

The future of the UK auto industry

What role for government?

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Executive summary

The UK auto industry is facing a set of problems which could lead to a serious decline in production and employment: it is lagging behind European competitors in managing the transition to electric cars; Brexit has made the UK a less attractive investment location for non-British manufacturers; and there is some uncertainty over the future direction of Jaguar Land Rover, the largest employer among the UK-based car assemblers.

Given the industry's economic and political importance – it has nearly 200,000 employees, mainly in the Midlands and the North - the government is bound to be involved in finding a way through these problems. Its ability to do so is complicated by the fact that the industry is almost entirely foreign owned. The big assembly plants are run by multinational companies which also have factories in the EU and elsewhere and are not necessarily committed to the UK.

Part of the rationale for the Faraday Battery Challenge, launched by Theresa May's Conservative government in 2017, was to create a domestic supply chain for car batteries and thus make it more likely that the assemblers would make their electric cars in the UK rather than elsewhere. There was also a hope that one of the big Asian battery producers such as Samsung might be induced to build a gigafactory in the UK.

That latter hope was disappointed. The Asian companies preferred to invest in the EU, mainly in order to be near the big German auto industry. The one British success was the decision by Nissan to make its first electric car at its Sunderland plant. This was linked to a small battery factory, built by AESC, a separate company which was then partly owned by Nissan; that company was later acquired by Envision, a Chinese renewable energy group. In 2021 Envision announced plans to build a full-scale gigafactory, the first of its kind in the UK, in Sunderland.

That decision was welcomed by the government, but one gigafactory would not be enough to supply the predicted volume of UK-built electric cars as the transition away from petrol and diesel engines continued. Attention then turned to a new entrant, Britishvolt, which had ambitious plans to build a gigafactory in the north of England. This firm made a promising start, and it won a provisional grant from the government. But it was never able to raise the capital that it needed, and it went into administration at the start of 2023. As things stood when this paper was written, prospects for a second UK gigafactory seemed to depend on whether Tata, the Indian conglomerate which owns Jaguar Land Rover, would build one.

Meanwhile some 25 gigafactories are in operation, under construction or planned in the EU. The extent of the UK's lag has prompted criticism of the government for not doing enough, through subsidies and in other ways, to promote investment in car batteries. Yet the principal reason why the Asian companies went to the EU and not to the UK was not the size of the subsidy but the size of the market – and the proximity of the big European car makers. That was an advantage which the UK could not match.

Gigafactories are only one part of the battery supply chain, and UK-based battery component makers, often with help from government, have made good progress in the last few years, some of them working on novel battery technologies. Many of these firms have their eye on international customers – car makers and battery manufacturers which are looking for ways of improving battery performance. Whether more gigafactories are built in the UK is not crucial to their future.

A promising battery sector is taking shape in the UK, but the lag in gigafactories remains a matter of concern. This paper argues that the UK should not try to match the subsidies that are available in the EU and the US but should focus on other ways of encouraging investment, and on removing obstacles – most obviously high energy costs – that put UK-based battery firms at a disadvantage. Self-sufficiency in all phases of the battery supply chain is not a realistic objective; even if more gigafactories are built the UK will remain a significant importer of battery components and materials.

What is also important, for this and other industries, is a greater degree of stability in government policy. The erratic conduct of UK industrial policy over the last two years has been confusing for business and bad for investment. The government is right to support the auto industry as it makes the transition to electric vehicles, but that support must be consistent, and based on a realistic assessment of where the industry now stands and how best it can compete in the world market.

Introduction

The UK auto industry is facing a set of problems which could lead to a serious decline in production and employment. Given the size of the industry – it has nearly 200,000 employees, mostly in the Midlands and the North – and its contribution to exports, the government is bound to be involved in finding a way through these problems.

There are three main sources of anxiety. First, the industry is falling behind its European competitors in managing the transition to electric cars. Second, Brexit has made access to the industry's principal export market more difficult and reduced the attractions of the UK for non-British investors. Third, there is some uncertainty about the future direction of Jaguar Land Rover, the largest employer among the British car makers.

A more recent threat, affecting not just the UK but the whole of Europe, is the protectionist shift on the part of the Biden administration in the US. The Inflation Reduction Act provides generous subsidies to encourage the production in the US of electric cars, car batteries and battery components. Together with other US advantages, including lower energy costs, these incentives are causing some European companies to consider shifting their investment from Europe to the US.¹

What can the government do to help?

1. For an assessment of the threat to Europe from US subsidies, see "How not to lose it all: two-thirds of Europe's battery gigafactories at risk without further action", a report by Transport & Environment, March 2023.

Background

A complicating factor for the government, as it looks for ways of supporting the car makers, is that virtually the whole of the industry is foreign owned. All the larger assembly plants are run by multinational companies which also have factories in the EU and elsewhere and are not necessarily committed to the UK. This stems in part from the collapse in the 1970s of the one-time national champion British Leyland. The stronger parts of that company, including Jaguar and Land Rover, were later acquired by non-British firms. During the 1980s three Japanese companies, Nissan, Toyota and Honda, built assembly plants in the UK, mainly to secure access to the European market.

These ownership changes, together with the Japanese investments, contributed to a revival in car production, and the industry was generally stable in the 1990s and early 2000s. From a low point of 924,000 vehicles in 1980, production in those years was running at an average rate of about 1.5m vehicles a year. But the industry was badly affected by the recession that followed the world financial crisis in 2008, and car sales fell sharply. The then Labour government, responding to pressure from the manufacturers, set up the Automotive Council, charged with reviewing the industry's future. This marked the start of a period of closer government involvement in the industry's affairs, which was taken further by David Cameron's government after Labour's defeat in the 2010 election.

The new government, a coalition between Conservatives and Liberal Democrats, adopted an active industrial policy (a sharp break from the non-interventionist stance of the Thatcher and post-Thatcher Conservative governments), focused on improving the competitiveness of important industries, including cars.

The world motor industry was then in the early stage of decarbonisation, the replacement of internal combustion engines by cleaner forms of propulsion, principally batteries based on lithium-ion cells.² Lithium-ion technology had been pioneered in Japan, first for use in small electronic devices and later applied to cars.³ The Japanese lead was soon challenged by South Korea and then on a much bigger scale by China, which has become the world's leading manufacturer of electric cars, car batteries and battery components.

Cell makers in these three countries became the dominant suppliers to American and European auto companies as they began to develop electric cars⁴. Tesla, for example, an American newcomer which was to achieve spectacular success, formed an alliance with Panasonic of Japan to build what Elon Musk, the chief executive, called a gigafactory. This was a term

2. The cell is a device that converts chemical energy into electrical energy. An electric car battery is made up of a number of cells, which are made in volume by cell makers in large, capital-intensive factories. The cells are converted, either by the cell makers or by the car assemblers, into modules and then into battery packs. The principal cell components - cathode, anode, electrolyte and separator - are generally bought from outside suppliers, although there are some examples of vertical integration.

3. For an account of the early development of electric cars and the rise of the Asian battery makers see "Batteries for electric cars: a case study in industrial strategy", Geoffrey Owen, Policy Exchange, April 18, 2018. See also Seth Fletcher, *Bottled lightning: superbatteries, electric cars and the new lithium technology*, New York 2011; Henry Sanderson, *Volt rush, the winners and losers in the race to go green*, One World Publications, 2022.

4. Car makers do not generally make their own cells, although there are some exceptions, notably BYD in China.

invented by Musk to refer to a large, energy-intensive battery factory with an annual capacity of 20-30 gigawatt hours (GWh) or more.⁵

By 2010, when the coalition government took office in the UK, an international race in electric cars was taking shape, and the UK was falling behind. In 2013, following discussions within the Automotive Council, the government set up the Advanced Propulsion Centre (APC), jointly financed by the industry and the government, to support investment in low-carbon forms of propulsion, including hydrogen fuel cells as well as batteries.

In 2017 Theresa May's Conservative government (she had replaced David Cameron after the Brexit referendum) launched the Faraday Battery Challenge, designed to attract investment from British and non-British firms which were either in the car battery business or could be encouraged to enter it. Two new institutions were set up: the Faraday Institution, to fund battery-related scientific research, and the UK Battery Industrialisation Centre (UKBIC), to enable cell makers and component suppliers to test their products in advance of commercialisation. Innovate UK, the government agency which backs later-stage research when firms are nearing commercialisation, was given additional funds to support the battery sector.⁶

More help for the auto industry came in 2020 from Boris Johnson's government. Within the Advanced Propulsion Centre a new fund was set up, the Automotive Transformation Fund (ATF), which had a broader remit than Faraday. It provides grants to firms that are engaged in developing, not just batteries and battery components, but other electric vehicle components and non-battery technologies.

5. A gigawatt hour represents one billion watt-hours and is used as a measurement of electricity generating capacity.

6. The thinking behind the Faraday Battery Challenge was set out in a letter from Sir Mark Walport, chief scientific adviser, to the Business Secretary in 2017, Government Office for Science, March 3, 2017.

Consequences of government intervention

In the period since these programmes were launched there have been some setbacks and one notable success. A big disappointment was the decision by Honda, which had opened its Swindon plant in 1992 and employed some 3,500 workers, to pull out of the UK. This was mainly caused by declining sales of Honda cars in Europe and a reassessment of the company's global strategy, but Brexit was also a factor. Honda's withdrawal was largely responsible for a sharp fall in UK car production last year, although the semiconductor shortage was also an important factor. Output amounted to 775,014 cars in 2022, compared to 859,575 in 2021 and 1.3m in 2019, the last pre-Covid year; in that year 81 per cent of the industry's production was exported, of which just over half went to the EU.

The two American companies which had long been investors in the UK, Ford and General Motors, have also stopped making cars in the UK, although some of their factories, including Ford at Halewood and the ex-Vauxhall plant at Ellesmere Port (now owned by Stellantis), are still in operation. Halewood is being converted to make electric vehicle components, while Ellesmere Port has been modernised and will be making electric vans⁷. Both projects have benefited from government grants.

The UK's two largest car assemblers are now Nissan and Jaguar Land Rover, followed by BMW and Toyota. Below them is a group of low-volume specialist car makers, including Bentley, Rolls-Royce, Aston Martin and Lotus (Table 1).

7. The Ellesmere Port electric van project appears to be in some doubt as a result of the rules of origin requirements set out in the UK-EU Trade and Cooperation Agreement, see below p20.

Table 1 UK car production in 2022

Company	Country of ownership	Principal factories	Units
Nissan	Japan	Sunderland	238,329
Jaguar Land Rover	India	Castle Bromwich, Halewood, Solihull	202,788
BMW Mini	Germany	Oxford	188,222
Toyota	Japan	Burnaston, Derby	105,590
Bentley	Germany	Crewe	15,639
Vauxhall+	France	Ellesmere Port, Luton	9,510
Others*			16,936
TOTAL			775,014

*Includes Aston Martin, Lotus, Rolls-Royce, Caterham, LEVC, McLaren and Morgan

+Includes Vauxhall, Citroen and Peugeot products made at IBC Luton

Source: SMMT

Another disappointment was the failed attempt by James Dyson, who had built a successful business in vacuum cleaners and other household appliances, to break into the electric car market. This had involved a substantial commitment of money and talent over several years, including an investment in an American developer of solid-state batteries (seen as a likely replacement for lithium-ion). Several experienced executives from the motor industry were hired, and a number of prototype cars were produced. But Dyson could not get costs low enough to create a profitable business, and the project was abandoned in 2019.⁸

The big success came in 2013, when Nissan, which had been making cars in Sunderland since 1986, decided to make its electric car, the Leaf, on the same site. This was linked to the construction of a small battery factory by a separate company, Automotive Energy Supply Corporation (AESC), which was then partly owned by Nissan. In 2018 Nissan sold AESC to Envision, a Chinese company.⁹

In 2021 Envision announced plans to build a large gigafactory in Sunderland, the first of its kind in the UK, to supply batteries to Nissan and potentially to other customers; this project was supported by the Automotive Transformation Fund.¹⁰ The factory is expected to come on stream in 2025 with an initial capacity of 12 GWh, rising to 25 GWh by 2030 and later to 35 GWh.

That Envision had chosen to invest in the UK was a relief for the government. (The Chinese company was also building a plant in France to supply Renault, and it later announced plans to build a gigafactory in the US to supply BMW.) However, one gigafactory on its own would not be enough to supply the predicted volume of UK-built electric cars as

8. Autocar, June 3, 2020.

9. Nissan retained a minority interest in the Sunderland battery plant.

10. Nissan also received government support, not from the ATF, which does not directly support car assembly, but through the Treasury-administered scheme known as the Exceptional Regional Growth Fund.

the transition away from petrol and diesel engines continued. According to forecasts by the Faraday Institution, based on the expected growth in production of electric vehicles, UK demand for battery manufacturing capacity would reach over 100GWh by 2030, the equivalent of five gigafactories.¹¹

How to create this additional capacity has been a major preoccupation for the government and the industry over the last few years.¹²

11. UK electric vehicle and battery production potential to 2040, Faraday Institution, June 2022.

12. For an assessment of the gigafactory gap and its likely consequences see Written evidence from the Advanced Propulsion Centre to the House of Commons Business and Trade Committee, May 2023.

A promising newcomer

Part of the rationale for the Faraday Battery Challenge was that the creation of a domestic battery supply chain would help to anchor the existing car assemblers to the UK. But there was also a hope that the government's commitment to the sector would encourage one of the leading Asian cell producers to build a gigafactory here. That has not happened. Three South Korean firms, Samsung, LG Chem and SK Innovation, chose to invest in Poland and Hungary, mainly in order to be close to the German auto industry. Others, including CATL, the largest Chinese battery producer, are investing in Germany itself, as is Tesla from the US, which is making cars and batteries at a site near Berlin.

Some European start-up firms, of which Northvolt in Sweden is by far the most successful, are also building or planning to build gigafactories. European-owned ventures are highly valued by governments since they reduce the industry's dependence on Asian technology and are more likely than the Asian transplants to contribute to research and development in Europe.

For the UK, the absence of Asian investment made the case for a home-grown battery firm all the more pressing.¹³ Hence there was an enthusiastic response in government to the emergence of an ambitious newcomer, which planned to build a gigafactory in the UK. This was Britishvolt, founded in 2019 by Orral Nadjari, an investment banker based in Abu Dhabi who had close connections with the UK (he had been educated at Cardiff University), and Lars Carlstrom, a Swedish businessman who had extensive experience in the auto industry.

Nadjari served as chief executive, with Carlstrom as chairman. Carlstrom resigned in 2020 following the revelation that some years earlier he had been involved in a tax dispute with the Swedish authorities. He was succeeded as non-executive chairman by Peter Rolton, chairman of Rolton group, an engineering consultancy, who had been advising Britishvolt from the start; he was an expert in renewable energy technologies.

During 2020 Britishvolt made two key appointments, Isobel Sheldon as chief strategy officer and Allan Paterson as chief technical officer. Sheldon had been director of business development at UKBIC, and before that had held senior positions in Johnson Matthey's battery division. Paterson joined from the Faraday Institution, where he had been head of programme management; he had previously worked at Cummins and at Johnson Matthey. In 2021 Graham Hoare, a former chairman of Ford of Britain and co-chairman of the Automotive Council, was brought in as president of global operations.

13. The only existing UK-owned cell maker, AMTE Power, based in Thurso, Caithness, does not compete in the high-volume automotive market. It supplies mainly specialist vehicle manufacturers and the energy storage market. It is currently planning to build a new factory in Dundee.

Unlike some other battery startups, Britishvolt did not obtain technology from one of the Asian battery companies. Instead, it developed its own cells, working closely with the innovation arm of Warwick University, known as WMG, and with UKBIC. By 2021 Britishvolt's work with its partners reached the point where it could begin to show sample cells to potential customers. Two small car makers, Aston Martin and Lotus, were sufficiently impressed to sign memorandums of understanding with Britishvolt, although this was a long way short of firm orders.

In seeking a location for its proposed gigafactory Britishvolt first selected St Athan in South Wales, close to a car assembly factory which was being built by Aston Martin. But there were planning difficulties, and the company opted for a bigger site at Blyth in Northumberland, which had the attraction of good transport connections and access to renewable energy; it was regarded as one of the best available locations in the UK for a gigafactory. The company said that the project would involve a total investment of £2.6bn, creating 3000 skilled jobs and up to 5000 more in the supply chain. Construction would start in the summer of 2021 and production of cells would begin by the end of 2023.

Nadjari's plan was to finance the project mainly through equity. In 2021 he considered going public through a Special Purpose Acquisition Company (SPAC), which was then a popular route into the stock market for early-stage firms, but this idea was not pursued. Nadjari himself was the largest shareholder, followed by William Harrison, a Texan investor.¹⁴ Another investor was Glencore, the mining group, which took shares in Britishvolt as part of an agreement for the long-term supply of cobalt. Some British investors, including Ashtead, an equipment rental company, came in later.

With the development of cells making good progress and plans for the Blyth factory taking shape, Britishvolt was seen in government as a much-needed British-owned player in the gigafactory business. There were hopes that Blyth could become the nucleus of a battery cluster, attracting investment from British and non-British component and material suppliers.

Britishvolt was in close touch with the Automotive Transformation Fund, which was eager to support a second gigafactory; it had earlier provided a grant to Envision for the new plant in Sunderland. In January 2022 the ATF announced that it had agreed in principle to supply funds to Britishvolt, subject to certain conditions being met. The amount of the grant was £100m, with the first payment due to be made in March 2023.

The Blyth project was strongly supported by Boris Johnson and other ministers. Kwasi Kwarteng, then Business Secretary, described it as a pivotal moment for the battery sector and a major boost for Britain. The government, he said, was "proud to make the investment necessary to ensure that the UK retains its place as one of the best locations in the world for auto manufacturing".¹⁵ According to a statement from the Advanced Propulsion Centre, Britishvolt had the potential to become "a real national champion". It had made the transition from research through to commercialisation, and the Blyth project offered "a once in a generation

14. Harrison's private equity firm, Cathexis, controlled ISG, a construction company which had won the contract to build the Blyth factory.

15. Press statement. Department of Business, Energy and Industrial Strategy, January 21, 2022

opportunity to reengineer the industry's supply chain".

The government's support was expected to encourage more private investors to come in, although the terms of the grant were far from generous. It covered a smaller proportion of the expected capital expenditure than most other ATF grants, presumably reflecting the riskiness of the project, and it contained some provisions which were unhelpful. For example, Britishvolt would not receive the money until it had ordered and paid for the machinery that was to be installed at Blyth – more a reimbursement of costs incurred than a grant. This was bound to make investors nervous.

More serious for the company's fund-raising efforts was a change in the investment climate, caused mainly by the Ukraine war and the rise in energy costs. Foreign investment into the UK fell sharply in 2022, and Britishvolt had great difficulty in securing the funds that it needed. To make matters worse, the resignation in July of Boris Johnson was followed by a period of political turbulence and economic uncertainty in the UK. The much-criticised Truss-Kwarteng mini-budget in September came at a time when Britishvolt, struggling to find a partner or acquirer, was close to agreement with potential investors. The effect of the budget was to undermine confidence in the UK economy, and the investors decided not to proceed.

In the closing months of 2022 Britishvolt was in crisis. The question for government was whether the survival of the only British-owned contender in a sector deemed to be essential for the achievement of net zero, and for the future of the auto industry, was important enough to justify an injection of public funds. One possibility was to bring forward the first £30m of the government grant that had been due to be paid out in March 2023. Another was for the government to take a stake in the business.

Senior people in the Johnson government badly wanted Britishvolt to succeed. Throughout 2022 strenuous efforts had been made, notably through the Office for Investment, to bring in foreign investors. In the end, despite the high hopes that had been invested in the company, ministers concluded that it was not viable. The biggest weakness, which the government had no power to remedy, was the absence of committed customers for its cells.

At the end of October the government told the company that it would not step in with emergency funding. Frantic efforts to find other backers over the next two months proved fruitless. On January 18 the company went into administration; most of its 232 staff were made redundant.

The administrators then set about finding a buyer for the assets, and at the end of February they agreed a deal with an Australian company, Recharge Industries, which acquired Britishvolt's intellectual property and its battery technology. The new owner is expected to use the Blyth site to produce storage batteries for the electricity industry. It may later make car batteries, but it has made no decision on the timing of any such investment.

Jaguar Land Rover

Attention then shifted to other ways of securing investment in gigafactories. The obvious customer for any new factory was Jaguar Land Rover (JLR), which had already committed itself to an all-electric future. It had launched its first electric car, the Jaguar I-Pace, in 2018, but this vehicle was assembled in Austria and the battery packs were supplied from LG Chem's factory in Poland. The expectation was that JLR would convert its UK factories to make electric cars, and this has recently been reaffirmed by the company. It announced in April that it will spend £15bn over the next five years on a new suite of electric cars; this will include seven new models, one of which will be an all-electric Range Rover to be launched late in 2024.¹⁶

Jaguar had traditionally been a manufacturer of up-market specialist cars, competing against such firms as Mercedes, BMW and Audi. Following an unhappy period as part of British Leyland in the 1960s and 1970s, it was floated as an independent company and then acquired by Ford. The American company later bought what was left of the old Rover company, principally Land Rover and Range Rover. Another change of ownership took place in 2008 when what was now called Jaguar Land Rover was sold to the Indian conglomerate, Tata Group.

JLR has had a mixed performance under Tata's ownership. Run for ten years by Ralf Speth, who had been hired from BMW, it expanded its model range and pushed into new markets, especially China. But it was hit hard by the collapse in demand for diesel-powered cars. When Thierry Bolloré, former head of Renault, took over from Speth in 2020, he faced the need to streamline the model range and to accelerate the transition to electric cars. Neither task was completed by the time Bolloré stepped down in 2022, leaving the owners with difficult questions as to the company's future.

In view of JLR's small scale compared to its main competitors, there has been speculation that Tata might sell the Jaguar side of the business or find a partner. However, last month's announcement made it clear that Tata would continue to invest in Jaguar, aiming to strengthen its position at the high end of the luxury car market.

The April announcement left open the question of how and where the company would obtain its batteries. Its owner, Tata, was known to be planning an investment in a European gigafactory, with Spain as well as the UK being considered as a possible location. Newspaper reports at the end of May suggested that Tata will opt for the UK, thanks to a package of financial support from the government which will include subsidised

16. Financial Times April 19, 2023

energy costs.¹⁷ According to these reports, the factory will be built at the Gravity Campus near Bridgwater in Somerset, a 600-acre site with good transport and electricity connections.

If these arrangements are confirmed, it will take 3-5 years before the new factory is in full operation. In the meantime, JLR will need to obtain cells from an established cell manufacturer and convert them into battery packs in its own factories.

17. Financial Times, May 24, 2023

Should the government have done more?

A favourable Tata decision will be welcome news for the industry after the disappointment over Britishvolt. But it will still leave UK car makers a long way behind their European competitors. Could this have been avoided if the government had supported the industry more generously? How does its approach differ from that of the EU?

In 2017 the European Commission launched the European Battery Alliance, an integrated European plan for investment in car batteries. This paved the way for what the EU calls an Important Project of Common European Interest (IPCEI), a funding mechanism through which two or more governments are permitted to support high-priority projects on terms that would normally fall foul of EU state aid rules. The first project for batteries, supported by seven member states, was approved in 2019, the second, involving twelve countries, in 2021.

These programmes were launched at a time when the European car makers, some of which had been hesitant about making the switch to electric cars, were beginning to formulate their electrification strategies. At the start this mainly involved supply agreements with Asian battery companies, but the car makers also invested in European-owned suppliers. For example, Stellantis formed a joint venture with Saft, the French battery firm, to create the Automobile Cells Company (ACC).¹⁸ Daimler-Benz, owner of Mercedes, later took a one-third stake in this company, which plans to build gigafactories in France, Germany and Italy. Volkswagen formed a link with Northvolt, which has become one of its major suppliers; it holds a stake of just over 20 per cent stake in the Swedish firm.

By the start of 2023 some 25 gigafactories were in operation, under construction or planned in the EU. Many of them were partly financed by national governments through the IPCEI programmes. For example, ACC's gigafactory at Kaiserslautern in Germany (a former Opel plant) received a grant of €437m, of which €51m came from regional funds and the rest from the federal government.

A new EU initiative, launched in 2022 in response to the energy crisis, is the Temporary Crisis and Transition Framework (TCTF), which allows governments, for a limited period up to 2025, to support energy-saving investments including battery projects. This is the mechanism through which the German government is helping to fund a Northvolt gigafactory at Heide in Schleswig-Holstein – a project which is seen in part as a response to America's Inflation Reduction Act.¹⁹

18. Stellantis had been formed in 2021 by a merger between Fiat-Chrysler and PSA of France, which owns Peugeot and Citroen. PSA had previously bought the Vauxhall/Opel business from General Motors. Saft is a subsidiary of Total, the French oil company.

19. Financial Times May 13, 2023

How important have subsidies been in stimulating investment in the EU? For the Asian companies, subsidies clearly influenced their decisions on where to build their European factories. (In the case of Poland and Hungary cheap labour and low construction costs were also important.) But the principal reason why they went to the EU and not the UK was not the size of the subsidy but the size of the market. Germany had a far bigger auto industry than the UK and was the home to three of the largest European manufacturers – Volkswagen, Daimler Benz and BMW.

Elon Musk of Tesla briefly considered the UK, but this did not reach the stage of a firm proposal. When he announced his decision to build a factory near Berlin, he said he had done so partly because German engineering was outstanding. The UK had not been in the running, he said, as it was considered too risky because of the uncertainty caused by Brexit.²⁰ BYD, the Chinese car and battery maker, which is planning to build a plant in Europe, said its shortlist included sites in Germany, France, Spain, Poland and Hungary; it had ruled out the UK because of Brexit.²¹

If Tata builds a gigafactory in the UK, support from the government will obviously have influenced its decision. But Tata, through JLR, is already a large investor in the UK.²² The Asian battery companies were in a different position. It is unlikely that, even if the British government had been able to offer bigger subsidies, they would have chosen the UK rather than the EU.

As for the funding of start-ups, some of the people involved in trying to save Britishvolt believe that the terms on which Northvolt and other European firms received assistance in their early days from government or semi-government sources (before they were generating revenue and before they had secured firm orders from car makers) were less onerous than those imposed by the UK on Britishvolt. It is true that some of the conditions attached to the provisional Britishvolt grant, designed to reduce the risk to government if the company failed, may have deterred potential private investors, but this was not a decisive factor in the company's eventual demise.

When Northvolt was getting started, in 2017, the business environment was different from what it was when Britishvolt was founded. The great gigafactory race was just beginning, and Northvolt looked like a potential star in an emerging industry. By 2020 the market was more crowded, making Britishvolt's attempt to break in all the harder. The fact that Northvolt's two founders were former Tesla executives gave the company a credibility which Britishvolt lacked. Northvolt has been an exceptional performer in the European battery business; no other start-up has come close to matching its achievement.

It was unfortunate that Britishvolt's crisis came at a time of political and economic uncertainty in the UK, involving, among other things, frequent changes in the leadership of the business department, which had the primary responsibility for the auto industry. There may also have been a view in some parts of the Conservative Party that the car manufacturers should be left to find their own solutions to their various problems, even

20. Financial Times November 12, 2019.

21. Financial Times March 12, 2023.

22. Tata also owns the Port Talbot steelworks in South Wales.

at the cost of factory closures. But this is hard to square with the fact that the biggest problem – the shift from petrol and diesel engines to electric cars – stems directly from government decisions over which the car makers had no influence.

In these circumstances, there was a good case for government support. It was also reasonable to believe that the UK had at least some of the capabilities - for example, in battery-related research and in parts of the battery supply chain – which, if fully exploited, should enable British firms to compete in a growing world market. That was part of the justification for the Faraday Battery Challenge.

Gigafactories, for all their size and prominence in the public debate, are only one part of a complex supply chain which includes high value, technically demanding components, mostly made by independent companies. The work of the Faraday Institution, Innovate UK and the other government agencies has strengthened this part of the industry - which was relatively weak in international terms before the programmes were launched. The quality and quantity of battery-related research have been increased, as has the number of well-trained electrochemists. There is now a substantial number of early-stage battery firms, some of them working on novel technologies which have the potential to improve battery performance.

For example, Nexeon, born out of research at Imperial College, is developing silicon-based anode material. This is a material which has higher energy capacity and lower cost than graphite, which has long been used for the anode in lithium-ion batteries. Nexeon's technology is at least on a par with its American competitors, some of which have been backed by government grants. It has a pilot plant at Milton Park, near Oxford, and is now considering possible sites for its first full-scale manufacturing plant. Nexeon has been involved in several Faraday-backed collaborative R & D projects and has recently won a grant from the Automotive Transformation Fund; it has also secured funds from non-British investors.

Many of these early-stage firms have their origins in university-based research. They include: Nyobolt, co-founded by Clare Grey, professor of chemistry at Cambridge, which is developing ultra-fast battery charging technologies; Ilika, a specialist in solid-state batteries, which came out of Southampton University; and About Energy, a joint spin-out from Imperial College and Birmingham University, which is working on a battery modelling technique that had been developed at the Faraday Institution. Some of these firms have attracted the interest of foreign investors; Faradion, a leader in sodium-ion batteries (a technology that has advantages over lithium-ion in sustainability and storage capacity), was bought last year for £100m by Reliance Industries, an Indian conglomerate which is making a big push into renewable energy.

There have also been setbacks, notably the failure of Johnson Matthey, one of the few large British companies to have taken an interest in car batteries, to establish itself in the industry. This company had long been a supplier to the auto industry of catalytic converters, which reduce the

pollutants coming out of internal combustion engines. The shift to electric cars posed a threat to this business and Johnson Matthey embarked on an expensive effort to develop active cathode material, the most important of the ingredients that go into the cell. The aim was to become a credible rival in this field to companies such as BASF in Germany and Umicore in Belgium. Despite heavy investment, including the construction of a factory in Poland, Johnson Matthey concluded last year that it had no realistic chance of making an adequate profit, and pulled out.

Like Johnson Matthey, many of the new British entrants to the battery business have their eyes, not so much on the UK market, as on international customers - car makers and battery manufacturers that are looking for ways of improving battery performance. More gigafactories in the UK would be helpful, but not crucial to their future.

The UK-based car assemblers are in a different situation; batteries have to be integrated into their manufacturing process, and battery production is usually located close to where they are making cars. What form that integration should take, and how deeply the assemblers need to be involved in the different stages of battery production, will vary from company to company.

There is a large amount of inter-country trading, not so much in complete batteries, which are costly to transport over a long distance, as in cells, cell components and materials. When the gigafactories now under construction in the EU come on stream, car makers in the UK will be able to source cells from a variety of European suppliers and make them into battery packs in their own factories. However, the view in the industry is that, at least for the high-volume assemblers, importing cells from other parts of Europe involves significant extra costs, arising from additional working capital, the need to maintain larger stocks, and possible safety risks. Whether these costs are large enough to deter the assemblers from making electric vehicles in the UK will depend on the particular circumstances of each company.

A more immediate challenge facing the UK car assemblers stems from the UK-EU Trade and Cooperation Agreement (TCA), which was signed in 2021 as part of the new trading arrangements made necessary by Brexit. Part of the purpose of the agreement was to reduce imports from Asia and to encourage the build-up of battery capacity in Europe.

Under the rules of origin contained in the TCA, a UK-built electric car can only be exported tariff-free to the EU if it meets increasingly stringent requirements in terms of how much of its value derives from non-UK and non-EU materials. As Table 2 shows, these requirements are phased in over a six-year period. There is a sharp break at the start of next year for battery packs and battery cells; the allowable value of non-UK/EU content falls from 70 per cent to 40 per cent and 50 per cent respectively. These items account for a large proportion of the electric car's value, and European car makers have been heavily reliant on Asian suppliers; the agreement calls for a switch to European suppliers from the start of next year.

Table 2 Rules of origin for batteries under the UK/EU Trade and Cooperation Agreement. Maximum permitted non-UK/EU input value as percentage of total value

	2021-2023	2024-2026	2027-
<i>Electric vehicles</i>	60	55	45
<i>Battery packs</i>	70	40	30
<i>Battery cells</i>	70	50	35

When the Trade and Cooperation Agreement was signed the 2024 requirement was seen in the industry as challenging but manageable. For a mixture of reasons, including the increasing cost of imported materials over the last few years and the fact that many of the projected EU battery factories are not yet in operation, manufacturers are now finding it impossible to meet the 2024 deadline.

Stellantis (which has over 5,000 employees in the UK and two plants at Ellesmere Port and Luton) has urged the UK government to renegotiate the TCA; it has warned that unless the 2024 deadline is scrapped and the current rules of origin stay in force until 2027, its planned investment in electric vans will become unviable.²³

Other European manufacturers are supporting Stellantis.²⁴ They are pressing the European Commission to recognise that the new rules of origin due to take effect next year are no longer realistic, and that the industry should be given more time to reduce its dependence on Asian suppliers. The Commission's reaction is awaited.

23. Financial Times, May 17, 2023.

24. Financial Times May 18, 2023.

Where now?

Although the complaints about the TCA are coming from the EU as well as the UK, the warnings from Stellantis and others about possible plant closures add to the pressure on the UK government to do more to help the industry. But the main criticism of government policy, from the industry and some politicians, has been and still is the failure to match the subsidies available in other countries.²⁵ Is this criticism valid?

The use of subsidies to kickstart a new or emerging industry has a mixed record. A subsidy-backed project will only survive if the fundamentals of the business are sound (and continue to be sound after the subsidy is withdrawn) and if the other conditions necessary to the success of the venture are in place. For gigafactory entrepreneurs, as the Britishvolt story shows, early support from customers is essential.

The UK should not engage in a subsidy race with the EU and the US. Where there are obstacles which discourage investment, such as high energy costs, the government should seek to remove or mitigate them. The Sunak government has recently announced plans to support energy-intensive industries by exempting them from certain costs linked to renewable energy obligations; this should benefit makers of electric vehicles and batteries.²⁶ There are other areas, for example land use and planning regulations, where potential investors in UK gigafactories, which need very large sites, face particular problems.

How much more investment there will be in gigafactories depends to a large extent on decisions made by the big UK-based car assemblers.²⁷ Nissan, when the new Envision plant is built, will have a dedicated gigafactory linked to its Sunderland assembly plant. JLR will be in a similar position if and when the Tata gigafactory is built. BMW is reported to be considering a plan to re-equip the Cowley plant to make the next generation electric Mini.²⁸ Toyota makes mainly hybrid cars at Burnaston, near Derby, and has not decided when or whether that plant might be converted to make fully electric cars.

All these companies have choices as to where to put new investment and where to build their new models. Successive governments have made the UK a more attractive location for investment in electric cars - it is wrong to regard the support programmes as a failure. But decisions by the multinationals will be determined as much by their overall view of business conditions in the UK, including the availability of skills and the market for their products, as by direct government support.

Of great importance for potential investors, domestic and foreign, is the consistency of government policy. Between 2010 and 2019 successive

25. For a critical assessment of government policy, covering fuel cells as well as batteries, see "Battery strategy goes flat: Net-zero target at risk", House of Lords Science and Technology Select Committee, July 2021.

26. In February 2023 the government introduced what it called the British Industry Supercharger. The scheme will exempt energy-intensive industries from certain costs arising from renewable energy obligations as well as reducing network charges.

27. The specialist car makers do not have the volume for a full-scale dedicated gigafactory; there may be scope for smaller battery plants to cater for their needs.

28. Last year BMW announced that production of the electric Mini would move from the UK to China, but this plan appears to be under review.

governments pursued a broadly similar approach to the auto industry. But the erratic conduct of industrial policy since then, including the scrapping of Theresa May's industrial strategy in 2021, has been confusing for business, and not conducive to new investment.²⁹

It is true that since the arrival of Rishi Sunak as Prime Minister in October 2022 decision-making in government has become more orderly, and confidence in the management of the economy has been restored. But there is still uncertainty about industrial policy.

As far as the auto industry is concerned, the Sunak government has recently restated its commitment to making the UK "one of the best locations in the world for the manufacture of electric vehicles, with an end-to-end zero emission vehicle supply chain".³⁰ How that ambition is to be achieved, and whether it implies more generous support for gigafactories, remains unclear.

A useful next step would be to undertake a realistic assessment of where the industry now stands, what the support programmes described in this paper have achieved, where any further financial support from the government should be directed, and how the market for electric cars is likely to evolve. Out of that assessment should come a coherent policy on which manufacturers and investors can rely.

29. In March, 2021, the Johnson government scrapped the industrial strategy that had been launched by Theresa May in 2017, and closed down the Industrial Strategy Council, which had been charged with monitoring the progress of the strategy.

30. Powering up Britain, Department for Energy Security and Net Zero, March 2023.



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