chain.

E4tech received input from senior representatives of 12 UK chemical and material companies, and in phase 1 over 60 companies declared an interest in the battery value chain.

What seems to be required are broadly two things:

1. Clear demand signals

While UK chemical companies are keen to invest locally, they need clear and early demand signals to give them the confidence to scale up. The development of a UK giga-factory would send a strong signal that we are serious in our intention to establish a market for EV chemicals in the UK.

2. Filling the existing gaps in the supply chain

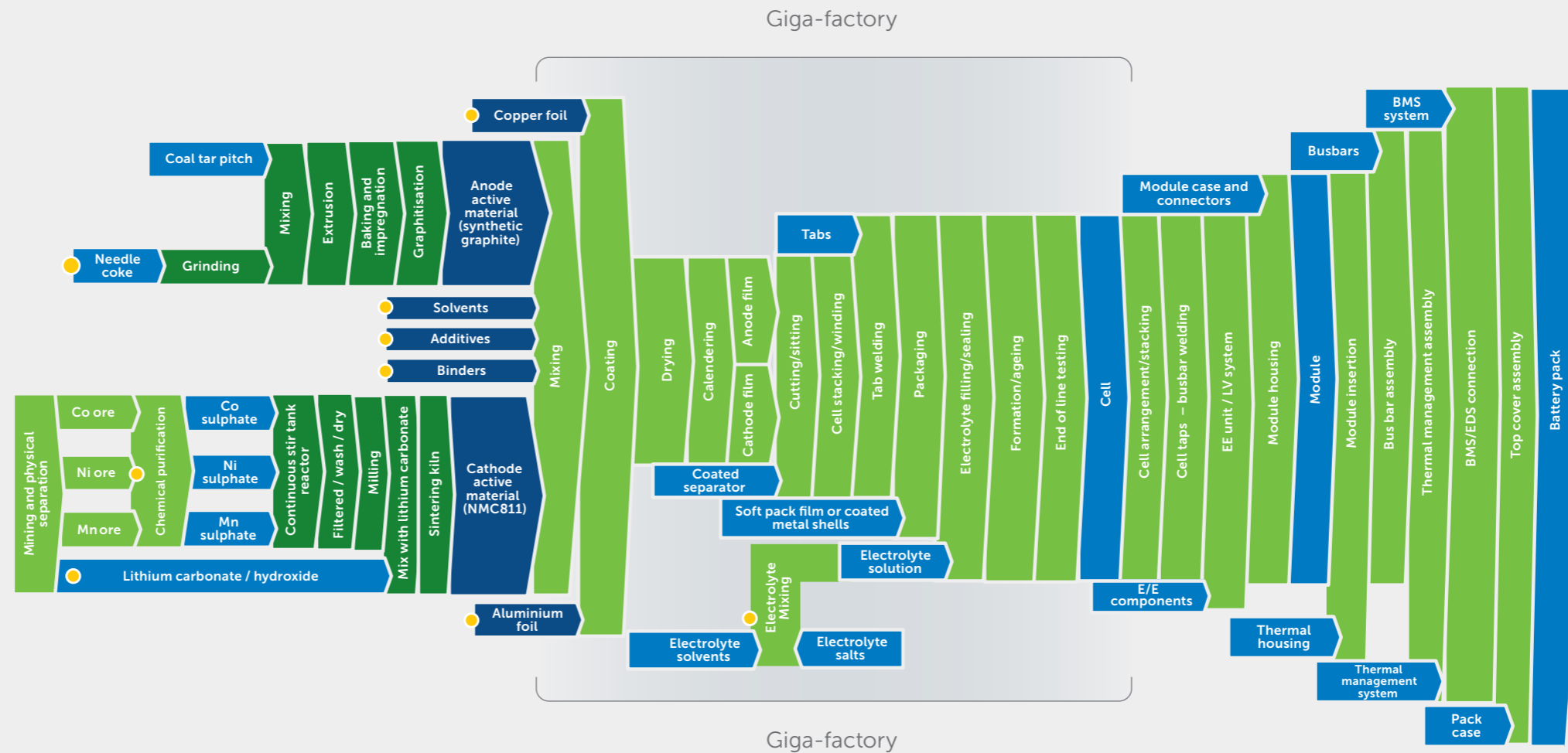
With UK chemical companies keen to find new markets for its existing product portfolios and utilise its IP and know-how in processing, and to fill the gaps in the current supply chain, there is an opportunity to create a £4.8bn a year supply opportunity by 2030.

If we work together (with support and investment from the UK Government) there is a significant opportunity to add growth, value and resilience to the UK chemical and automotive sectors at the same time.

Value chain structure

The diagram opposite maps the materials and processes needed to create a Li-ion EV battery pack. The panels illustrate the relevant processes required to create a fully functioning EV battery supply chain in the UK.

- **Green panels** indicate a manufacturing process
- **Darker green panels** indicate manufacturing processes where UK companies have indicated they are willing to invest if a strong demand signal is made by the UK automotive industry
- **Blue panels** indicate a semi-finished product
- **Dark blue panels** indicate a semi-finished product where UK companies have indicated they are willing to invest
- **Yellow highlights** indicate current UK activity that could be built upon in the future



1 Building giga-factories in the UK

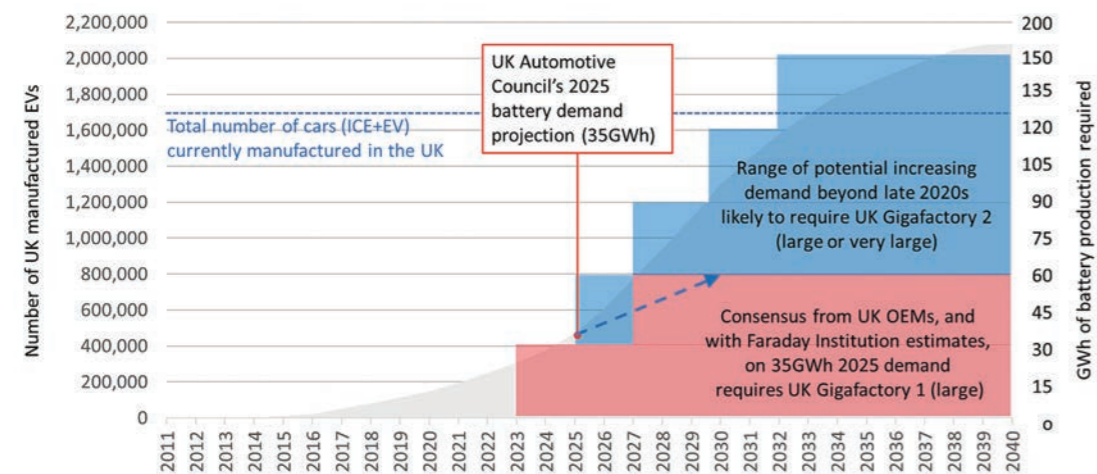
Initiatives such as the FBC, UKBIC and APC competitions have already de-risked a range of leading R&D and scale-up projects utilising government and industry co-investment.

For a UK battery industry to fully develop, the UK needs a large scale battery, electrode and cell manufacturing facility – also known as a ‘giga-factory’.

A giga-factory will link the automotive and chemical sectors and provide the necessary incentive to improve the stages in the value chain which are currently underdeveloped. Local suppliers of critical cell materials will help to improve the investment case for these facilities.

But we shouldn’t stop there. Confirming the development of multiple giga-factories in the UK would substantially raise confidence and incentivise UK chemical companies to invest.

Growing UK demand



Battery cell production facility



Battery R&D

2 Creating a fully developed UK based supply chain

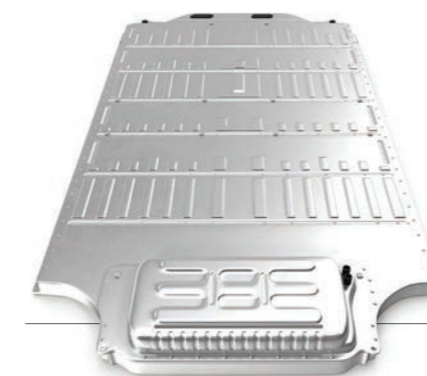
The UK’s battery cell and electrolyte production is ready to expand, building on a strong existing base.

Anode materials (which use needle coke produced in the UK) could also be processed here, adding significant further value.

Nickel, cobalt and lithium processing (as well as further lithium exploration) can be expanded here in the UK. It will need additional permits and investments in new processes and large plants to allow it to compete.

The UK is also capable of manufacturing cathode materials – another critical and high-value component of the battery cell.

Access to low carbon electricity will also be essential. The UK is already committed to delivering some of the cleanest, lowest carbon energy in Europe, protecting the environmental reputation of both the cell makers and the OEMs.



3 Therefore enabling the healthy development of an ecosystem with a route to market

UK chemical and automotive supply chain companies have already begun to develop new collaborations and battery technologies through the £88m investment in collaborative R&D (CR&D) funding via the FBC.

Coupled with the £78m investment through the Faraday Institution, which helps the development of the ecosystem in research, plus £80m in the UKBIC and other existing investments in the High Value Manufacturing Catapult, the UK has created an attractive platform for companies to invest in world-leading R&D.

Alongside internal R&D and support from the FBC, numerous highly innovative UK chemical companies are developing future battery chemistries and are poised to enter the supply chain.

Further support for collaborative R&D (CR&D) and scale-up will be required to enable UK companies to get to market faster.

The next steps – we need to act together and now

UK chemical companies have confirmed they will invest in the developing market for EV batteries.

For the UK to become a leading player, it is imperative that we deliver an integrated supply chain and R&D ecosystem faster than our European counterparts.

Before UK chemical companies invest, they need the right signals from the UK automotive industry to demonstrate we are committed to developing battery production here in the UK.

The UK Government also has a vital role to play, such as the continuation of targeted CR&D.

The UK Government will also need to support accelerated planning and permitting, linked to regional economic development plans – including

links to infrastructure, skills development and targeted FDI within the regions. In addition, support for access to low-cost, low-carbon energy will be crucial in establishing the manufacture of EV batteries and their valuable components in the UK. This will add further support to deliver the ambitions of the Government's Clean Growth Strategy.

Together, we need to ensure that investment is coordinated by applying innovative thinking across our industry, allowing the automotive sector, the chemical sector and the wider economy to capitalise on the opportunities that are currently open to us.

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This work deepens collaboration between the automotive battery cell industry and the chemicals industry

The context for the work is the UK Industrial Strategy. The work was co-sponsored and managed by Innovate UK and the Advanced Propulsion Centre UK. Discussions with the automotive battery companies were led by the WMG, University of Warwick. Discussions with the chemical industry were facilitated by the Innovate UK Knowledge Transfer Network. The consultancy work and this report were executed by E4tech, steered by the sponsoring organisations.

Other key stakeholders identified as beneficiaries of this activity

ISCF Faraday Battery Challenge
Chemistry Council and Chemical Sector more broadly
Automotive Council and Battery Supply Chain
UK Government (BEIS, DIT)

Innovate UK



Innovate UK
Knowledge Transfer Network

