The Global Race Is On

The manufacture of lithium ion batteries is increasing at an exponential rate, which is driven by the global growth in electric vehicles (EVs). Global supply is expected to increase five-fold over the next decade from 297 GWh per annum in 2018 to 1.6 TWh p.a. in 2028 (Figure 1). China has secured first-mover advantage and cornered a substantial proportion of the market. In 2018, around 68% of lithium ion batteries were manufactured in China, compared to 10% in the US and just 4% in Europe. However, with the market set to increase substantially, there is a massive opportunity for Europe to take a bigger portion of the global market.

Europe Playing Catch-up

With a stream of high-volume battery manufacturing plants (‘gigafactories’) coming online over the next decade (Figure 2), Europe can recover some of the lost ground to China. Europe’s market share of the global battery supply market is expected to reach 14% by 2023 and 17% by 2028. European gigafactories serving the growing European market have an advantage over Chinese manufacturing facilities in that they face lower transportation costs and can avoid import tariffs.

European growth is, however, not being achieved by local European firms but by Chinese and Korean battery companies who are seeking to increase their share of the global market and see co-location of OEMs and battery manufacture in Europe as the dominant business model over the long term. Notable plans include LG Chem’s construction of a 45 GWh p.a. plant in Poland, Samsung’s 16 GWh p.a. plant in Hungary and CATL’s 14 GWh p.a. plant in Germany.

The Gigafactory Boom: the Demand for Battery Manufacturing in the UK

The transition to electric vehicles will substantially increase the demand for batteries. Across Europe, there is a race to develop battery manufacturing factories to meet this demand. The UK is well-positioned to be a major player in this market. By 2040, the Faraday Institution estimates that eight gigafactories will be needed in the UK and consequently employment in the automotive industry and battery supply chain could increase from 186,000 to 246,000 jobs.
In the UK, the Nissan Sunderland plant was one of the first sites in Europe to manufacture EV batteries. Established in 2007 as a joint venture between Nissan, NEC and Tokin Corporation, the Automotive Energy Supply Corporation (AESC) started production in 2010. However, the size of production has remained small with current production of around 2 GWh p.a. In 2018, Nissan announced the sale of AESC to Envision Group.

The UK Demand for Gigafactories
The Faraday Institution expects UK battery demand to be sufficient to support one UK gigafactory from 2022 and a second factory from 2025. However, the UK needs to move fast if it is to secure these initial gigafactories and capture a substantial share of the European market. It may take up to five years to design and then build a new gigafactory in the UK. A considerable amount of time will be spent on locating a suitable site, securing permits/licences and construction of the plant itself.

Over the longer term, we forecast demand for EV battery production in the UK to reach 130 GWh p.a. by 2040. This would support about eight gigafactories in the UK assuming each plant has a production capacity of 15 GWh p.a. Such domestic demand (which assumes no battery import or export) represents 11% of the projected 1,200 GWh p.a. of European battery production.

What Does a Gigafactory Look Like?
The term 'gigafactory' was initially coined by Elon Musk as a name for one of Tesla’s lithium ion battery and EV manufacturing plants, such as the ‘Gigafactory 1’ plant located in Nevada. It is now used more widely to define any large battery manufacturing plant, such as the Northvolt gigafactory in Sweden. A typical gigafactory produces cells and modules used in EVs, as well as undertaking wider activities such as laboratory analysis, prototype engineering and R&D.

Figure 4 illustrates the detailed activities undertaken in the manufacture of a lithium ion EV battery module. We estimate that a gigafactory undertaking these activities in the UK would directly support between 2,000 and 3,000 jobs and indirectly support a further 7,000 to 8,000 jobs in the battery supply chain.
Employment Supported by the EV and Battery Manufacturing Industry

If the UK managed to supply all of its domestic battery demand through eight new gigafactories, we estimate that employment in the automotive industry and its battery supply chain could increase from 186,000 to 246,000 full-time equivalent (FTE) jobs by 2040 (Figure 5).

Employment manufacturing vehicles with traditional internal combustion engines will decline as people start to purchase EVs in greater numbers. However, we expect that an additional 83,000 new FTE jobs in the EV and battery manufacturing industry would be supported, comprised of:

• 8,000 jobs in EV manufacturing;
• 26,000 jobs in battery manufacturing;
• 47,000 jobs in the battery supply chain; and
• 2,000 jobs in battery R&D.

Employment levels in the 125,000 jobs indifferent to the powertrain (the mechanism that transmits engine power to the axle) are predicted to be unaffected by the transition and unchanged over the period to 2040.6

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6 We assumed that the 1.2% per annum growth in EV and internal combustion engine vehicles produced in the UK is offset by the same per annum increase in labour productivity.
**Risks to the Automotive Industry without Battery Manufacturing**

The increase in automotive employment is far from certain. Our research and discussions with the automotive industry and battery manufacturers suggest that financial, legal, regulatory and safety considerations will push automotive OEMs and battery manufacturers to be located in close proximity to one another.

Lithium-ion batteries are classified as miscellaneous dangerous goods which means they need to be carefully handled, packed and transported. As volumes increase this could become more costly and challenging for the industry. Locating battery production close to EV production also helps support a just-in-time manufacturing system by reducing working capital, shortening the cross-border supply chain and lowering carbon emissions caused by transportation.

If the UK does not attract and develop a battery manufacturing industry, then there is a risk that the production of EV’s could move out of the UK and gravitate towards where the batteries are manufactured. Without UK battery manufacturing, we estimate that car production in the UK would decline and there would be a potential loss of some 114,000 existing automotive jobs by 2040 (Figure 6).

**Figure 6: UK automotive industry jobs to 2040 in the absence of battery manufacturing**

![Graph showing automotive industry jobs to 2040](image)

Source: Faraday Institution estimates

**What Needs to Happen?**

Although the UK will have the battery demand to support one gigafactory by the early 2020s, the challenge to secure interest from global firms should not be underestimated. The UK cannot hope to attract gigafactories through the provision of a low cost-base alone but needs to come closer to matching the financial and administrative incentives offered by other European countries. For example, France and Germany have recently offered financial incentives of €750 million and €1 billion respectively to EV battery manufacturing firms.

We conclude that HM Government should consider the following actions:

- further moves to establish coordinated, ambitious and centralised leadership;
- further efforts to communicate the attractiveness of the UK as a global and regional battery manufacturing location; drawing on the content of this report; and
- new efforts to de-risk the business case by undertaking prospective site selection, the preapproval of relevant permissions, the construction of basic on-site physical (especially energy) infrastructure and the development of the requisite EV battery skills and training infrastructure.

While the growth of the EV market will not start to accelerate until the early 2020s, the UK government needs to act now to secure a UK gigafactory otherwise a significant economic opportunity will be missed. Securing battery manufacturing in the UK will support the rapid growth of EV production and future proof employment in the UK automotive industry.

**About the Faraday Institution and Faraday Insights**

The Faraday Institution is the UK’s independent research institute for electrochemical energy storage research and skills development. We bring together academics and industry partners in a way that is fundamentally changing how basic research is carried out at scale to address industry-defined goals.

Our ‘Faraday Insights’ provide an evidence-based assessment of the market, economics, technology and capabilities for energy storage technologies and the transition to a fully electric UK. The insights are concise briefings that aim to help bridge knowledge gaps across industry, academia and government. If you would like to discuss any issues raised in this ‘Faraday Insight’, or our wider battery research programme, please contact Stephen Gifford.

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