UK battery ecosystem case studies

UKRI
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Apply for grants

UK businesses can apply for feasibility study and collaborative research and innovation project grants. Projects funded so far include those aimed at improving battery lifespan, range, charging rate, reuse, remanufacture and recycling.

The Faraday Battery Challenge (FBC) programme is investing £541 million to drive the growth of a world-class scientific, technology development and manufacturing scale-up capability for batteries in the UK. Its main objectives are to:

- **Ensure the automotive industry meets its net zero commitments** by enabling the development and scale-up of sustainable battery technologies.
- **Enable the country to prosper from a just and fair transition to battery electrification** across the nation, through the development of a world-class intellectual and physical supply chain

This document gives an overview of the UK Government's funding impact, delivered through the UK Research and Innovation (UKRI) FBC programme and highlights many success stories of organisations that have been funded over the last five years.

An expanded version of this report will be released in later this year but this preview features headline impacts of funded projects and initiatives from:

1. **Faraday Battery Challenge (FBC) case studies**
2. **Other FBC Activities:**
   - FBC Investment Readiness case studies
   - The FBC skills programmes
   - The Cross-Sector Battery Systems Innovation Network
3. **Faraday Institution (FI) case studies**
4. **The UK Battery Industrialisation Centre (UKBIC)**
5. **Advanced Propulsion Centre (APC) case studies**
6. **High Value Manufacturing Catapult (HVMC) case studies**

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Foreword

The Faraday Battery Challenge (FBC) is a pioneering 'lab to factory' mission-led programme, supported by a £541 million investment from the UK government. It focuses on delivering the application-inspired research, business-led innovation, national innovation infrastructure and human talent required for the UK to prosper from the transition to electrification. This document illustrates the breadth and depth of cutting-edge capability that has been built since the start of the FBC and why the UK is a leading place for battery technology development.

Batteries are crucial for decarbonising transportation in the automotive sector and across sectors such as aerospace, rail, marine and off-highway vehicles, and for static storage. The transition to an electrified future will require many types of batteries, with some yet to be imagined. To ensure the UK's long-term success, it is important that we develop the next generation of battery technology and de-risk the associated production processes.

Delivered by Innovate UK on behalf of UKRI, the FBC supports the development of sustainable batteries that are cost-effective, high-performance, durable, safe and recyclable. The programme is positioning the UK as a leading scientific, technological and industrial player in battery development, with investment helping UK companies to grow and signalling to investors that the UK is an attractive opportunity for battery innovation and production. It is also promoting innovation and collaboration among researchers, businesses and other stakeholders to enhance the UK's credibility in the sector.

The support provided by the FBC extends beyond the automotive industry, encompassing, for example, cross-sector skills, policy and regulation development. Its three main pillars, application-inspired research, business-led innovation and national scale-up capability, draw together activities to accelerate electrification, build a globally competitive scientific and technological capability at scale and harness our best talent to solve battery technology challenges.

The UK is home to a battery ecosystem where businesses and academia can pioneer and commercialise battery technology. This review demonstrates the impact of UKRI funding within this ecosystem that is fast becoming a go-to place for battery research, innovation and business. It also outlines the relevant contacts and funding for businesses and researchers who are interested in applying for funding or investing in the UK's battery industry.

Tony Harper, Director,
Faraday Battery Challenge

Faraday Battery Challenge case studies

The Faraday Battery Challenge (FBC) has supported over 165 organisations and funded 98 projects, including 72 business–academic collaboration projects, and helped to create 525 jobs and retain a further 212. FBC-funded projects have a 2.0 average increase in technology readiness level. Here are just a few funding impact success stories.

Echion Technologies has grown from two to more than 40 staff, upgraded its facilities, and launched its niobium based XNO® battery materials.

"When you have a radical new idea in the batteries sector, getting it to the point where customers will buy it at volume takes a lot of up-front investment, which involves risk. UKRI's support helped us to de-risk the process and build relationships with organisations we might not otherwise have worked with."

Dr Alex Groombridge,
Chief Technology Officer, Echion Technologies

WIZer Battery, led by WAE, has developed battery technologies that combine high energy with high power. The project has enabled WAE to set up a battery intelligence division called Elysia, employing 25 people, and serving automotive manufacturers, battery asset financiers and fleet operators. Imperial College London and the expertise of the Faraday Institution's Multi-scale Modelling project were used to inform a state-of-the-art battery modelling system able to analyse multiple competing battery models running at the same time. This required high-powered processing and machine learning provided by Codeplay Software.

"The project enables us to take an enormous amount of battery data and start to look at it in a much bigger way than we can in the on-board world, where we are constrained by storage and processing time. We've got 30 or 40 different projects already."

Rob Millar,
Head of Electrical, WAE

"WIZer was foundational in developing the approaches to physics-informed and health-adaptive battery management algorithms which Elysia has commercialised. Through collaboration across industry and academia, Elysia has brought to market real-world performance benefits based on cutting-edge industry-relevant battery research."

Timothy Engstrom,
Manager, Advanced Battery Technologies, Battery Intelligence, WAE

Cornish Lithium is part of a £500,000 feasibility project, 'Securing Domestic Lithium Supply Chain for UK' (Li4UK), led by mining consultant Wardell Armstrong International with support from the Natural History Museum's advanced lithium laboratories. The project has proved that lithium can be extracted from lithium-enriched waters deep within the subsurface with potentially saleable heat energy, which could be used by local industry to lower its carbon footprint. Cornish Lithium has built a pilot plant and is investigating building a demonstration plant.

Within five years, Cornwall has the potential to produce a significant portion of the UK's lithium requirements with the creation of up to 300 jobs.

"Producing lithium from geothermal waters is particularly attractive because it has a very low environmental impact. Following our success with our 2,000-metre-deep borehole, we see an exciting future for lithium extraction from geothermal waters across Cornwall."

Jeremy Wrathall,
CEO and founder, Cornish Lithium

AMPLiFII-2, led by engineering consultancy Delta Cosworth, helped to develop a sustainable supply of battery packs for electric and hybrid vehicles. The project adapted the manufacturing technology, developed by the initial AMPLiFII (Automated Module to pack Pilot Line for Industrial Innovation) project, for implementation by the project partners Ariel, Trackwise, Potenza, Jaguar Land Rover (JLR), JCB, Alexander Dennis and Warwick Manufacturing Group (WMG). It achieved successful outcomes for all the partners and will feed into future programmes.

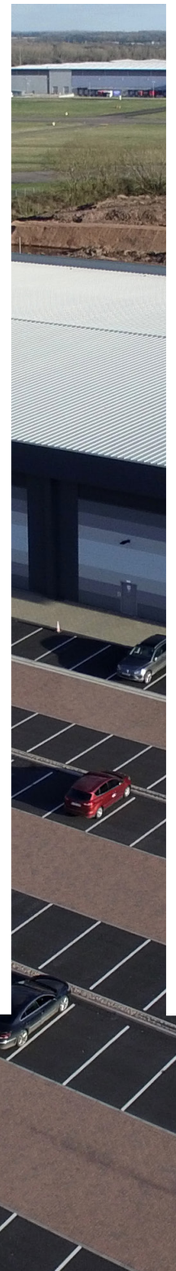
"Some original equipment manufacturers [OEMs] came out with products early on but a lot of the niche manufacturers or premium brands were holding off until performance improved, and costs reduced. Premium OEMs want to provide products that perform higher or faster or for longer periods than other products. [Through the project], we have opened the electrification opportunities to lots of other manufacturers. Not just the larger ones, but also smaller companies. This project has opened the market."

James Arkell,
former Head of Programmes at Delta Cosworth

I-CoBat (Immersion Cooled Battery), a project led by M&I Materials Ltd, is testing the viability of new battery cooling techniques to encourage faster EV adoption. M&I Materials Ltd needed to reduce the volume/weight of its MIVOLT environmentally friendly synthetic immersion cooling liquid.
The company teamed up with Ricardo Ltd to design an innovative module that directs the coolant only to where it is needed and thus reducing the volume required. Simulations and performance tests by project partner WMG demonstrate 43% faster EV charging and tests at the University of Liverpool show no unwanted reactions between the liquid and the internal battery chemistry. For M&I, the project has led to collaborations with EV manufacturers. MIVOLT is being used in Faraday Future battery packs, and M&I is working with Norton Motorcycles and the APC to produce an electric superbike and is moving into the aerospace sector through Project InCEPTion.

"Being able to use the facilities and research know-how of our partners has meant that we could get much quicker to where we wanted to be. The opportunity to work with renowned organisations like Ricardo and WMG has really raised our profile, too."

Mark Lashbrook,
Technical Director, M&I



LIBRIS (Lithium-Ion Battery Research in Safety) is a collaborative project that has developed new technologies and methodologies to inform and improve the safety in the design, testing, transportation and use of EV batteries. During the project, Tri-Wall UK sourced a sustainable and fully recyclable thermal mitigation material that contains the effects of lithium-ion thermal runaway and has developed a new range of environmentally sustainable packaging designed specifically for lithium-ion cells, batteries, modules, full EV packs and static storage solutions. The new products were developed with the UKBIC, are assembly line-ready and were tested with the UK Health and Safety Executive and WMG. The project partners were 3M, JLR, Denchi Power, Potenza Technology and Lifeline Fire & Safety Systems.

**"Technology is moving faster than regulations can keep up with. Should someone want to store or move batteries, there's insufficient accessible guidance to indicate that they need to consider the risk of a thermal runaway event and provide appropriate mitigation materials and methodology. We wanted to get an understanding of the issues so that we could write clear packaging definitions and produce a product-specific range to meet that.
We wanted to inform industry on potential issues and what needed to be done to mitigate them, so they could responsibly store and move batteries."**

Mike Valentine,
Projects Lead of battery transport solutions, Tri-Wall UK

SUNRISE has developed a new anode material based on silicon, as a drop-in replacement for graphite, that enables a battery to store up to 50% more energy by volume, with the potential to dramatically increase EV range. Nexeon Limited has been leading the project, working with Synthomer and University College London. After establishing proof of concept, a large-scale manufacturing processes was developed. Work is now underway with customers in the UK, Europe and Japan in the automotive, consumer electronics and power tool sectors. In 2022, Nexeon hired 50 people, and, in August 2023, it secured a site for its first commercial volume plant. The company also secured long-term raw material supply with OCI and is scheduled to begin supplying commercial material in 2025, initially for Panasonic.

"We've known for a long time that attacking the anode in lithium-ion batteries could be the key to reducing their weight. And we've been working on silicon as a potential anode material since 2006. The challenge was to find the precise form of material that can provide the long cycle life that a vehicle needs (being able to be charged at least a thousand times). And that has the potential to be made on a very large scale, for millions of electric vehicles, cheaply enough to make them viable."

Dr Bill Macklin,
Chief Engineer, Nexeon Limited

FBC Investment Readiness Programme case studies

Over three years, the FBC Investment Readiness Programme has supported 35 UK-based SMEs across the battery supply chain in their fundraising journey. Selected SMEs join a 12-week programme of workshops, including one-to-one mentoring sessions, led by Innovate UK KTN and supported by external experts and investors.
The programme supports the SMEs to develop their investor pitch, finesse their proposition and develop a defendable understanding of their finances and plans. It culminates in a live showcase event where they pitch to an audience of investors interested in the battery sector.

>> **Read more** about the 2021 cohort
>> **Read more** about the 2022 cohort
>> **Read more** about the 2023 cohort

Breathe Battery Technologies, an advanced battery management software developer based in London, received a £1.5 million investment led by Speedinvest alongside industry-leading angels. Breathe Battery Technologies received a Faraday Institution Entrepreneurial Fellowship award in 2019, and subsequently reached significant technical and commercial milestones in the growing market for intelligent battery management software.

"We are thankful to the Faraday Battery Challenge and KTN for running the investment programme. It was a great opportunity for us to showcase our solution to potential investors and we're delighted with the results."

Dr Ian Campbell, CEO and co-founder, Breathe Battery Technologies

"Breathe Battery Technologies offers a unique solution because its software looks deep inside battery cells, considering not just the measurable aspects of the battery – current, voltage, temperature – but, by using that information, to model what's happening inside the cells electrochemically. Breathe has developed intelligent software that provides useful insights, and we are very excited to invest in it."

Rick Hao,
Principal, Deep Tech, Speedinvest

About the FBC skills programmes

FBC is working to fill the skills gap in the UK battery supply chain via two national initiatives with active participation across the UK battery ecosystem.

The National Electrification Skills Framework and Forum aims to build on the original vision outlined in the National Electrification Skills Framework and Forum (2021), which articulated the need for a co-ordinated national approach to workforce development, in parallel to the development of technology, as part of the net zero agenda.

In collaboration with Enginuity, Warwick Manufacturing Group (WMG) and the UK Battery Industrialisation Centre (UKBIC), the University of Coventry will lead the NESFF consortium. The NESFF's vision is to ensure that the national workforce has the necessary skills and development to effectively deploy electrification technologies and help the country meet its net zero commitments. Identifying these skills needs and a framework for delivery, as well as encouraging greater workforce inclusion and diversity, are priorities for the independent consortium.

The consortium will work closely with the Innovate UK Workforce Foresighting Hub and its members, and other local and national bodies, to ensure that future skills development will meet the needs of rapidly emerging net-zero technologies and help position the UK as a global electrification leader.

The Battery Workforce Training Initiative is aimed at supporting UK regional battery industry needs and focuses on vocational or technical skills level 2 to 3 development which are needed to ensure a proficient battery manufacturing workforce.

The initiative is also seeking to actively catalyse further investment into the development of regional workforces and, as a nation, ensure that the UK has the mix of skills, talent, diversity and experience required to compete on the global stage.

University College Birmingham will lead a regional partnership that will deliver a training programme aimed at supporting the local workforce with skills development. The 'Digital Enhanced Battery Ubiquitous Training-West Midlands' (DEBUT-WM) project will bring together academic, industry and government experts to deliver the programme via a blend of traditional physical training alongside advanced immersive digital technologies such as augmented, virtual and mixed reality.

Newcastle University will apply its funding to support its 'National Battery Training and Skills Academy'. The Academy will support and engage those in the North-east with education and skills initiatives, retraining schemes and battery degree apprenticeships. The Academy will feature innovative alternative and virtual reality technology to help engage individuals, particularly schools and young people. Retraining 'boot camps' will also feature; designed to help operators and engineers ensure they have the skills needed for the future of the industry. The Discovery Museum's 'Steam to Green' exhibition will also be supported by Newcastle University via the Academy.

The trio of projects will work together to develop a battery industry workforce of the right quality and quantity in the UK and catalyse investment in battery workforce development.

About the Cross-Sector Battery Systems Innovation Network

The Cross-Sector Battery Systems Innovation Network, supported by FBC and Innovate UK KTN , brings together a community of researchers and innovators in battery manufacturing, the related supply chain and end-users. The community, which now has over 5,500 members, aims to:

- open new markets for the battery industry, by introducing this community to new sectors, thus support the growth of the UK economy.
- promote innovation in batteries by identifying technical gaps for their introduction in various sectors.
- help to decarbonise a wide range of sectors, such as rail, maritime, aviation and construction, by enabling the adoption of batteries, thus supporting the net zero agenda.

The UK Batteries Network Hub features news, resources, events, a networking platform and a landscape map. To date, over 200 introductions have been logged through the networking platform and the landscape map features nearly 500 organisations.

As part of its outreach activities, the Network delivered the Batteries For webinar series, which has explored opportunities in the aviation, maritime, rail and defence sectors, and attracted over 2,000 registrations overall. In addition, the Battery Caffè podcast series had over 1,800 downloads.

The Network recently launched the UK Battery Recycling Industry Vision to 2035 which identifies critical areas for research and innovation, policy and regulation, infrastructure and skills. It emphasises the need for sustainable battery recycling processes, safe and rapid discharging of packs, and access to a trained, skilled and diverse workforce to secure the UK's supply of battery materials including cobalt and lithium, two critical minerals with limited global supply.

Faraday Institution case studies

The Faraday Institution is a key delivery partner for the FBC and the UK's independent institute for research, skills development, market analysis, and early-stage commercialisation. Case studies in each of its four main focus areas are featured below.

Electrochemical energy storage research

The SOLBAT project is addressing fundamental scientific challenges that need to be overcome before high-power solid-state batteries with commercially relevant performance can be realised for automotive applications. A series of high-profile papers outlines the significant steps that the project is taking in understanding how and why solid-state batteries fail – insight with the potential to inform manufacturer strategies for avoiding cell failure.

Early-stage commercialisation

About:Energy, a joint spin-out from Imperial College London and the University of Birmingham, was set up in January 2022 to help commercialise the battery modelling capabilities that have been developed by the Faraday Institution's Multi-scale Modelling Project. The company's data and models are helping to accelerate battery commercialisation by reducing reliance on physical research, and enhancing battery design, management and performance predictability.

One of About:Energy's founders, Kieran O'Regan, is a graduate of the University of Birmingham and alum of the Faraday Institution's PhD programme. The company received a Faraday Institution Entrepreneurial Fellowship, and an Advanced Propulsion Centre (APC) grant. It has also been involved in a collaborative R&D project as part of the FBC Round 5 Initiative. After being part of the UKRI Knowledge Transfer Network (KTN) Investment Readiness Programme, it completed a pre-seed investment round and now employs 14 people.

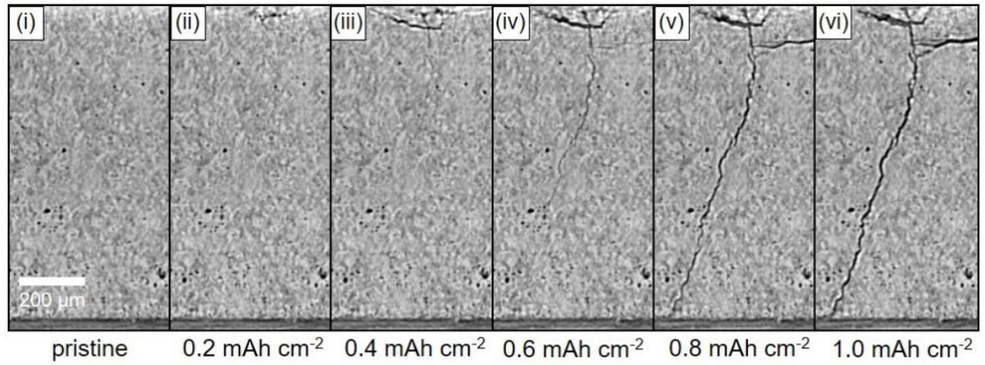


Image - Development of a dendrite crack.

Skills development

As part of the Faraday Institution's commitment to developing a dynamic and diverse pool of battery technology talent, it delivers a bespoke PhD training programme to enhance researchers' skills, knowledge and aspirations, equipping them for future careers in academia, industry or policy-making. To July 2023, more than 70 PhD researchers have been funded in five cohorts, with more than a 100 more being affiliated to its research projects. The programme includes training in technical, commercial and transferable skills, providing multiple networking opportunities and the chance of an internship. Many members of the first cohort have secured their first positions in the UK battery sector.

Informing policy

The Faraday Institution provides an independent, evidence-based understanding of battery economics, the societal issues and capabilities associated with batteries, and the UK's competitive position. It does this through commissioned studies, insight publications and responses to public consultations.

Its report on UK Electric Vehicle and Battery Production Potential to 2040 is a go-to resource for journalists and the Government and informed the UK Government's decision to fund UK-based battery giga-factories.

To June 2023 the organisation's 17 Faraday Insights have been downloaded more than 32,000 times.

The organisation's impact can be seen in more than 40 success stories.

Find out how to get involved with Faraday Institution initiatives.

Read more about the Faraday Institution's impact in its annual report.

The UK Battery Industrialisation Centre

The UK Battery Industrialisation Centre (UKBIC), the country's national manufacturing battery development facility, has supported scale-up in many ways, for example, helping one customer to perform an exhaustive test programme, including simulated extreme conditions such as very low and high temperatures, and stringent mechanical tests. The facility produced cylindrical 21700 lithium-ion battery cells for demonstration purposes. This led to the customer achieving section 38.3 of the UN Manual of Tests and Criteria for transport, which enabled the business to demonstrate its technology to potential investors and customers.

Advanced Propulsion Centre case studies

Advanced Propulsion Centre (APC) is funded by the Department for Business and Trade and works with industry and academia to unlock investment in the research, development and industrialisation of propulsion technologies to support the UK automotive industry transition to a net-zero future. Since its foundation in 2013, the APC has funded 199 low-carbon projects involving 450 partners, from start-ups to established manufacturers, and has helped to create or safeguard over 55,000 jobs in the UK. The technologies developed through these projects are projected to save over 350 million tonnes of CO_2, the equivalent of removing the lifetime emissions of 14.1 million cars.

Brill Power's intelligent Battery Management System (BrillMS) provides up to 60% increased battery life and 15% greater energy yield. It uses cell-level power electronics to swap parallel groups in and out to prevent weaker cells being overly stressed. This automatically balances the cells during charge and discharge, reducing the formation of hot spots and preventing a diverging spread of capacities within the pack. Brill Power received funding and support through the APC Technology Developer Accelerator Programme (TDAP) to validate and commercialise the system.

"The majority of cells within a battery are still usable when the pack is sent to waste. While studying how batteries degrade over time, our team envisioned a method that would use every cell to its full potential."

Stuart Grondel,
Strategy and Operations Manager, Brill Power

Hyperbat brings together the engineering excellence of Williams Advanced Engineering (WAE) with Unipart's capability in manufacturing safety-critical products for premium manufacturers. The joint venture was inspired by H1PERBAT, an APC-funded consortium set up in 2017, led by WAE, and including Unipart, Coventry University and Aston Martin, established to build a high-performance, low-volume, flexible battery capability, while exploring second-life options for car batteries. Hyperbat is now recognised as a premium manufacturer of high-performance EV battery packs. The company recently secured a multi-million-pound contract to supply 90-kWh lithium-ion battery packs for the new Lotus all-electric Evija, the world's most powerful production car, capable of reaching 0-62mph in under three seconds and a top speed of over 200mph.

Hyperdrive Innovation Limited established its credentials as a leading battery supplier through its collaboration with Nissan, a relationship that was forged through the APC-funded High Energy Density Battery (HEDB) project. A £9.7 million grant enabled Hyperdrive's latest battery technology to be brought to market and culminated in a global supply agreement to incorporate its lithium-ion cells into Nissan's high-performance battery systems. The project also enabled the design of a new, universal modular energy storage system, and the installation of a pilot line for prototyping and pack assembly at the company's state-of-the-art Sunderland facility. Hyperdrive's compact modular battery pack is readily available as a standard product with integrated battery management, avoiding the investment, resource and time needed for bespoke battery development. The first applications include the Nissan Leaf, the delivery fleet of one of the world's largest online grocery retailers and JCB.

Echion Technologies, a spin-out business of the Cambridge University Engineering department, was founded in 2017 with the goal of commercialising super-fast-charging lithium-ion batteries for electric vehicles. Through APC TDAP funding and support, the company identified a viable target market and established a robust business plan, rapidly transitioning from academic research to commercial entity. Echion's innovative battery niobium anode materials for Li-ion batteries are capable of safe, fast charging in under 10 minutes, and have a high energy density and a product life more than 10,000 cycles. Their unique, proven benefits include high operational efficiency coupled with low total cost of ownership, enabling end-users to sustainably electrify heavy-duty transport and industrial applications such as rail, high-power off-road vehicles, high-utilisation truck fleets, buses, delivery vans, mining equipment, high-performance hybrids and motorsport vehicles.

High Value Manufacturing Catapult case studies

The High Value Manufacturing Catapult (HVM Catapult) group of research, development and innovation centres were opened by Innovate UK in 2011. Its purpose is to help move the world-leading research of UK universities towards commercial uses. The HVM Catapult comprises seven centres, offering capabilities spanning basic raw materials through to high-integrity product assembly processes:

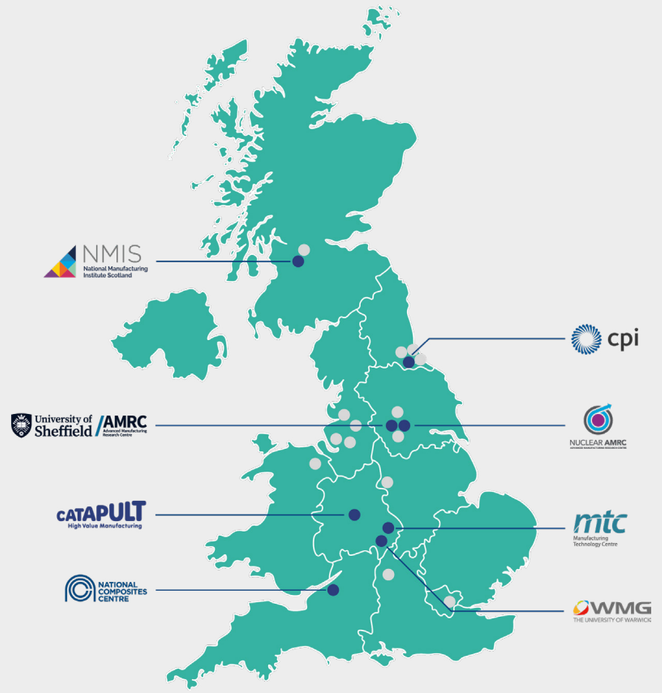
- **University of Sheffield Advanced Manufacturing Research Centre (AMRC)**
- **CPI**
- **Manufacturing Technology Centre (MTC)**
- **National Composites Centre (NCC)**
- **National Manufacturing Institute Scotland (NMIS)**
- **Nuclear Advanced Manufacturing Research Centre (NAMRC)**
- **WMG**

Battery R&D takes place across the HVM Catapult. Material synthesis and process scale-up are carried out at CPI. Electrochemistry and cell development are handled by WMG, which is also responsible for pack development and recycling. The scale-up of manufacturing takes place at CPI, WMG, MTC, AMRC, NCC and NMIS. JLR and Tata Sons. With continued support from Innovate UK, HVMC, APC and the FBC, JLR has worked with WMG to accelerate its electrification journey.

The collective knowledge of the WMG team has accelerated and widened JLR's exposure to the commercial lithium-ion battery marketplace and has enabled the company to become more engaged with an emerging battery and electric vehicle supply chain, to secure competitive advantage. This programme of collaborative research has increased the skills embedded within JLR, and the company's capacity to conduct its own research and development. The creation of a battery-pack testing facility within JLR's own facility was informed by test methods, procedures and equipment developed by WMG in the Energy Innovation Centre, including knowledge transfer that was helped by the migration of staff from WMG to JLR.

"After more than 10 years of joint research, JLR continues to collaborate with WMG to develop pioneering technology and is a cornerstone of battery research and development programmes."

Paul Whitwood,
Chief Engineer – Batteries, JLR



The diverse and multi-disciplinary battery research environment within WMG has also benefited the wider, national automotive industry, through WMG's leadership of APC's Electrical Energy Storage Spoke, the national co-ordinating centre for electrical energy/battery systems research for the automotive sector.

Throughout this journey, the support from WMG and the wider HVM Catapult network has enabled JLR to develop its hybrid, plug-in hybrid and pure electric vehicle programmes, including the Jaguar iPace World Car of the Year 2019.

This journey has culminated in the latest announcement of JLR's parent company Tata Sons announcing a £4 billion investment delivering electric mobility and renewable energy storage solutions for customers in the UK and Europe. This includes building a 40GWh battery cell giga-factory in the UK.

Electroflight worked with MTC to investigate the feasibility of laser cleaning of battery cells to improve efficiency, reliability and productivity of aerospace battery systems. MTC was tasked with identifying new cleaning methods and technologies to improve the cleaning process and subsequently enhance the wire bond weld strength and bonding strength consistency.

Laser cleaning was identified as the most suitable cleaning process and in the first phase of the project, MTC investigated the feasibility of laser cleaning of the battery cell to remove oxidisation and contamination. A series of experimental trials were conducted and a total of 36 cells were laser programmed, cleaned and characterised to assess the impact of the cleaning method on bond strength and variability.

Phase Two of the project focused on further optimising the cleaning process on both old and new cell batches. The results were compared against Electroflight's existing manual wet chemistry and mechanical cleaning methods, and optimum laser cleaning parameters were established.

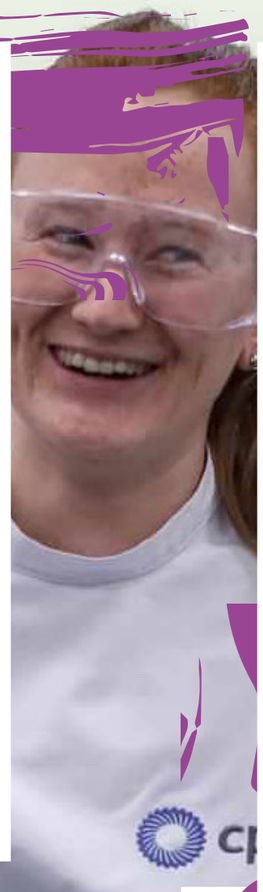
Following the completion of the testing, MTC identified an optimum laser power output to achieve targeted improvements in wire bond strength. This output resulted in a 130% increase in bond strength of the negative terminals and 40% increase for positive terminals, and a significant reduction in variability. The optimised cleaned cells also showed significant improvement on repeatability and pull testing performance of the cells during the wire bonding process.

Other factors that impacted wire bonding test results were also identified, such as variations in oxide layer thickness due to different batches of battery cells.

Following the completion of the project, MSS introduced Electroflight to laser systems manufacturer IPG Photonics to support the adoption of onsite laser technology in-line with the findings from MTC's study.

"This has been a great project to be a part of, and an example of how we collaborate across teams at the MTC to deliver fantastic results. Our findings have led to significant improvements in a process that is fundamental to the manufacturing of battery systems, and this has identified exciting opportunities for Electroflight."

Chris Powley,
Principal Research Engineer, MTC



LiNa Energy worked with CPI to advance the development of safer, more sustainable battery technology.

Industries are under pressure to reduce their carbon footprint and rationalise natural resources and potentially harmful chemicals. Meanwhile, growing demand for better energy storage systems is pushing lithium-ion battery technology – the current gold standard – to its limits.

Electric vehicles, renewable energy providers and energy-intensive sectors such as building, transport and manufacturing all demand scaled-up energy storage solutions. Safety issues and heat build-up means that stacking lithium-ion batteries together is not an option. And the laws of physics preclude squeezing greater energy into increasingly smaller housings. Another problem with lithium-ion batteries is the rising cost of cobalt, a key ingredient.

CPI worked with SME LiNa Energy and Lancaster University to develop LiNa Energy's novel sodium-metal-chloride (Na-MTL-Cl) battery technology. Made without lithium or cobalt, this innovative approach promises more efficient, safer and sustainable modular energy storage that overcomes the technical and physical limits of current battery technologies.

CPI's contribution included:

- **Offering advanced knowledge in hydrometallurgical separation methods.**
- **Developing tailored inks and quality control methods.**
- **Optimised layering techniques to deliver longer, safer battery life, cycling, and charging.**
- **Investigating low-cost components and modular design to enable simpler, lower-cost recycling.**
- **Leveraged local and national networks to raise LiNa Energy's visibility and showcase its solutions to industry, funding organisations, and investors.**

CPI helped LiNa Energy prove that its Na-MTL-Cl battery is a workable and scalable alternative to lithium-ion batteries, being comparable in performance and cost-competitive. The technology has the potential to decarbonise automotive transport and to provide effective batteries for industrial and commercial users worldwide.

The partnership has also cemented LiNa Energy's credentials as a market-changer in greener energy storage and diffusion in the UK and beyond. It enabled LiNa Energy to create a 1kWh demonstrator and accelerate the Na-MTL-Cl battery from technology readiness level 5j (TRL5) to the prototype stage (TRL6).

The next step is to pilot, scale-up and commercialise a mid-sized battery ideal for behind-the-meter installation.

Outcomes included the creation of a 1kWh demonstrator and accelerated the Na-MTL-Cl battery from technology readiness level (TRL) 5 to the prototype stage (TRL6).

"I am delighted with the outcomes of our collaboration with CPI. This project has advanced our Na-MTL-Cl battery technology, demonstrating its enormous potential to decarbonise automotive transport and provide efficient and effective energy storage solutions."

Gene Lewis,
LiNa Energy's CEO

"MTC has been excellent to work with. Everyone on the project was engaged from the start and incredibly proactive, and their passion and enthusiasm are reflected in what we've been able to achieve in a short space of time. The team also really understood the brief and identified a solution that not only met our technical objectives, but also our commercial and strategic objectives too."

Douglas Campbell
Technical Director, Electroflight

For further inquiries contacts any of the relevant organisation mentioned in this booklet

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UK Battery Industrialisation Centre:
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Advanced Propulsion Centre:
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High Value Manufacturing Catapult:
Website - https://hvm.catapult.org.uk/