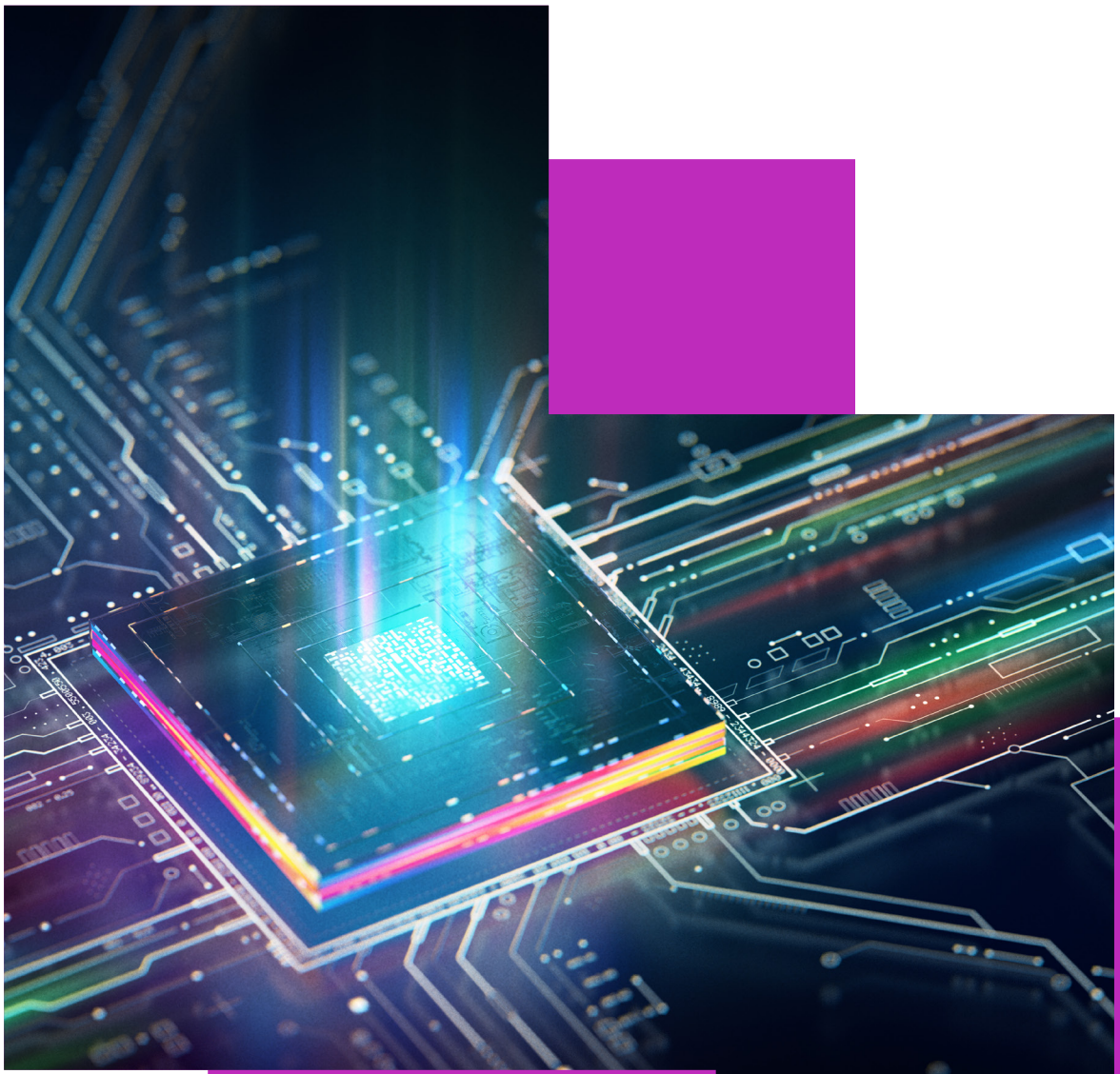
Delivered by
Innovate UK

Driving the Electric Revolution

2023 Annual Report



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Welcome

What a year 2023 has been!

Over the past four years, Driving the Electric Revolution (DER) Challenge, delivered by Innovate UK, has announced the investment of over £80 million across 101 projects. Within these projects we have commenced support to 28 skills projects with the Electric Revolution Skills Hub at Coventry delivering a focal point for business, teaching and individuals in their desire to be upskilled in this exciting space.

The vision and application of the much-needed facilities being delivered by the Driving the Electric Revolution Industrialisation Centres (DER-IC) is now a part of the available infrastructure ecosystem. The impact this is having, and the visions of what this could become, are inspiring. There is more to be commissioned and an ever-growing opportunity to deliver and it remains, as I said last year, that development of industrial processes is crucial to not only delivering the underpinning technology for net zero but also doing it in an environmentally, socially, and ethically right way.

The catalysation of activity through Innovate UK funding in addition to the support provided across the system from Innovate UK Business Connect through to our network of Catapults has, I believe, facilitated significant cross sectoral opportunities within our community. The full impact of these projects will become apparent in due course, but I can say from the ongoing engagements this will be spectacular.

This year also saw the return of Engage with… LIVE where we had c.300 people from across the country come together at Millennium Point in Birmingham for a day of seminars, exhibition, and incredible networking. We were fortunate to have Dr Dave Smith, our National Technology Advisor, deliver a keynote speech which was followed by sessions of significant interest on topics including skills and finance. We have plans for Engage with… LIVE for early 2025 so please keep your eyes open for the announcement.

There are now PEMD activity being supported by Innovate UK across every region, be it from Driving the Electric Revolution, CLIMATES or from our core business support or innovation funding mechanisms.

This is a true testament that high quality innovation takes place where people have the passion, commitment and drive to make it happen and where there is a business need to grow, evolve, and deploy.

I have to conclude with a thank you to everyone who has supported the Challenge activities. The team will continue to work with each and every one of you as we build plans for future activity to further support and build the UK as a significant player in PEMD technologies and manufacturing. This will however be my final foreword to this annual report as I move onto a new role outside of Innovate UK. On a very personal note, your support, encouragement and engagement with me and the team has been tremendous and please continue to offer your support. I am moving to a role where I will be more embedded in this amazing technology and how it will make a difference to the global net zero ambitions.

Will

Will Drury
Challenge Director

Challenge overview

Mission

'Driving the Electric Revolution will be the catalyst to building **£5 billion more Power Electronics, Machines and Drives (PEMD) products in the UK by 2025**. Encouraging industry across all sectors to invest and collaborate with academia to establish a PEMD supply chain.'

Objectives

The objectives of Driving the Electric Revolution Challenge are to:

- Leverage the UK's world leading research capability in PEMD to help industry create the supply chains necessary to manufacture the PEMD products developed here.
- Identify gaps in the supply chains and help industry fill them.
- Ensure cooperation and collaboration so we do not duplicate effort, waste time and can reuse solutions across all sectors.
- Help fill the skills gap by retraining, upskilling and repurposing engineers into PEMD supply chains.

Delivery

The Challenge has four fundamental areas of activity:

1. Industrialisation Centres

£33 million investment for four national centres of excellence in PEMD, based at existing areas of expertise in:

– Newcastle and Sunderland

– Newport and Swansea

– Nottingham, Warwick and Birmingham

– Strathclyde

These centres support research and development allowing businesses and researchers to develop and scale new PEMD technologies and manufacturing processes.

2. Collaborative research funding

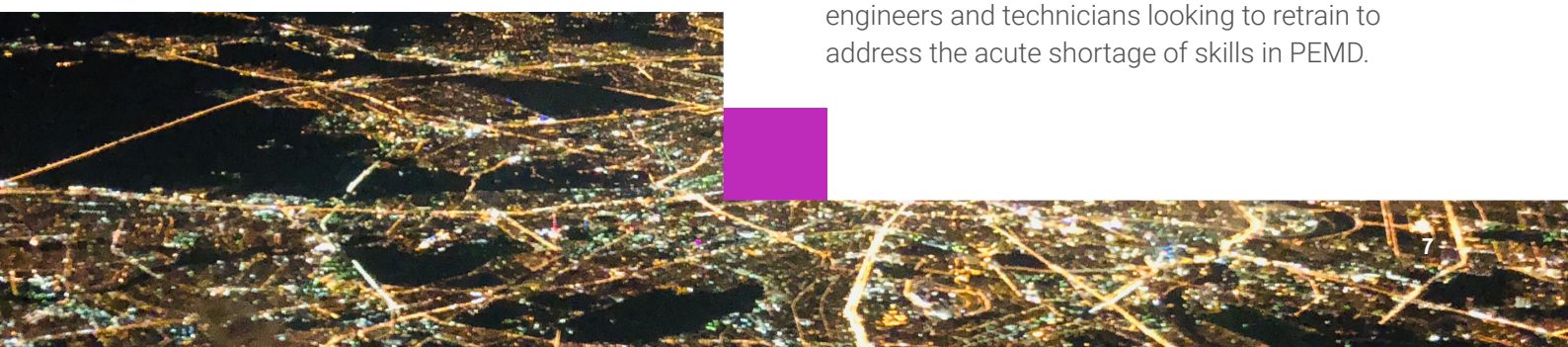
£20 million programme of collaborative research funding to help businesses create future supply chains in the high volume and low volume PEMD supply chains. These projects are developing innovative new processes for the next generation of PEMD technologies.

3. Filling gaps in the supply chain

£19 million for projects to fill gaps in the PEMD supply chain and deliver quick benefits to the UK's economy.

4. Training and skills development

£6 million to support skills and training provision. It focuses on activity for all levels, from school leavers and undergraduates, to experienced engineers and technicians looking to retrain to address the acute shortage of skills in PEMD.



Funding

Grant funding from the Driving the Electric Revolution Challenge has been allocated to over 150 organisations collaborating on more than 80 projects. So far:

- 67% of the Challenge's funding has been allocated to industrial partners
- 9% to Research Technology Organisations (RTOs) or Catapults
- 23% to Academic institutions

From the Challenge funding given to industry around 45% has been given to small or micro enterprises (SME) companies. A breakdown of the funding allocated to each of these organisations is shown in Figure 1.

The Driving the Electric Revolution Challenge is working across sectors and the UK to ensure electrification supply chains are strengthened and developed to help us reach net zero.

Figure 2 shows the number of projects funded by the Challenge and the location of the participating organisations.

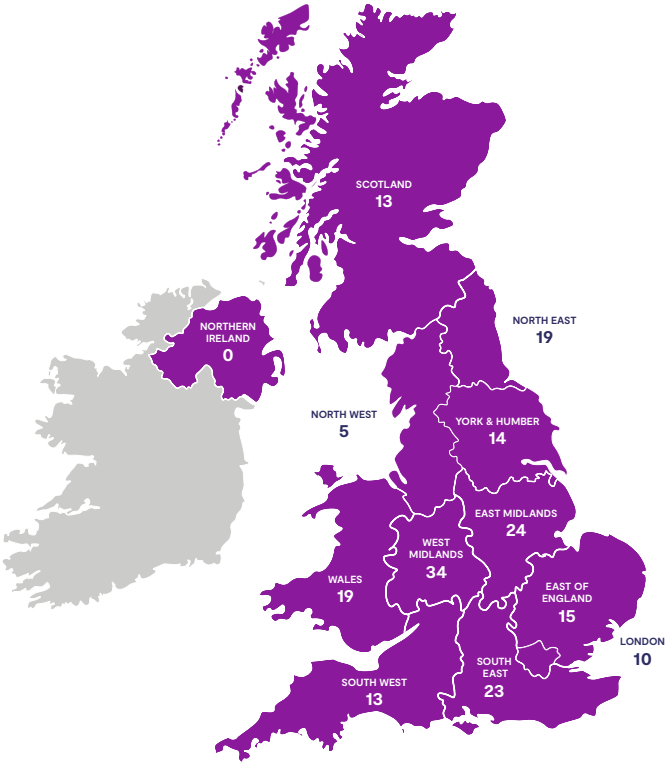


Figure 2: Location and number of projects funded by the Challenge

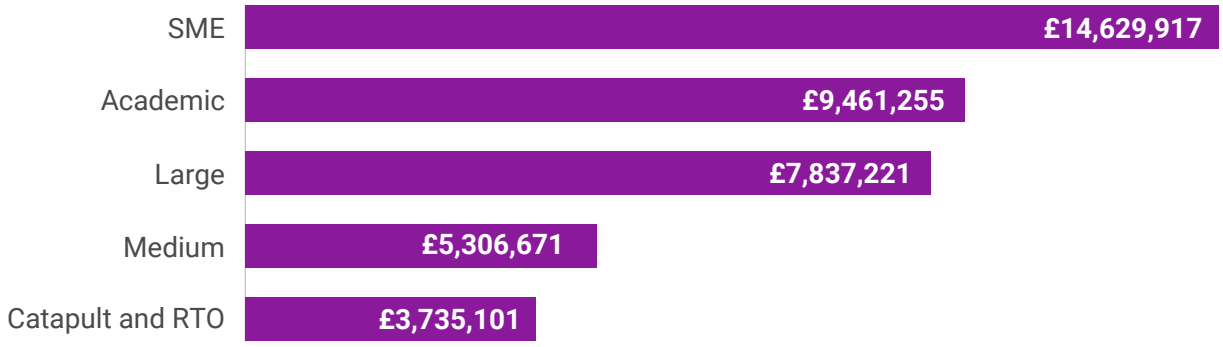


Figure 1: Amount of funding each organisation type has received from Driving the Electric Revolution

Find full details of Driving the Electric Revolution projects at https://gtr.ukri.org/

2023 overview

Collaborative Research and Innovation

Earlier this year, we announced the winning projects from our funding competition 'PEMD Scale-up: Strand 1 and 2'. Announced in February 2023 it saw us provide over £6m in funding for projects which will support the UK manufacturing of the components that will underpin net zero.

Read details of projects funded through the Supply Chains for net zero competition in the Annex.

Skills work packages

This year saw the skills work packages begin in earnest with a funding competition, the Undergraduate Award, the Electric Revolution Skills Hub and two STEM initiatives all running.

The Electric Revolution Skills Hub

The Electric Revolution Skills Hub will be a new online platform for the PEMD community to support the UK's workforce in developing the skills needed to deliver net zero technologies.

£1 million was awarded to Coventry University who are using the funding to establish a platform connecting PEMD training and education course providers with employers and learners seeking to develop their skills. You can find out more about the Electric Revolution Skills Hub on LinkedIn.

Proto EV

ProtoEV is a motorsport STEM competition for school students, college students, youth clubs, and apprentices in the UK. The participating teams learn how to convert petrol go karts into fully electric e-karts, which they then test and race to see which is the fastest and most efficient. ProtoEV is designed to give young people a hands-on experience in electric vehicle engineering. It also provides a platform for developing problem-solving skills, learning teamwork, and developing an enthusiasm for motorsport. The competition allows teams to showcase the engineering capabilities of the next generation of engineers, and to spark an interest in electric vehicles. ProtoEV is also a great way to inspire young people to pursue a career in engineering.

Throughout the activities and challenges, young people expressed their enjoyment of driving, fixing, and modifying the karts. The students enjoyed developing the logos and identities for the teams. As part of the project, the young people were interested in learning about electric components and problem solving in order to construct the kart. They showed real motivation and ability in tackling the project. We were pleased that the skills within the team were sufficient to be able to solve all the problems. It was evident that everyone worked together as a team and was enthusiastic. There was a lot of interest among the young people in testing the karts and participating in the final time trials on the track.

Magnets in Motion STEM box

Working with the Curiosity Box and the University of Bristol, the Challenge created a STEM experiment kit. It explores the wonder of electromagnets and their importance in the future of our everyday life, as well as incorporating literacy, maths, physics, and engineering.

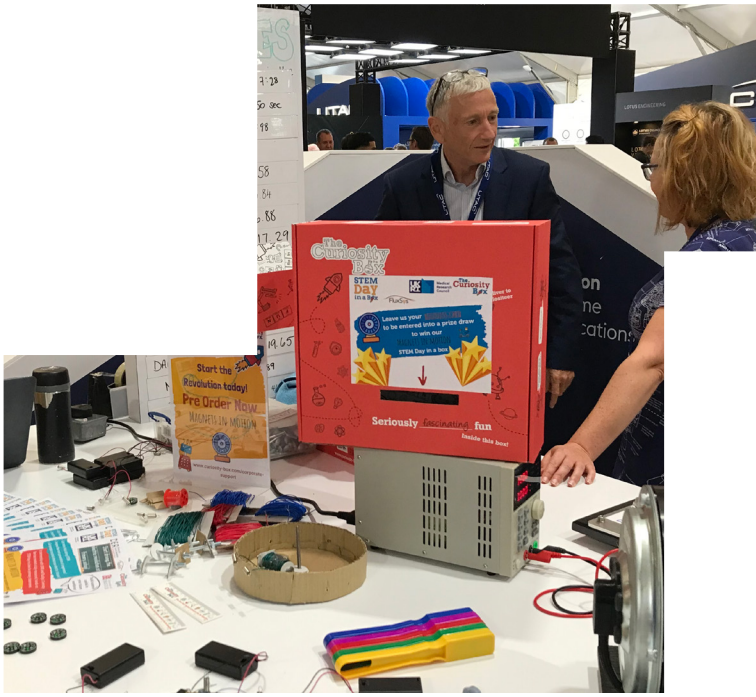
Students learn all about:

- The different properties of objects.
- How magnets are used in life today.
- How to make a non-magnetic object magnetic.
- Engineering their very own electromagnets.

The box is designed for upper Key Stage 2 and the transition into Key Stage 3.

In 2023 the pilot boxes engaged 2040 young people, Coventry and Birmingham received over 50% of the boxes in the Midlands, while the remaining have been distributed to Gloucestershire, Cambridgeshire, and London.

Over 2000 young people between the ages of 10-14 have participated in hands-on activities exploring electricity, electromagnets, and electric motors using the DER and Curiosity Box Magnets in Motion Motors STEM Day in a Box. Following prototyping and testing during 2022, the final version of the 'STEM Day in a Box' has been distributed to schools across the UK, making it the first school resource of its kind. We expect an additional 1200 young people to be reached in Q1 2024 and are working with the British Science Association to achieve CREST award accreditation for the kit.



People

The UKRI Challenge team is at the heart of the delivery of the Challenge.

Delivery Team

Will Drury

Challenge Director

Will joined Innovate UK in January 2020 from engineering and environmental consultancy Ricardo where he was Global Technical Expert: Power Electronics and Head of Electronics and Electric Machine Products.

At Ricardo Will led the strategy in PEMD component development and approaches to engineering solutions for clients. Will also worked extensively in business development, engaging customers from strategy through to product design with globally reach.

Will holds a PhD from the University of Bristol in Electrical Engineering, is a Chartered Engineer, Fellow of the IET and Senior Member of the IEEE. Will is a visiting Professor in the Electronics & Electrical Engineering Department at the University of Strathclyde since January 2021. He sits on the IET Transport Sector Executive, previously holding the position of deputy-chair. Will also sat on the EPSRC Centre for Power Electronics (CPE) advisory group and was a visiting fellow to the University of Warwick until 2019.

Venn Chesterton

Deputy Challenge Director

Venn has been Deputy Challenge Director since September 2019 and was instrumental in shaping the Challenge before this. Before Innovate UK, Venn was the Ultra Low Emissions Vehicle and Energy Lead at the Transport Research Laboratory where he led on numerous UK and EU research projects designed to accelerate the transition to low emissions vehicles. Before that Venn worked on sustainable transport projects at Transport for London.

Martyn Cherrington

Innovation Lead

Martyn joined Innovate UK in 2017 and the Driving the Electric Revolution team as Innovation Lead in 2019. In 2021 he took up the role of Interim Deputy Challenge Director before returning to Innovation Lead. He has a broad technical background, including chemistry and materials engineering, and has EngD in large-area electronics from Swansea University. Prior to Innovate UK he worked at the Knowledge Transfer Network, Tata Steel and L'Oréal. Since 2023 Martyn led the work on the CLIMATES programme.

Iain Mauchline

Innovation Lead

Iain joined the Challenge in late 2021, combining Driving the Electric Revolution work alongside his role as Innovation Lead for Electronics, Sensors, and Photonics for Innovate UK. Iain holds a PhD from Strathclyde University in Optoelectronics and has over 30 years' experience in the electronics and photonics fields. Working most recently as Engineering Director at OptoSci, a photonics systems and sensors SME. His background covers many technical and application areas of ESP: design and manufacture, education, training, harsh and industrial environments, commercialising research, photonics, telecommunications, and semiconductors.

Jan Taylor

Innovation Lead

Jan is an Energy Engineer. His career has been diverse, ranging from modelling and simulation of structures, fluid dynamics and heat transfer through technical software development where Jan rose to lead a software R&D department for a multinational oil service company. He then moved into an operational role leading the introduction of new technologies to oil and gas drilling. This led to deployments across the globe and managership of countrywide operations in Italy. There followed several years in operational consultancy for oil and gas majors followed by directorships in companies involved in software development, personnel deployment, renewable technologies, and industrial LED lighting. Jan joined what was to become UKRI in 2017 and has since been involved in the EPSRC research themes of mathematics and advanced materials as well as university and business engagement. He joined the DER team in October 2023.

Hugh Falkner

Innovation Lead

Hugh joined the Challenge in December 2022, from the Transforming Foundation Industries Challenge. He has a PhD in off-grid wind energy from Leicester University and has worked in the PEMD sector as a designer of welding and plasma cutting equipment, fire alarms, emergency lighting and off-grid wind and solar controls. Prior to joining Innovate he spent 20 years as an energy consultant with Ricardo and Atkins, specialising in electric motor system efficiency.

Jonny Bunt

Programme Manager

Jonny joined the Challenge in January 2020. Previously he delivered business-wide change programmes and projects in commercial and public sector organisations, encompassing a broad range of fields including digital transformation and target operating model implementation, new product and capability development and integration, GDPR transition, organisation-wide terms and conditions harmonisation, and cancer protocol and pathway re-design.

Lorna Thomas

Project Manager

Lorna joined the Challenge in September 2019 as a Project Manager. She was previously a Project Manager in a large public sector organisation based in Thames Valley. At Driving the Electric Revolution, Lorna also leads on the Challenge evaluation undertaken by the external evaluation partners. She is an Associate Member of the Association of Project Management. Her special interest areas are Risk Management and Equality, Diversity, & Inclusion.

Arben Farhati

Impact and Performance Manager

Arben joined Innovate UK in October 2023 from The Welding Institute (TWI), where he was a Senior Project Leader/Researcher for the Electron Beam Department. At TWI Arben led Electron Beam Technology development for welding processes, approaches to engineering solutions for clients, and delivery of Innovate UK and EU research-funded projects. Arben was also extensively involved in business development, preparing research proposals, and engaging with customers and funding bodies. Throughout his career, he has been part of significant projects in the renewable energy sector and assisted PhD students with their studies. Arben holds a Doctorate in engineering from Brunel University of London and he is enthusiastic about the opportunity in applying his expertise to advance technological developments for the NetZero economy.

Nicholas Ansell

Impact and Performance Manager

Nicholas joined the challenge as a Researcher in February 2022, and was appointed as Impact and Performance Manager in December 2022. He moved on in August 2023. Before joining Innovate UK, Nicholas spent two years working in sustainability and business development for a leading London-based AgTech company. He has an MSc in Global Development from the University of Copenhagen, completing mixed-method social research projects on urban displacement and vertical farming before graduating.

Hristo Yordanov

Finance Business Partner

Hristo joined Innovate UK in July 2016 from operational consulting firm KLB Group where he was a junior consultant working on finance optimisation projects. Hristo holds a master's degree in international Banking & Finance, as well as an Advanced Diploma in Accounting and Business from the Association of Chartered Certified Accountants and is currently sitting his final exams to become a member of the association.

Claire Lawrence

Executive Assistant

Claire joined Innovate UK in 2019 as Personal Assistant to Challenge Fund Directors. Claire provides essential support to six Challenge Directors across various sectors, including Driving the Electric Revolution's Will Drury. She brings a wealth of experience and transferable skills with her from her previous positions within the IT industry. In January 2023 she was appointed as Executive Assistant to the Executive Director of Digital & Technologies Domain, as well as continuing her support of the Challenge Directors.

Mustaphis Koleoso

Project Support Analyst

Mustaphis joined the challenge as a Project Support Analyst in October 2022 and moved on in May 2023. Before this, he was part of the Innovate UK graduate scheme. This gave him an opportunity to work in several Innovate UK teams including Operations teams, the Health & Life Sciences, and the Global Teams.

Programme Board

The Programme Board is a major component of the Challenge Fund programme governance and assurance structure. The Board supports and makes recommendations to the Challenge Director and the Challenge Fund Steering Board on matters of delivery, strategy, and assurance. The Board helps to identify and support approaches that will lead to the successful realisation of desired outcomes and benefits, as defined in the Challenge business case.

Guy Woolley

Challenge Senior Responsible Owner (SRO)

Guy Woolley is the Chief Operating Officer at Innovate UK and the Challenge SRO. He has worked at Innovate UK since 2014, joining as Head of Process Improvement and Business Change. He then took on the role of Deputy Director Programme Management Office, supporting the creation of UKRI to bring the seven research councils, Innovate UK, and Research England into a single organisation. He then became the Director for Major Programmes Governance at Innovate UK.

Clare Lindsay

Deputy Director Governance and Assurance, Innovate UK

Clare provides input to the Board on governance, benefits, and risk. Clare's background is in project and programme management across the private and public sectors.

John Toplis

Head of Property and Capital Portfolio, Innovate UK

John provides expert property, development and project management advice and support on all of Innovate UK's capital programmes including the UKRI Challenge Fund, Catapult Centres, Aerospace and Automotive programmes. John is also acting as the grant Monitoring Officer on the DER-IC project to ensure the centres deliver to the grant terms and conditions, milestones and KPIs.

Dr Emily Stebbings

Head of Appraisal and Evaluation, Innovate UK

Emily provides specialist advice and expertise on economic appraisal across the Innovate UK and UKRI Challenge Fund portfolios and heads the evaluation unit at Innovate UK. Her research background is in environmental economics, particularly sustainable supply chains, the marine economy and renewable energy.

Dr Samantha Francis

Engineering and Physical Sciences Research Council (EPSRC) representative

Samantha is a Deputy Director for the Research Base for EPSRC. Responsibilities include leadership in Engineering, ICT, and managing the Portfolio and Research Infrastructure portfolios.

Ian Constance
External Board Member

Ian is CEO of the UK Advanced Propulsion Centre where he oversees delivery of high value, high impact research. Ian has held positions globally in the automotive industry with over 25 years' experience.

Andrew Hodgson OBE
External Board Member

Andrew is a chairman in automotive and circular economy sectors, and previously held senior roles in the energy, aerospace, and subsea sectors. He has been awarded three Queens Awards for Industry.

Mark Scully
External Board Member

Mark is responsible for leading on the Aerospace Technology Institute technology strategy and the delivery of the R&T projects portfolio. These include both ultra-efficient and zero carbon propulsion systems, next generation aircraft systems, and associated technologies for aircraft design, manufacture & assembly, operation, and end of life.

Advisory Group

The advisory group provide the Driving the Electric Revolution Challenge team with expert advice and guidance. Co-chaired by independent industry leads and bringing together representatives from the industry and academia, the advisory group ensures the ongoing strategic focus of the Challenge and provides wider sectoral input.

In 2023 the advisory group members were:

- Philippa Oldham (Co-chair)
- Dr Graham Bruce (Co-chair)
- Alex Barnett
- Dr Felix Langley
- Dr Steve Lambert
- Dr Thomas Wildsmith
- Guy Blundell
- Jeff Townsend
- Jillian Hughes
- Kiran Harish
- Phil McGoldrick
- Professor Bill Drury
- Professor Derrick Holliday
- Professor Geraint Jewell
- Professor James Widmer
- Professor Matt Boyle OBE
- Sarah Mlundira
- Vicki Edmonds

"Over the past 12 months the Driving the Electric Revolution Challenge has demonstrated continued progress and influence within the PEMD sector, a key component in our pursuit of net zero objectives.

This growth and impact have been evident nationwide, and within the Semiconductors and the critical materials supply chain. Integral to this achievement has been the cohesive collaboration within the community, alongside the invaluable guidance and support provided by the Driving the Electric Revolution Programme Board.

The dedication and involvement of external members of the program board have been particularly commendable."

Guy Woolley

Innovate UK Business Connect Partners

Paul Huggett

Industrial Technologies Knowledge Transfer Manager (KTM)

Paul is responsible for technical communities in power electronics, and cross-sector liaison relating to electronics. Paul is the electronics technical and strategy liaison with government agencies and leads on the Driving the Electric Revolution Challenge as well as the PEMD work at Innovate UK Business Connect.

Dr Sven Knowles

Industrial Technologies Knowledge Transfer Manager (KTM)

Sven's background is in leading technology innovation, business strategy and product development. He has managed a portfolio of technology companies and investments across the globe. At Innovate UK Business Connect, he manages the Driving the Electric Revolution Challenge.

Raluca Popovici

Industrial Technologies Knowledge Transfer Manager (KTM)

Raluca has an engineering background in Aerospace Systems Engineering, having done projects for IMechE and NATO. Raluca interacts with small companies, large organisations, academics, and government to help advance Robotics and AI technologies whilst helping manufacturers adopt these solutions and move into a more digital and automated scene. For the Driving the Electric Revolution Challenge, Raluca helps organisations network to boost electrification technologies within the UK.

Alexandra 'Alex' O'Brien

Events Manager

Alex has been an Event Manager within Innovate UK Business Connect for a year and is thrilled at the range of in-person, hybrid, and virtual events they have organised. Previously Alex worked in events for a small trade association producing conferences, exhibitions, and award ceremonies. Alex has supported the Driving the Electric Revolution team in the organising and delivery of Engage with LIVE! 2023.

Anita Onwuegbuzie

Events Manager

Anita is an Event Manager within Innovate UK Business Connect for eleven years, who has worked with the Driving the Electric Revolution team in delivering targeted online and in-person events. They played a vital role in ensuring the success of including Engage with LIVE! 2023.

Matthew Cliffe

Marketing Manager

Matt is the Marketing Manager for the Challenge that is delivered by Innovate UK. Throughout the year, Matt has successfully promoted events, funding competitions, and news announcements for the programme. Matt's delivery of the marketing activities including promoting the flagship Engage with... LIVE! 2023 conference, sharing the monthly Driving the Electric Revolution newsletter and growing the Driving the Electric Revolution Community LinkedIn group has significantly contributed to increasing engagement for the overall Challenge Fund.

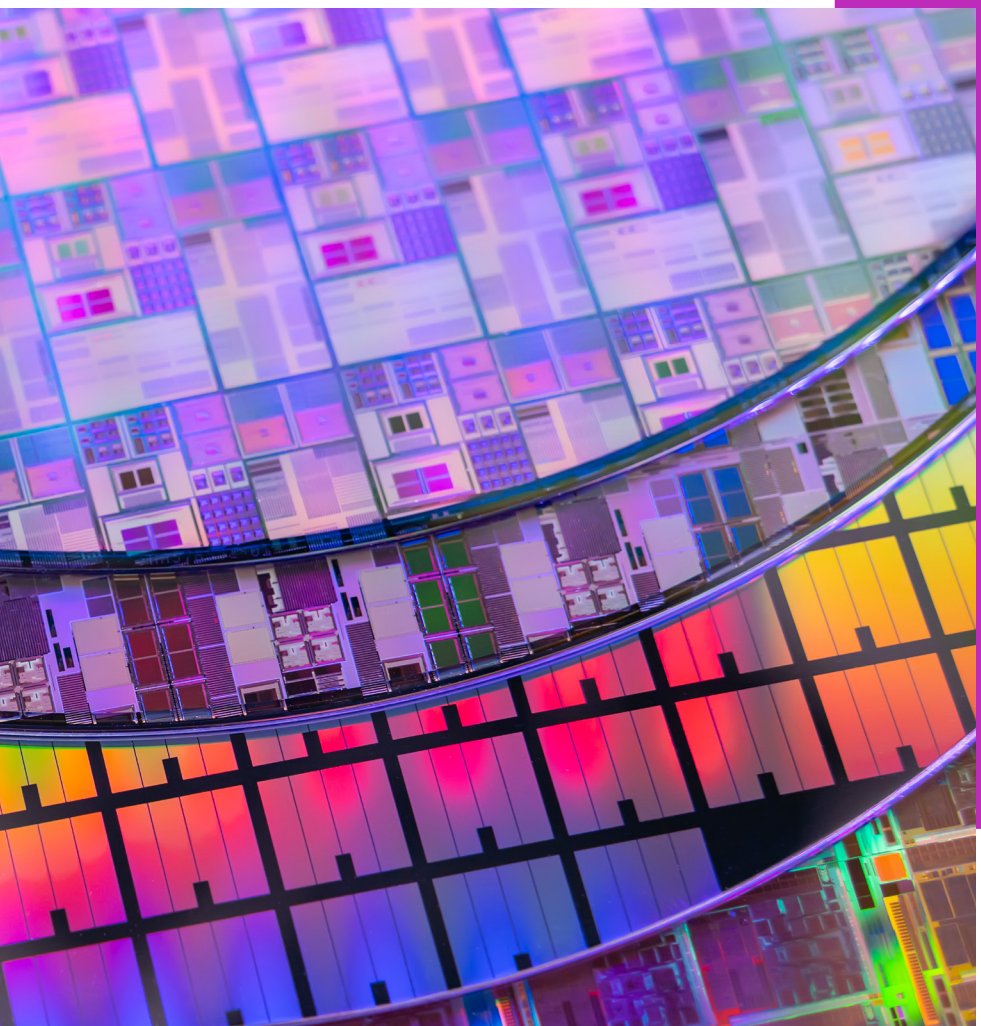
The Role of Innovate UK Business Connect

Innovate UK Business Connect is part of the Innovate UK, the UK's innovation agency. The Driving the Electric Revolution community remains strong with over 2,500 members representing over 500 organisations from across the UK. Innovate continues to be vital in attracting new entrants to the community and connecting businesses.

With the support of Innovate UK and UKRI, Innovate UK Business Connect supports businesses on their innovation journey. It identifies strategic goals and innovation pathways, as well as providing a rich annual portfolio of activities at a regional, national and global level.

A key purpose of the Innovate Business Connect is to provide innovators with new partners and new opportunities beyond their existing in order to accelerate ideas into real-world solutions. It connects ideas, people, and communities to drive innovation that changes lives.

A specialist in creating meaningful impact by convening innovative industries across traditional sector boundaries and bringing together innovation ecosystems, Innovate Business Connect has approximately 300 staff across the UK, with deep technical sector expertise, and over 45,000 organisations as part of its network. Throughout the UK, Innovate Business Connect has extensive connections in the industrial and research sectors of the country. In this way, it can generate cross-sector collaborations by bringing together different communities.



Driving the Electric Revolution support

Innovate UK Business Connect has a long history of working in support of PEMD technologies to drive economic growth and address societal challenges. It has achieved this by working with others including a wide range of partners, from academia to industry, government, and the public sector.

Innovate UK Business Connect has promoted and provided information about the Driving the Electric Revolution Challenge to a targeted network of more than 3,500 unique PEMD focused individuals and included Innovate UK Business Connect's provision of:

- PEMD focused, cross sector newsletters. Click here to subscribe to the Innovate UK Business Connect Driving the Electric Revolution newsletter.
- Direct community support for consortium building, collaborations, and assistance in project development.
- Online events, including the 'Engage with…' webinar series, Electrifying Interviews and EDI events.
- Repository of Recordings and presentations from historic 'Engage With…' webinars.
- Provision of information about the Driving the Electric Revolution challenge to a targeted network of PEMD focused unique individuals.
- Updating the Driving the Electric Revolution programme page with the latest information.

Electrifying Interviews with McLaren Applied

The 'Electrifying Interviews with McLaren Applied' were produced to increase the number of young people from diverse backgrounds to be interested in entering engineering as a profession. This is facilitated by early exposure to STEM concepts through engaging and relatable role models. This approach humanises STEM, removes barriers, and empowers youth to explore careers they may not have otherwise considered.

Power Electronics, Machines and Drives (PEMD) are crucial for the UK's net zero goals. Industries transitioning to electrification are creating an urgent demand for next-generation PEMD technologies and the associated STEM skills required for their implementation and deployment.

The Driving the Electric Revolution programme has an aim to make engineering and PEMD accessible and appealing by facilitating 60-minute webinars and 5-minute LinkedIn 'Electrifying Interviews'.

McLaren Applied Ltd (www.mclarenapplied.com), formerly part of McLaren Group and since 2021 an independent company, offers PEMD solutions in motorsports, automotive, transport, and mining. The 'Electrifying Interviews with McLaren Applied' captured the employees' enthusiasm, insights, and promising career paths. Their relatable backgrounds were captured to inspire prospective young individuals to explore educational and career prospects in engineering, Power Electronics, Machines and Drives.

Engage with... webinar events

The 'Engage with...' webinars were initiated in April 2020 at the very start of the Covid-19 pandemic to enable everyone to continue meeting, engaging, and communicating with leading companies and organisations involved in PEMD. These are held in a repository and continue to be used to form collaborations and cohorts between companies and organisations.

From 2020-2022, this webinar series held 57 'Engage with...' events, to which 3,057 people attended. Over 560 questions were answered and 125 new introductions were made between Innovate UK Business Connect and DER related companies, all exploring future opportunities for partnerships, collaborations, and projects. 'Engage with...' has directly led to several new business opportunities taking advantage of the economic opportunities from the global transition to clean technologies.

- Agri Lincoln
- Arcola
- Belcan Engineering
- British Glass
- Centre for Future Clean Mobility, Exeter University
- Control Techniques, a Nidec Brand
- CSA Catapult
- Cummins
- Custom Interconnect Ltd
- Department for International Trade
- Driving the Electric Revolution Industrialisation Centres
- DTE Network+
- Dynex Semiconductor
- Electrified Automation
- Equipmake
- Fluxsys
- Future Electrical Machines Manufacturing Hub
- Greenspur Wind
- Hirst Magnetic Instruments
- Horizon Europe
- Industrial Drives
- Made Smarter Innovation Network
- Magnomatics
- McLaren Applied
- NEMA
- Network Rail
- Nexperia
- NPL
- Paragraf
- Performance Projects
- Pure Electric
- Ricardo
- RNLI
- Rolls-Royce
- Romax Technology Ltd
- Siemens
- SP Energy Networks
- STFC
- Turbo Power Systems
- UK Electronic Skills Foundation
- Universal Balancing
- Verlume
- YASA
- ZeroAviva
- ZF

Engage with... LIVE! 2023

The Engage with... LIVE! 2023 conference, at Millennium Point in Birmingham, showcased Power Electronics, Machines and Drives (PEMD) supply chain community to enable technology providers to work towards global decarbonisation and building net zero economy.

The one-day in-person event demonstrated the latest PEMD examples from sectors including aviation, automotive, energy generation and supply, manufacturing, marine, off-road, rail, robotics & AI, semiconductors, and skills.

It was a unique opportunity for companies to network with future suppliers and customers across multiple industries, explore new business collaborations, and identify routes to access funding and finance.

The event encouraged companies to network and promote their products and services to broader audiences by utilising multiple networking sessions, exhibition spaces, exhibitor technical demonstrations, skills development, and an opening up of the UK PEMD sector network to international businesses.

Dave Smith (UK's National Technology Adviser) and Will Drury (Executive Director, Digital & Technologies, Innovate UK) kicked off the event with a keynote speech on Critical Technologies for National Ambitions.

The Electric Revolution Skills Hub (ERS Hub) presented their electrification dedicated industry-first platform for courses, career opportunities, tools, and skills development, all designed to alleviate skills gaps. The Driving the Electric Revolution Industrialisation Centres (DER-IC) chaired a session of bankers and investors providing the UK manufacturers with follow-on and alternative methods of non-grant funding. There was also representation from Catapults including the Compound Semiconductor Application Catapult (CSAC) and the Energy Systems Catapult (ESC).

Themes included:

- Compound semiconductor power electronics and drives supply chain development.
- Electric machine manufacturing process innovations.
- Materials and end-of-life recycling in PEMD.
- Building a skills pipeline to enable supply chain growth.
- Follow-on and alternative methods of non-grant funding.

Engage with... LIVE! attracted 300 attendees and 40 presenting companies who formed more than 117 relevant introductions. This resulted in both new and existing businesses engaging with Innovate UK products and services, developing new business opportunities, and accessing non-grant funding.

- Advanced Electric Machines
- Advanced Propulsion Centre (APC)
- Carbon Three Sixty
- C Brandauer & Co Ltd
- Cenex
- Centre for Modelling and Simulation (CFMS)
- Clas-SiC Wafer Fab
- CSconnected
- Custom Interconnect Limited
- Driving the Electric Revolution Industrialisation Centre (DERIC)
- EDRMedeso
- Energy Systems Catapult
- Electric Revolution Skills Hub (ERS Hub)
- Engineering Development Trust- Industrial Cadets
- ePropelled Ltd
- FluxSys Ltd
- Future Electrical Machines Manufacturing Hub (FEMM Hub)
- Fuzzy Logic Studio
- Gencoa
- GE Verona
- GreenSpur Wind
- H V Wooding Ltd
- Hexagon
- Hirst Magnetic Instruments Ltd
- HyProMag Ltd
- IMAPS-UK
- Industrial Systems and Control Ltd
- Lotus Cars Ltd
- Magnomatics Ltd
- McLaren Applied
- Nascent Semi
- National Physical Laboratory (NPL)
- OxDrive Ltd
- Power Electronics UK
- PPM Power
- RAM Innovations Ltd
- Sensor Technology Ltd
- Semiwise Ltd
- Supply Design Ltd
- Talos Technology
- Tannlin Ltd
- The Blair Project & Oasis Play
- The Thinking Pod Innovations
- The University of Nottingham
- Turbo Power Systems
- Ultrawise Innovation
- University of Sheffield Advanced Manufacturing Research Centre (AMRC)
- Wavedrives Ltd

Reports

The Metals Technology Deep Dive report considers the metals currently used in PEMD technologies and within its related supply chains, to achieve a better understanding of how these metals directly affect the PEMD supply chain and their roles in bringing about net zero.

Driving the Electric Revolution in the AgriFood sector report published by Innovate UK Business Connect on behalf of UK Research and Innovation (UKRI) highlighting the opportunities and challenges of electrifying the agricultural and food sectors.

Innovate UK Business Connect's Chemistry and Industrial Biotechnology team in conjunction with the Driving the Electric Revolution Challenge conducted a review into the rare-earth materials and magnet supply chain opportunity for the UK with a report on **Understanding the UK Supply Chain Opportunity in Materials for Permanent Magnets**.

The '**When we Engaged with...**' series documents several of the Engage with LIVE...Webinars and includes the following companies:

- When we Engaged with... Electrified Automation
- When we Engaged with... Lincoln Institute for Agri-Food Technology
- When we Engaged with... Paragraf
- When we Engaged with... Rolls-Royce
- When we Engaged with... RNLI

Growing UK PEMD Manufacturing

Driving the Electric Revolution Industrialisation Centres

Driving the Electric Revolution Industrialisation Centres (DER-IC) is a UK-wide network of over 30 Universities and Research and Technology Organisations (RTO). Each network partner brings Power Electronics, Machines and Drives (PEMD) expertise, specialist knowledge and capability. Leveraging the collective strength of the partner network, DER-IC's mission is to work with industry to grow UK PEMD manufacturing capability, capacity, and competitiveness.

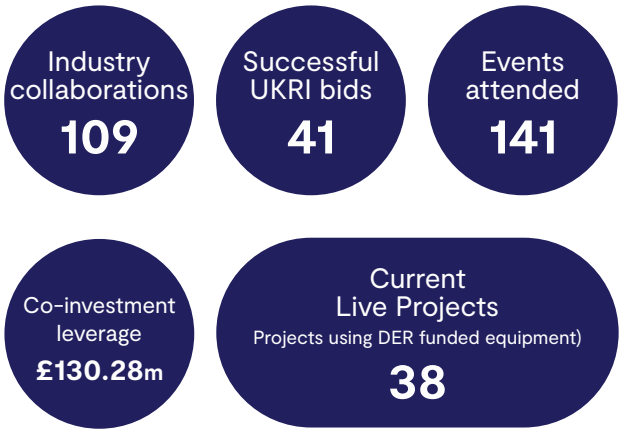
Backed by UK Government funding, Driving the Electric Revolution Industrialisation Centres reduce the cost and risk of manufacturing PEMD in the UK by providing open access to expertise and state-of-the-art manufacturing, test, and validation equipment.

The DER-IC network engages in collaborative research and development projects (CR&D) funded through UKRI, Innovate UK, regional initiatives, and other funding schemes, and can also provide access to equipment and capability through direct commercial contracts and Knowledge Transfer Partnerships (KTPs). DER-IC hosts an online portal enabling the wider supply chain to highlight their PEMD capabilities and link with the national DER-IC network, providing opportunities for collaboration. DER-IC can facilitate targeted introductions to expedite access to the most relevant researchers, engineers, and capability across the partner network.

By using DER-IC equipment and capability, supply chain partners can develop and verify their product and manufacturing process ahead of committing to capital investment, thus reducing cost and risk of new product introduction (NPI) and achieving a faster time to market.

DER-IC offers the following capabilities:

- Product and Manufacturing Process Equipment Design
- Manufacturing Process Development and Optimisation
- Prototype Manufacture and Scale-up Support
- In-Process and End-of-Line Test and Validation.
- Material and Component Characterisation.
- Electrification Skills Learning and Development.



* Note, figures are cumulative April 2020–Sept 2023.

More information on the DER-IC network and capability can be found on the website: www.der-ic.org.uk.

> With the evolving landscape of the electric revolution, the Driving the Electric Revolution Industrialisation Centres embody fundamental innovation and collaboration. Backed by UKRI investment and three years of steady development, the DER-IC network takes a lead role in championing the UK PEMD manufacturing supply chain. Through open access to advanced design, manufacturing, and testing facilities, we facilitate the manufacturing industry in creating cost-effective, innovative products without causing disruptions to ongoing production. Looking ahead, our commitment to collaboration, expertise, and distinctive capabilities remains crucial in propelling the electric revolution forward."
>
> **Matt Boyle :** *OBE, Executive Chair, Driving the Electric Revolution Industrialisation Centres*

The Electric Revolution Skills Hub

The Electric Revolution Skills Hub (ERS Hub) is empowering careers in electrification, offering access to essential skills, development pathways, job opportunities and industry collaboration. The Hub is keen to engage with the breadth of the electrification community to work towards the common goal of closing the skills gap in sectors such as manufacturing, transport, and energy.

In 2023, the ERS Hub successfully launched the digital platform with the features such as jobs, courses board and facility directory. Other key achievements include the release of the first version of the PEMD Body of Knowledge and the Self-Assessment Tool. All these are available for the community to use.

Electrification Self-Assessment Tool

Empowering Your Electrification Journey

Dedicated to driving industry growth by facilitating the development of deep sector-specific expertise and addressing the skills shortage, the Hub introduced unique features to enable the development of a dynamic and qualified workforce.

- Course Board - an extensive array of electrification courses and CPD from universities and training providers conveniently consolidated in one location.
- Jobs Board – dedicated to connecting potential candidates to electrification opportunities.
- Power Electronics, Machines and Drives Body of Knowledge framework (as illustrated on page 27) identifies technology, skills and proficiencies within the electrification ecosystem. Access the framework here.
- Self-assessment tool guides learners and experts in developing electrification capability. It allows ERS Hub users to explore their confidence and capabilities in the knowledge areas defined in the PEMD Body of Knowledge. Access the self-assessment tool here.
- Facilities Directory – Explore and discover the electrification resources in your area.
- Engaging the community – we grew our network through our wide-ranging activities, such as our presence at industry events, blogs, podcast and social media presence.

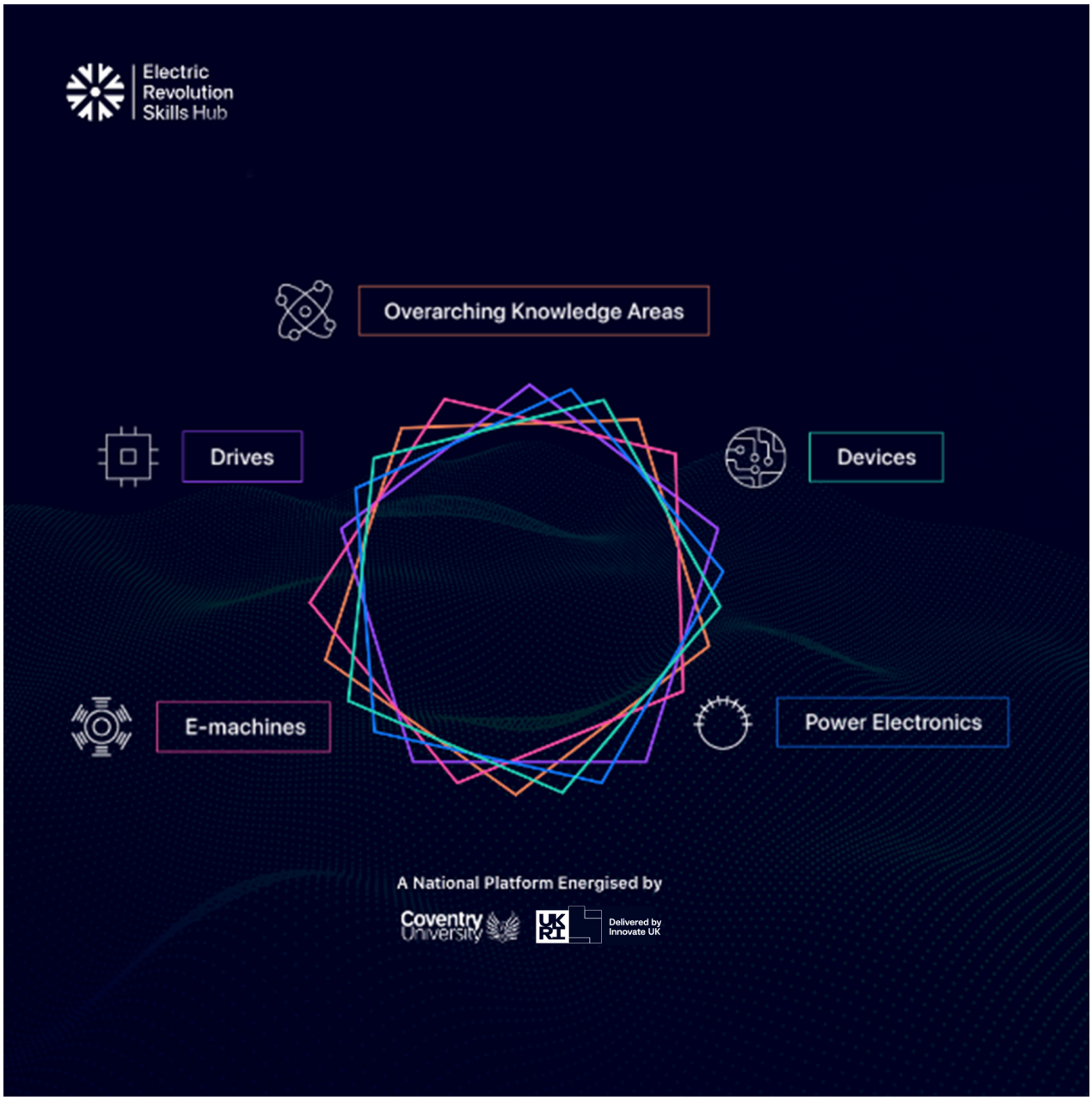
Underpinned by in-depth specialist knowledge, the Hub offers access to training, job opportunities and a community, making the platform the primary resource for skills guidance. Through talent enhancement and skill optimisation, ERS Hub connects individuals, employers, and training providers into one community.

PEMD Body of Knowledge

National Electrification Skills Framework and Forum

As a result of recent developments, the ERS hub will be working closely with Coventry University which is now leading the National Electrification Skills Framework and Forum (NESFF) in collaboration with Enginuity, Warwick Manufacturing Group (WMG) and the UK Battery Industrialisation Centre.

The consortium, will also be working closely with Innovate UK Workforce Foresighting Hub, harnessing its members' combined strengths and experience to deliver a framework and forum to benefit the UK electrification industry and society.



Communications and engagement

DER-IC events

The Industrialisation Centres had a busy 2023 attending six major events including:

- Centre for Power Electronics (CPE) conference
- CPE conference DER-IC extra time session
- AESIN conference
- Cenex LCV
- Society of Motor Manufacturers and Traders (SMMT) Meet the Buyer
- COP26 where the DER-IC team attended the electrification sessions in Glasgow

The Business Development Manager for DER-IC Scotland also exhibited at The National Manufacturing Institute Scotland 'Manufacturing a net zero future' event as part of the COP26 programme.

Case studies

The companies Clas-Sic and Performance Projects were written up as case studies. Published online they highlight the benefits funding from the Challenge has had on their businesses and the PEMD industry.

View Clas-Sic's case study at https://www.discover.ukri.org/clas-sic-case-study/index.html

View Performance Projects' case study at https://www.discover.ukri.org/performanceprojects/index.html

Challenge benefits and evaluation

A significant component of the Driving the Electric Revolution Challenge's success is the funding of projects through competitions. This section outlines some of the benefits work which was undertaken prior to December 2022. The Challenge tracks each initiative's progress and achievements step by step. In recognition of the critical importance of public expenditure accountability, we want to celebrate the success of the project and provide ongoing support during the funding period.

Over the coming years, we will be able to directly deliver wide range of benefits in the UK. Even though many of the long-term benefits will take time to materialize, early benefits from the successful Driving the Electric Revolution Challenge intervention are evident.

The process of collecting data on established Driving the Electric Revolution funded projects is underway in order to capture their success and impact directly resulting from the funding investment made by Driving the Electric Revolution. Including the co-investment acquired and the creation of jobs, the benefit is both financial and non-financial.

An overview of the Challenge's expected and realised benefits is provided below. A total of more than 40 projects have provided insights into the benefits and broader impacts of their projects to date.

Most of the participant data is taken from 44 formalised interview responses across 29 Collaborative R&D projects. In parts it is supplemented by interviews with the 20 funded participants from the Building Talent for the Future (BTFTF) skills-focused projects.

Thank you to all participants for their involvement and sharing this information with the Challenge team.

Building a community

A benefit of Driving the Electric Revolution's 'Engage with...' series has been the growth of the UK PEMD community. Innovate UK Business Connect has been able to connect 125 firms that would not have considered collaborating before the Challenge, thanks to over 2,500 participants. Driving the Electric Revolution has been successful in building and connecting the PEMD community, which has resulted in a more efficient supply chain in the UK.

Producing highly skilled jobs

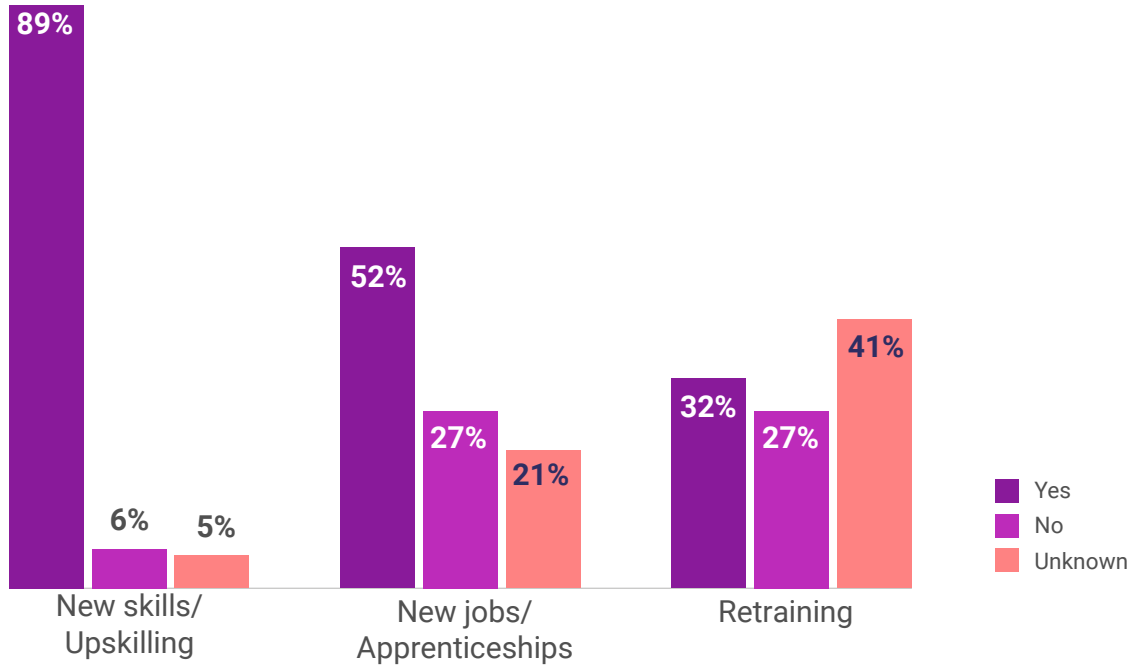
The challenge is focused to ensure training, retraining, and upskilling of existing and new businesses, exploiting collaboration between UK academics and UK businesses. The UK has around thirty thousand highly skilled workers involved in internal combustion engine supply chains. It is expected that a substantial number of these workers will need to be retrained and repurposed considering the shift to electric vehicles. Consequently, they will be able to work in PEMD supply chains in areas such as mechanical, electrical, software, manufacturing, and management.

According to the CR&D project participants surveyed, 89% indicated that their project had increased their understanding of new processes and technologies, resulting in new competencies, and upskilling within the organization's workforce. Based on interviews conducted within Cohort 1 participants, 82% indicated that their project focused on the development of new skills, upskilling, or a combination of both. According to CR&D respondents, 52% of their project had resulted in new employment or apprenticeships in the R&D or manufacturing sectors.

Number of jobs created or forecast by projects funded by the Challenge	
Jobs created: directly	10.5
Jobs created: indirectly via retention or organisation growth	32.5
Jobs forecast: through current vacant positions and predicted expansion	84

These new jobs will be cross-sector based in PEMD supply chains serving all Challenge focus sectors. To date, the Challenge has helped create or maintain 43 full-time equivalent (FTE) roles and is forecasted to lead to a further 84 FTE positions by 2025. Among them are machine operators, research and development engineers, and doctoral candidates.

Has your project resulted in any of the following?

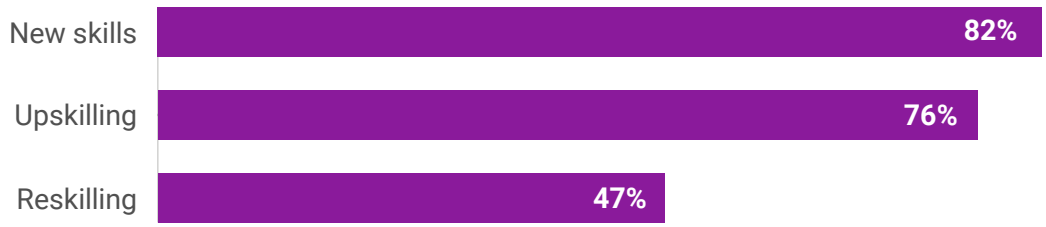


As part of the skills, benefits, and co-investment interviews, the answers were challenged and discussed. While only 32% of participants said that their project has facilitated retraining into PEMD, we expect this figure to evolve over time as 41% responded that this outcome is still an unknown.

Participants of BTFTF Cohort 1 are also addressing this directly, with 47% of respondents saying that their project targeted reskilling or retraining to some degree.

Several participants from this cohort have indeed gone on to develop courses to either improve the standards of existing workforces or train new employees seeking to enter PEMD. Cumulatively these have been delivered to over 400 adults so far addressing targeted elements within power electronics, electric machines, or a more general account of PEMD.

Percentage of participants from the BTFTF Cohort 1 who believe their project targeted new skills, upskilling or reskilling to some degree



Filling crucial gaps in the supply chain

With the purpose of developing a unique national coordination of activity across the PEMD sector in the UK, the Challenge has provided an opportunity to form successful collaborative working relationships where previously such networking opportunities would have not been available.

As a result of this approach, we have been able to fund projects that establish collaborative working partnerships and develop value chains that were previously unattainable. The network outreach has provided visibility for several SMEs and promoted partnership working.

The feedback from participants regarding cross-sector collaboration has been overwhelmingly positive. In the survey, 93% of respondents reported that their project enabled new cross-sector and end-to-end supply chain connections.

We have recorded numerous instances whereby SMEs have continued their working relationships with RTOs, Catapults, or academic institutions beyond the lifecycle of their initial project. There were many who had not previously worked together before they collaborated within the initial project consortium.

A similar principle applies to end-to-end supply chain links. Through these projects, the SMEs in upstream and downstream were able to establish new relationships, which could then be leveraged through direct collaboration or subcontracting. Over the next few years, we expect these figures to increase, resulting in real-term quantifiable added value.

Increasing export revenues and market share

Globally, PEMD is estimated to be worth more than £2 trillion by 2050, of which Europe will consume £700 billion. It is expected that the PEMD market will exceed £450 billion in 2025, mostly driven by the automotive, energy, and maritime industries, as their adoption is expected to be earlier and less regulated than other industries. As a result of Driving the Electric Revolution, the UK can increase its global market share from £7 billion (2.33%) to over £80 billion (4.5%) by 2050.

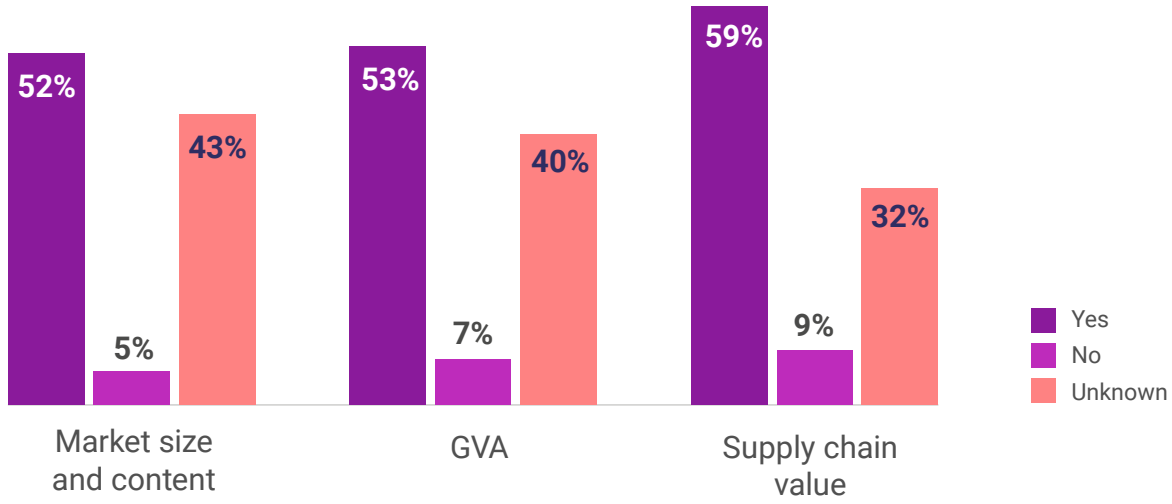
The majority of respondents (52% of them) reported that their project had influenced the size and content of the UK PEMD ecosystem. Similarly, participants reported a similar response rate (53%) regarding Gross Value Added (GVA) as an outcome of the project.

Across supply chains, this is further reinforced, as 59% of participants starting reported their projects had contributed to some extent of added value across the entire supply chain, either by reducing costs (time, materials, or labour) or by increasing value (through the development of new or improved products, capabilities, or processes).

In only 5% of cases, respondents explicitly indicated that their project did not affect the size or content of the UK PEMD market. According to 43% of respondents, such impact is still unknown, indicating longer-term exploration is needed.

Has your project enabled you to form new cross-sector or end-to-end supply chain linkages?

Has your project has had an impact on the UK PEMD ecosystem?

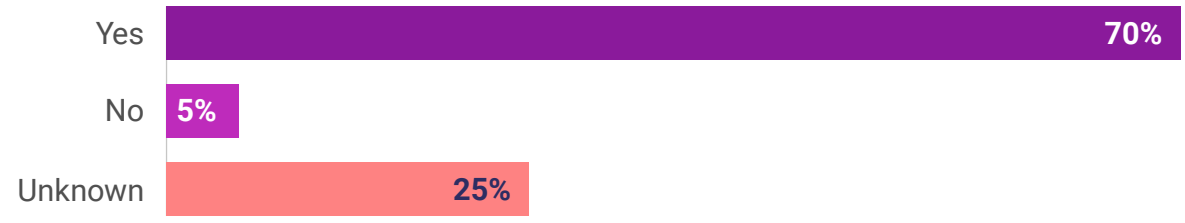


Wider and social impacts

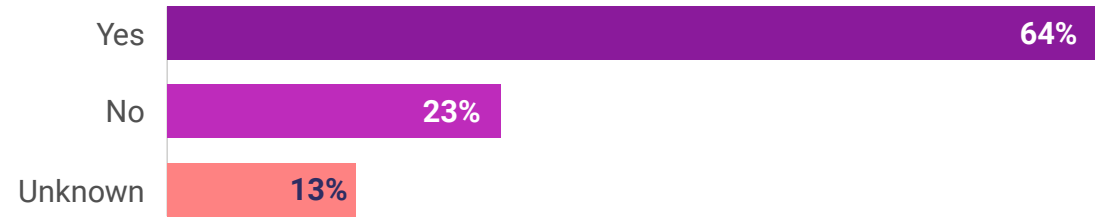
Surveyed CR&D project participants recognise that PEMD is essential to achieving net zero energy. About 70% of respondents were able to demonstrate that their projects had an impact on decarbonisation through EV. While 25% of respondents indicated an unknown, their projects are intrinsically related to electrification and therefore decarbonisation, but their impact depends on exploitation, which has yet to take place.

Another study, 64% of participants reported that their project had some kind of local impact. A variety of benefits to the local area were cited by participants, including local supply chain linkages, recruitment, new infrastructure, and agglomeration. It was observed across the UK in pockets ranging from South Wales to the Midlands to the north-east, and Scotland.

Can you demonstrate your project is having an impact on decarbonisation, through EV innovations or other means?



Can you demonstrate your project has delivered socio-economic benefits to the local area?



Supporting government policy

Supporting the delivery of government policy to meet climate change targets and industrial growth, the Challenge directly addresses the need to be able to manufacture the new products required to meet enacted legislation. A higher rate of modern technology introduction, simultaneous development of technology and manufacturing process will increase the likelihood of anchoring long-term production in the UK.

The Driving the Electric Revolution Challenge has been involved in various working groups across UKRI to ensure PEMD is recognised as a vehicle to enable government goals.

The importance of PEMD as an enabling technology has become more widely recognised and is earning its well-deserved place in many reports. Including in the 'Net Zero Strategy: Build Back Greener' where it provided vital context for delivering climate change targets. The Challenge was also instrumental in getting the Innovate UK CLIMATES programme off the ground ground and has supported the development of the National Semiconductor Strategy.

Annex: Project Directory

Funding competition: Accelerated Supply Chain

105895: Accelerating the UK E-Machine Preformed Winding Supply Chain

Description

Development of a flexible, scalable automated manufacturing processes and supply chain for next-generation motor and generator windings. This technology is applicable across most motor and generator types and powers and will increase motor and generator power density and efficiency.

The project extended existing motor and generator design simulation software to capture requirements and integrate automated manufacturing processes in design-for-manufacture assessments.

An automated winding pilot station was commissioned, followed by virtual and experimental validation.

Funding and project costs

Total project cost: £1,753,936

Driving the Electric Revolution funding: £831,876

Consortia members

- Belcan Engineering Services UK Limited
- Cummins Ltd
- GKN Hybrid Power Limited
- Motor Design Limited
- University of Nottingham

105894: High-T Hall

Description

The vision for this project was to develop and provide a supply chain for elevated temperature operation Hall sensors. These sensors can sense high frequency electromagnetic field switching for electric motors and drives, using a completely innovative Hall sensor made from graphene.

Until now it has been an expensive and time-consuming process to obtain sheets of graphene suitable for electronic devices. This inhibited the commercial uptake of graphene electronic devices. Paragraf Ltd solved this issue. The graphene created by Paragraf sits on a semiconductor wafer and is suitable for standard electronic device processing and packaging.

This project took this graphene material and processed and packaged it using standard manufacturing techniques. The fully packaged graphene Hall sensors were then tested in end user applications.

The project achieved the aim of graphene Hall sensors working at elevated temperatures. These Hall sensors were used to detect magnetic fields, and current levels in specific use cases. This has opened huge avenues for exploitation into the automotive market for graphene devices, and the partners are continuing to work together beyond the project to facilitate this.

Funding and project costs

Total project costs: £1,273,559

Driving the Electric Revolution funding: £629,159

Consortia members

- Paragraf Ltd
- Aero Stanrew Limited
- Compound Semiconductor Applications Catapult
- Rolls-Royce plc

105891: Short Loop Optimisation of Gallium Nitride Materials and Major Manufacturing Modules (SLOGaN M4)

Description

This ambitious project aimed to develop the 200mm GaN on silicon epitaxial materials and crucial manufacturing process modules to de-risk and accelerate a 200mm, 650V GaN High Electron Mobility Transistor capability for cross sectoral power electronic applications.

The complementary capabilities of the two industrial partners provide a route for a cost competitive, 200mm (8”) wide bandgap (WBG) power electronics capability that can scale to meet the growing demands of the UK PEMD supply chain for WBG materials.

The process optimisation was undertaken at Bristol University, with implementation and wafer mapping at Newport Wafer Fab so that real time, non-destructive assessments can be made as part of the process control methodology adopted for a future full flow GaN on Si power process.

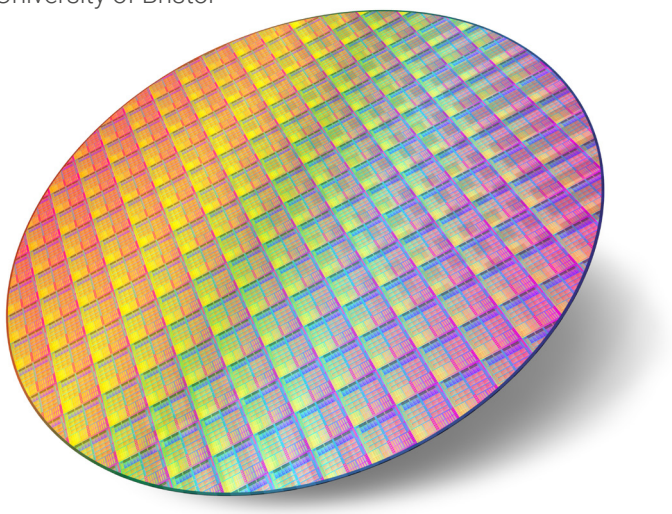
Funding and project costs

Total project costs: £988,283

Driving the Electric Revolution funding: £476,852

Consortia members

- Compound Semiconductor Centre Limited
- Newport Wafer Fab Ltd
- University of Bristol



105896: Automated Dynamic Testing of Magtec Power Controllers

Description

In this project, a radical innovation was developed to improve the test capability for electrical power controllers (drives). Enabling robust solutions for adapting drives through data acquisition and feedback into:

- Product design.
- Developing predictive modelling.
- Enabling scale up of production activity.

The partners developed independent test capabilities to allow for component, sub-assemblies, and final unit dynamic testing on an automated basis. Adapting best in class technologies from electrical test innovative markets (aerospace and automotive) to significantly improve drive lifespan and efficiency for robust applications into primary and new market opportunities.

Funding and project costs

Total project costs: £1,431,213

Driving the Electric Revolution funding: £715,607

Consortia members

- Magnetic Systems Technology Limited
- Tioga Limited

105900: Integrated Optical Sensor IGBT Module

Description

The project demonstrated the integration of Fibre Bragg Grating (FBG) optical temperature sensors into Insulated Gate Bipolar Transistor (IGBT) power modules to achieve accurate temperature measurement of individual semiconductor chips in multi-chip modules.

The integrated sensors provide direct thermal data to allow for improved module design, accurate drawing of thermal models, and therefore an enhanced level of reliability and robustness. By applying the integrated module in converters allows direct chip temperature monitoring for converter control and protection during operation. Being based on actual measurements, enables improved energy efficiency and longer operating life for the power modules.

A Dynex IGBT press pack was selected as the test vehicle, and FBG fibre sensors, compatible with the selected press pack module were designed and manufactured at City University along with software for temperature display, sensor calibration and interface with the FBG interrogator, the latter selected from UK represented suppliers.

Through the use of thermal modelling and experimental trials, the sensor layout and manufacturing methods, for the integrated module, were reviewed and optimized. This included the establishment of annealing and calibration processes. As a result of the methods selected, prototype samples were built and tested to demonstrate real-time measurement of 26 individual IGBT chips during power temperature cycling.

Funding and project costs

Total project costs: £388,234

Driving the Electric Revolution funding: £194,067

Consortia members

- Dynex Semiconductor Limited
- City University of London

105899: Die on Heatsink

Description

Electronic controllers for motors use transistors which must be cooled to remove the semiconductor losses that arise. YASA has a novel, patented method for mounting several small, standard transistors onto heatsink plates that are immersed in a flow of liquid coolant. This project aimed to improve power density and reduce controller weight further by improving the thermal and transient electrical performance of this technology.

Integrated assemblies were designed to include the transistor die, heatsink, power connections and drive circuits. The project was successful in developing a sintering process to attach silicon-carbide transistor die directly onto a liquid-cooled heatsink. The sintering process is crucial for this high-temperature power electronics assembly and was developed in collaboration with the CSA Catapult.

A small number of these assemblies were prototyped at CSA Catapult and tested to assess their electrical switching performance. They were found to perform favourably when compared with conventionally mounted transistor die in discrete plastic packages.

The developments made by the project are important prerequisites to motor controllers becoming more compact, and ultimately achieving the target power density of 100kW/l.

Funding and project costs

Total project costs: £199,877

Driving the Electric Revolution funding: £98,862

Consortia members

- YASA Limited
- Compound Semiconductor Applications Catapult

105902: Quietness Understanding in E-drive Technology (QUIET)

Description

In many market sectors there is an increasing demand for lower noise, vibration, and harshness (NVH) from electric drives. The NVH characteristics of these assemblies are difficult to predict, and problems often are not identified until late in a design cycle.

A "digital twin" approach with increased use of simulation as part of a design process was used during the project. This required a detailed investigation of multiple electrical, magnetic, mechanical, structural, control and software aspects to identify which eMotor design facets need to be simulated, and how. A test rig to measure structural borne vibration from <5kW, <6000 rpm electric drives was commissioned.

Methods developed were applied to the design of a test fixture. A full set of operational deflection shape measurements of an automotive servo drive fitted to the test rig and newly designed fixture were obtained and compared with predictions. Most vibration mode shapes were identified in both prediction and measurement, with some good agreement of the frequencies of these mode shapes.

Understanding gained during the project is being used by ZF's Servo Drives Centre of Competence in Solihull and has been implemented in the commercially available Romax Evolve software developed by Hexagon's software team in Nottingham.

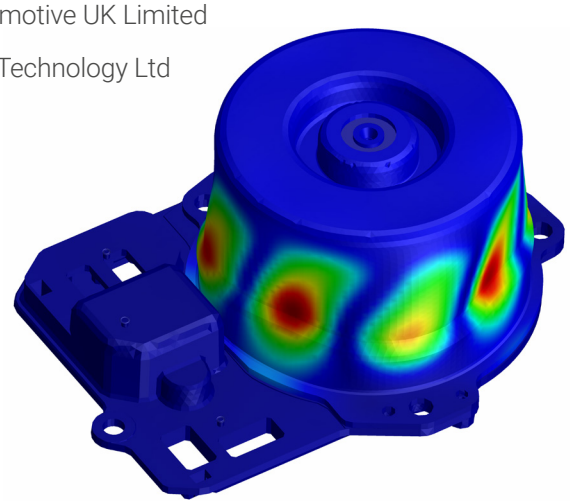
Funding and project costs

Total project costs: £997,352

Driving the Electric Revolution funding: £498,676

Consortia members

- ZF Automotive UK Limited
- Romax Technology Ltd



105903: STREAMLINED

Description

STREAMLINED was created to develop a UK-based supply chain of composite magnetic rotors for use in high power density machines. There is a rapidly growing market for these machines, driven partly by electrification requirements, but innovation is needed to produce the modern technologies at scale.

The project reviewed, adapted and upscaled its production technologies and facilities by building a 100,000 square foot manufacturing facility in Oxfordshire. This allowed it to scale up production and meet the growing demand. As a result, eight new jobs have been created.

During the project, a British luxury car manufacturer came on board as a customer and Lentus is also in talks with an Italian sports car brand. The company can now produce about 6,000 parts a year.

Funding and project costs

Total project costs: £714,693

Driving the Electric Revolution funding: £355,277

Consortia members

- Lentus Composites
- High Value Manufacturing Catapult
- National Composites Centre

105904: Lightweight Aluminium Windings (LAW)

Description

The collaborating partners developed a winding machine for aluminium wires. The winding machine provides the first UK supply chain solution for manufacturing aluminium coils. Coil winding is a critical component of motor and generator manufacture and is not provided by any UK manufacturer.

The advantages of aluminium coils are lower cost and lower weight compared with copper. The major disadvantage is the higher resistance, which decreases the efficiency of the e-Machine at low speeds. With the drive to higher speed motors, this disadvantage reduces. The project achieved a reduction in weight of e-Machines by 15% and increased recycling potential without compromising performance by developing manufacturing processes for winding coils from alternative material.

Funding and project costs

Total project costs: £659,734

Driving the Electric Revolution funding: £326,857

Consortia members

- Aspire Engineering Limited
- Dana TM4 UK Ltd
- Hydro Aluminium Rolled Products Limited
- University of Warwick

105901: HiCap

Description

Development of a UK manufacturing capability for readily scalable, in terms of capacitance and shape, thin film capacitors capable of operating at sustained temperatures of approximately 125°C. These devices are aimed at EV and other demanding industrial applications, and so, must be viable to economically manufacture in short lead times for low to medium volumes.

Funding and project costs

Total project costs: £354,993

Driving the Electric Revolution funding: £176,068

Consortia members

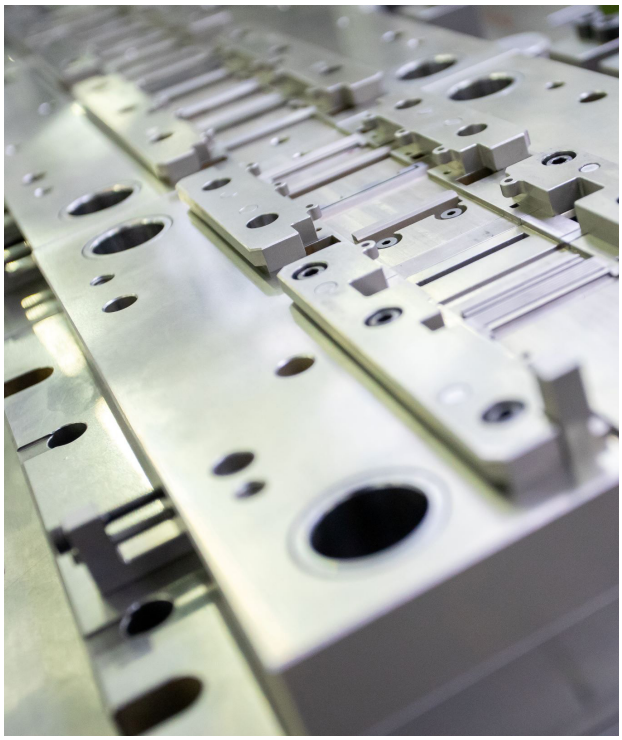
- API Capacitors Limited
- Compound Semiconductor Applications Catapult
- Integral Powertrain Limited

43016: High Volume E-Machine Stack Manufacture

Description

This project was designed to close the gap in UK-based supply of rotor and stator lamination stacks based on the demands of the automotive industry pushing for volume production of thinner laminations with finer details to meet higher performance requirements.

The project improved the production methods, tooling design, processes and material selection used in the creation of rotor and stator components to pave the way to a high-volume production of thinner laminations in the UK.



Funding and project costs

Total project costs: £897,796

Driving the Electric Revolution funding: £445,517

Consortia members

- C. Brandauer & Co. Limited
- University of Warwick

43784: Optimising through Life Cost of Industrial Gas Processing (MABEL)

Description

MABEL identified and demonstrated innovations in electrical machine system design to advance the efficiency and cost of high-speed electrical motors and generators.

Several opportunities are being explored to enhance the performance, and the value proposition, of high value systems that are used in direct drive applications where permanent operation of gas processing equipment is expected. It is important to consider all aspects of the system, including the magnetic, mechanical, control, and power electronic design, in order to optimize through life cost, which can lead to the exploitation of new market sectors.

Funding and project costs

Total project costs: £966,567

Driving the Electric Revolution funding: £679,518

Consortia members

- Turbo Power Systems Limited
- Newcastle University

Funding competition: Business-led innovation in response to global disruption

55544: Enhancing UK Engineering Skills to Drive the Low Carbon Economy

Description

This project provided free and highly focused online technical training to employees of UK companies who wished to up-skill in power electronics. It aimed to maximise the use of time for employees to up-skill whilst they had to remain at home for management of the COVID-19 pandemic.

This project catalysed a longer-term initiative in technical training to provide companies a forum to ensure their engineering teams are always up to date with the very latest in advanced engineering.

Electronic Minds produced 20 webinars providing free online technical training for engineers wishing to up-skill in power electronics. Because the training was free, it reached a wide range of participants and established itself as a provider of expert training. The company is now moving into commercial training and has secured several overseas contracts on the back of the webinars, leading to the recruitment of a new team member.

The hour-long webinars were released over a four-month period in 2020, enabling people to upskill while working and learning from home during the COVID-19 pandemic.

Electronic Minds partnered with the University of Warwick to produce the webinars, which are still freely available and are viewed daily. Roughly 3,000 people attended the live webinars.

Funding and project costs

Driving the Electric Revolution funding: £49,722

Organisation involved

- Electronic Minds

57574: Propulsion system to expedite the development of eVTOL technology

Description

The new generation of small electrified vertical take-off and landing (eVTOL) air vehicles promises exciting new opportunities for travel, business, and commerce. The propulsion technology for these vehicles is a critical contributor to their success as a technology.

The project aimed to remove barriers and expedite the route to market by creating a modular, scalable propulsion system to suit the majority of fan driven eVTOL vehicles.

From the data generated across many topologies, based on the simulation, a comparison of the benefits will be clear and, where necessary a scoring matrix will be created to account for additional criteria.

Funding and project costs

Driving the Electric Revolution funding: £49,267

Organisation involved

- Drive System Design

57890: Assessment of technical and commercial feasibility of a novel low-cost and ultra-efficient electric drive technology for drone delivery systems

Description

Electric drones are considered enabling technologies for the current and future of the drone package delivery market with huge market growth anticipated by 2030.

Camvertec aimed to develop a novel drive technology with brushless operation and a fractionally rated converter. Providing a robust, low-cost, and low-maintenance drive solution that cut the overall capital cost by up to 35%.

This project studied, assessed, and proved the commercial feasibility of the drive technology and set the foundation for commercialisation operation to move to the next phase. It scaled up the laboratory-proven prototype design to an actual size, fully optimised and characterised prototype design with its performance and economics quantified with respect to cost, size, reliability, and efficiency.

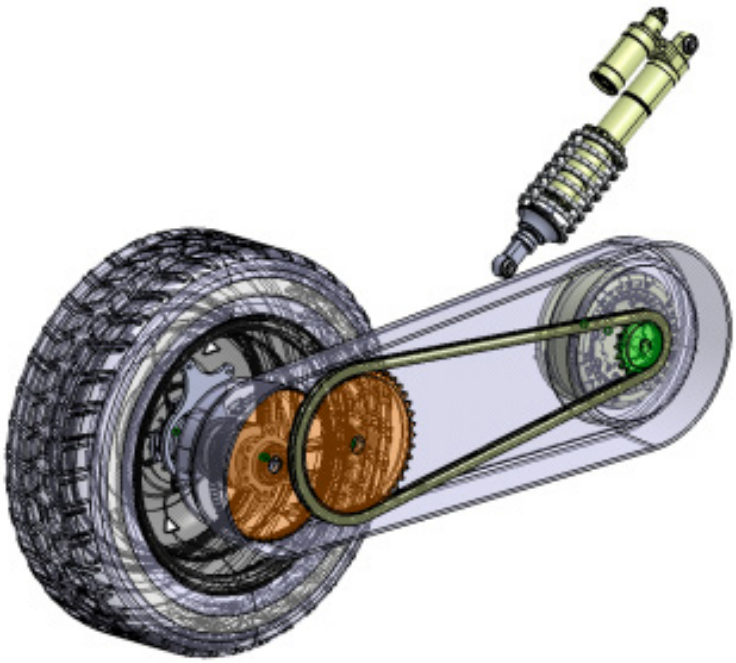
Funding and project costs

Driving the Electric Revolution funding: £48,796

Organisation involved

- Camvertec Limited

59007: Modular electric vehicle powertrain for small delivery vehicles - 'e-power-arm'



Description

Design study on simplifying the powertrain for lightweight electric vehicles. The project created a power pack housed within the suspension arm of the vehicle, called "e-power-arm". The objective was to take cost and weight out of the vehicle by sharing structures to their best advantage.

By creating such a component system, smaller electric vehicles are easier to engineer, and this supports the development of smaller and more efficient delivery vehicles.

Funding and project costs

Driving the Electric Revolution funding: £41,490

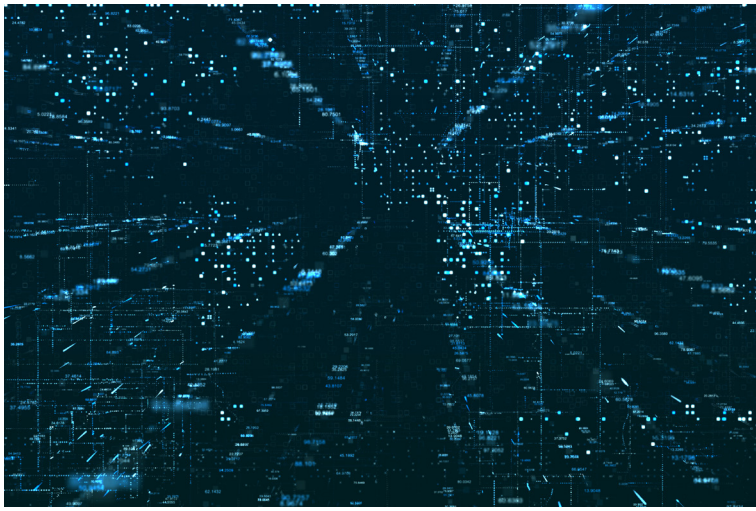
Organisation involved

- Nedra Limited

61334: Immersion-cooled power components and modelling

Description

This project focused on advancing next-generation immersion liquid-cooled power electronics for mainstream computing applications. This use of immersion-cooled power components aims to improve computing performance, reduce emissions, and help accelerate immersion-cooled, high-performance-computing systems into the mainstream.



Funding and project costs

Driving the Electric Revolution funding: £50,000

Organisation involved

- Supply Design Limited

63530: Design Development of an integration solution to utilise spare capacity in transport systems to provide local energy supplies in dense urban centres

Description

The project developed a product that safely connects electrically powered rail transport systems (DC traction), electric road vehicles (EV) and solar panels.

The application of the product allows transport authorities, rail operators, Network Rail, and light rail operators the opportunity to reduce operational costs and provide infrastructure in support of the rise in demand for EVs.

Additional opportunities are available with the electrical supply industry for low voltage supplies in dense urban areas for permanent back up supplies or temporary usage required by their clients.

Funding and project costs

Driving the Electric Revolution funding: £48,069

Organisation involved

- Power Supply Projects Ltd

66091: Additive Manufacturing for Electric Motors

Description

Winding has a significant impact on motor performance and cost of manufacturing. For most manufacturers, during production, winding and coil injection are major bottlenecks to the cost of production and product quality satisfaction.

Using Additive Manufacturing (AM) to produce the labour-intensive, complex motor windings creates opportunities to rapidly prototype electric motors in the UK. Moreover, such technology could present an opportunity for new high-performance motor designs that were previously infeasible with present manufacturing methods.

High frequency motors require "litz" wire to produce low resistance windings at high alternating current frequencies found in applications such as e-vehicles. This project successfully built "litz" wire with AM methods allowing for high copper densities within the motor whilst maintaining the benefits of using multiple small conductors to make up a larger conductor.

Technelec filed a patent application following the project to protect the AM concepts which have enabled a >60% reduction in copper losses and look to continue to develop this work to find an optimal design to allow additive process manufacturers for series production.

Funding and project costs

Driving the Electric Revolution funding: £47,314

Organisation involved

- Technelec Limited

Funding competition: Catalysing green innovation

77130: UK-Alumotor

Description

The UK-Alumotor consortium, was formed to develop a supply chain around an innovative proprietary design for an electric motor. Over the nine-month project the partners identified and developed preferred manufacturing processes suitable for volume production of the patented motor design from a UK supply chain. Whilst refining the design to meet the future requirements of UK and international stakeholders.

The Alumotor design is made of aluminium, free from rare earth element magnets and has no windings. Instead, it uses air-filled channels in the standard version and flux barriers in the high-performance version.

The motor offers a low cost, robust and sustainable electrical machine, ideal for the low carbon vehicle and off-highway market.

The project secured additional funding in the Supply Chains for Net Zero competition and is developing the motor further in the Alumotor 2 project.

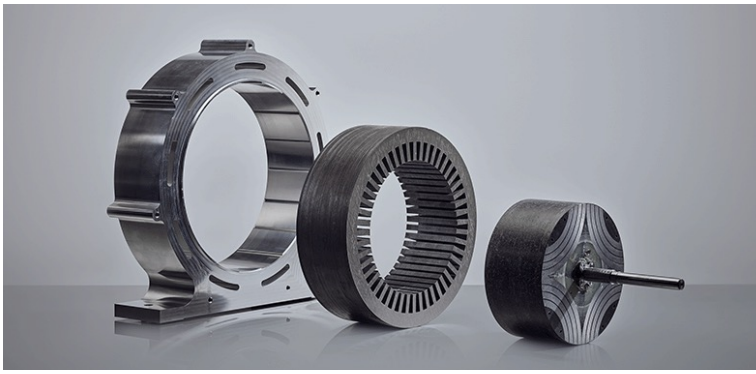
Funding and project costs

Total project costs: £497,790

Driving the Electric Revolution funding: £331,743

Consortia members

- Ricardo UK Limited
- Aspire Engineering Limited
- C. Brandauer & Co. Limited
- Global Technologies Racing Limited
- Phoenix Scientific Industries Limited
- University of Warwick



75543: Industrialisation investigation for WaveDrives' radical magnetically geared electric actuator

Description

More capable and sustainable actuation with lower lifetime cost of ownership is needed to enable advances in mobility and healthcare, transport electrification and smarter manufacturing.

WaveDrives' Sarcomere Inspired Linear Actuation (SILA) is designed to meet this need. Inspired by muscle structure, SILA is more flexible, controllable, and efficient than market-leading comparators due to its' non-contact magnetic transmission. Application specific SILA units for bionic-prosthetics and aerospace utility were in development for delivery at the end of 2022 and early 2023.

This industrialisation investigation:

- Explored feasibility and requirements for automated construction of SILA's innovative magnetic transmission.
- Modelled the novel magnetic structure to quantify manufacturing quality.
- Identified options for further improving manufacturing methods.

The project laid strong foundations for current work to scale-up SILA production in preparation for large scale early-adopter trials and planned agreements with WaveDrives' first SILA manufacturing and distribution partner.

Funding and project costs

Total project cost: £224,751

Driving the Electric Revolution funding: £176,205

Consortia members

- WaveDrives Ltd
- University of Bristol Electrical Energy Management Group

75678: RIFT 10 to 30 kW EV motor: Manufacturing Readiness and Supply Chain development (RIFT-MaRSC)

Description

The RIFT 10 to 30 kW integrated machine and power electronics is an innovative approach to an ultra-efficient electric vehicle (EV) motor, bringing forward a unique range of advantages including:

- Significant weight reduction (around 50%).
- Lower cost.
- Plus other features that result in a range increase of up to 75%.

Today, in the industry, most EV motor components are imported from Asia. For UK manufacturers to compete, it is necessary to decrease the production labour required in manufacture. This will be achieved by designing manufacturing advancements, reshoring the supply chain, improving the UK production capacity and maintaining a low unit cost.

Funding and project costs

Total project costs: £361,763

Driving the Electric Revolution funding: £278,188

Consortia members

- Rift Technology Limited
- University of Warwick

75835: Rare-Earth Extraction from Audio Products (REAP)

Description

Project REAP proved that rare earth magnets can be extracted from cars and flat screen TV loudspeakers and recycled.

HyProMag, the company behind REAP, used its short loop recycling process to investigate the viability of a UK-based supply chain of recycled neodymium iron boron rare earth magnets. Having a local, sustainable supply chain will drive electrification forward, reduce landfill, reduce environmental damage, and benefit the UK economy.

Funding and project costs

Total project costs: £256,144

Driving the Electric Revolution funding: £174,745

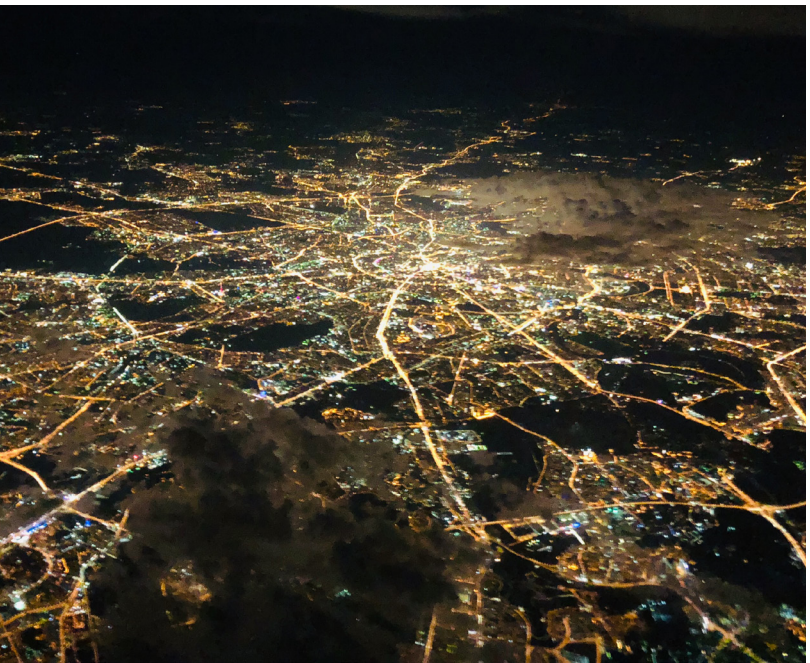
Consortia members

- Hypromag Ltd
- European Metal Recycling Limited
- University of Birmingham

76003: Manufacturing PSJ GaN Power Devices in the UK (M-PowerD)

Description

Building capability in the UK to manufacture the world's first, low cost, high voltage GaN power transistors. The project developed a polarisation super-junction high electron mobility transistor (PSJ HEMT) and processed it entirely in the UK. This project will allow a low cost bi-directional 3kV GaN PSJ HEMT to be built.



PSJ technology is a patented break-through concept for GaN developed in the University of Sheffield with Powdec of Japan. This concept enables ultra-high-performance power devices that have been proven to achieve more than three times higher voltage than existing GaN technologies. The initial target application will be for a smart power grid to replace the UK's ageing infrastructure.

Funding and project costs

Total project costs: £488,798

Driving the Electric Revolution funding: £379,849

Consortia members

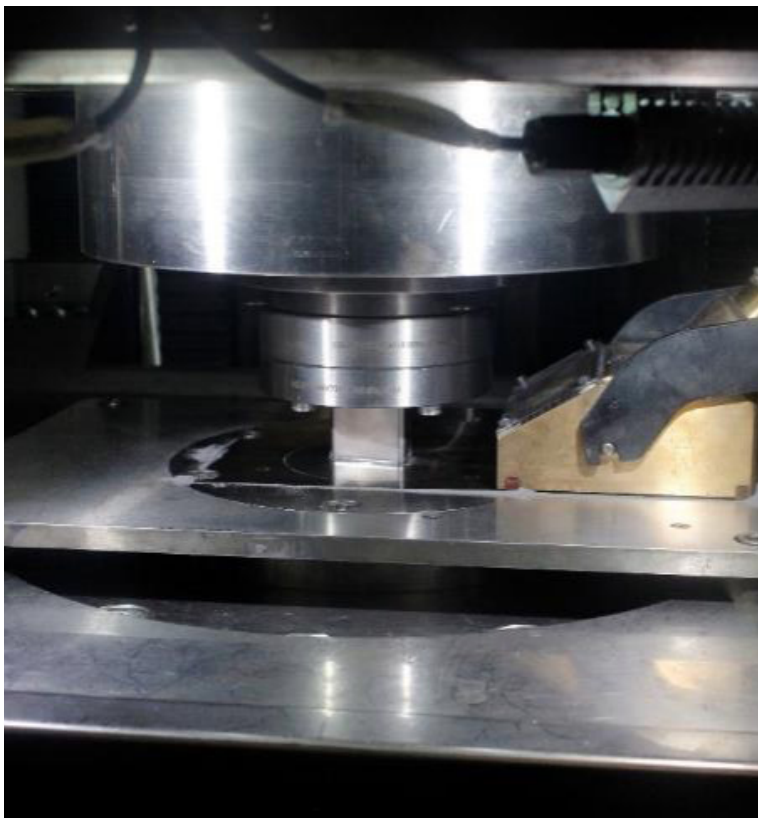
- INEX Microtechnology Limited
- Compound Semiconductor Applications Catapult
- University of Sheffield

76019: Improved Loss Modelling of Soft Magnetic Composite (SMC) Components

Description

SMC is a type of iron powder that can be compressed into component parts. There is a magnetic field that isolates each iron particle from its neighbours, reducing loss. SMCs have the potential to offer cheap, high-performance electric motors in comparison to laminations.

As part of this project, academic loss-modelling expertise is combined with component pressing expertise to provide a flexible loss prediction method. Consequently, motor designers are able to confidently design low loss high efficiency electrical machines, helping to promote the development of a dynamic UK supply chain with a faster time to market.



Funding and project costs

Total project costs: £238,367

Driving the Electric Revolution funding: £170,586

Consortia members

- SG Technologies Limited
- Newcastle University

76169: Gallium Nitride Silicon Carbide (GaNSiC)

Description

An innovative manufacturing process based on compound semiconductors was developed as part of Project GaNSiC. It is anticipated that next-generation electronic devices will be based on technologies such as gallium nitride (GaN) and silicon carbide (SiC), which enable processing speeds up to 100x faster than silicon transistors.

GaNSiC developed an ink jet/direct dispense manufacturing process that deposits a silver sinter paste onto pre-populated circuit boards to provide a suitable die-attachment method meeting Custom Interconnect Limited's mechanical and thermal efficiency requirements.

GaNSiC brings together experts in electronics manufacturing, material jetting and SiC/GaN device design. GaNSiC will quickly develop a required manufacturing process that will readily be commercialised as it would meet customers' requirements The project has enabled both SiC and GaN arrays to be incorporated into mixed technology products enabling the development of next-generation SiC and GaN products.

This innovation will result in an entirely unique SiC and GaN die attach capability in the UK, if not globally. The project has proven to be a catalyst for further R&D in this technology. It has unlocked significant public and private follow-on investment to continue to exploit new learnings, leverage commercial returns and strengthen the UK's position in the world market.

Funding and project costs

Total project costs: £287,644

Driving the Electric Revolution funding: £206,934

Consortia members

- Custom Interconnect Limited
- Compound Semiconductor Applications Catapult

76341: Development of Coil Winding and Magnet Assembly Manufacturing Processes for a Ferrite Based Permanent Magnet Generator

Description

The UK has set an ambitious target to increase its offshore wind capacity to 30GW by 2030. However, to achieve this target, it is reliant on imported wind turbines. A pandemic such as COVID-19 highlighted this dependence and vulnerability. This is particularly true in regard to the supply of raw materials such as rare-earth magnets. Consequently, it is of strategic importance that the UK develop its own wind turbine supply chain to meet its renewable energy targets.

All wind turbine Permanent Magnet Generators (PMGs) use conventional designs that rely on one vital material, rare-earth magnets. GreenSpur, a Time to Act subsidiary, invented, and patented a new and highly innovative approach, with a PMG that substitutes scarce and expensive rare earth magnets for cheap and abundant ferrite magnets.

The long-term vision of GreenSpur's project is to stimulate the development of a UK supply chain and manufacturing network that can build multi-MW generators for the UK wind market.

Funding and project costs

Total project costs: £499,999

Driving the Electric Revolution funding: £365,865

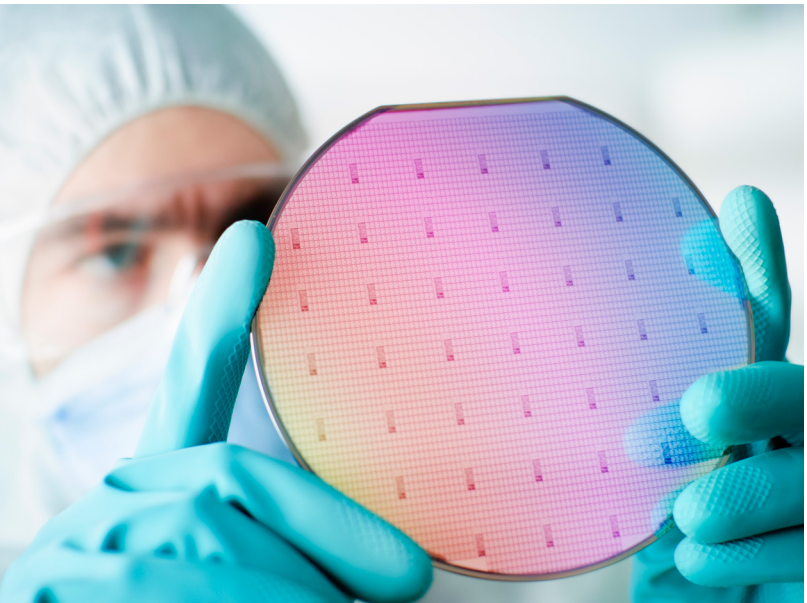
Consortia members

- Time to Act Limited
- University of Warwick

76399: SilicOn Carbide tRAnsistor Trench process (SOCRATES)

Description

SOCRATES introduced silicon carbide (SiC) and gallium nitride (GaN) trench processing technologies to the UK, establishing a critical capability into the PEMD supply chain for power transistors. This nine-month project defined the critical semiconductor manufacturing processing steps required for introducing a disruptive SiC power metal-oxide-semiconductor field-effect transistor (MOSFET) supply chain for automotive power electronics to the UK.



Current SiC diodes and transistors are still based on planar devices commercialised in 2001 and 2011 respectively, which are limited in terms of efficiency and reliability.

The proposed trench technology revolutionised the performance of SiC transistors, with lower on-state resistances, and enhanced energy efficiencies. VGaN-on-SiC devices will further drive performance and costs advantages.

Funding and project costs

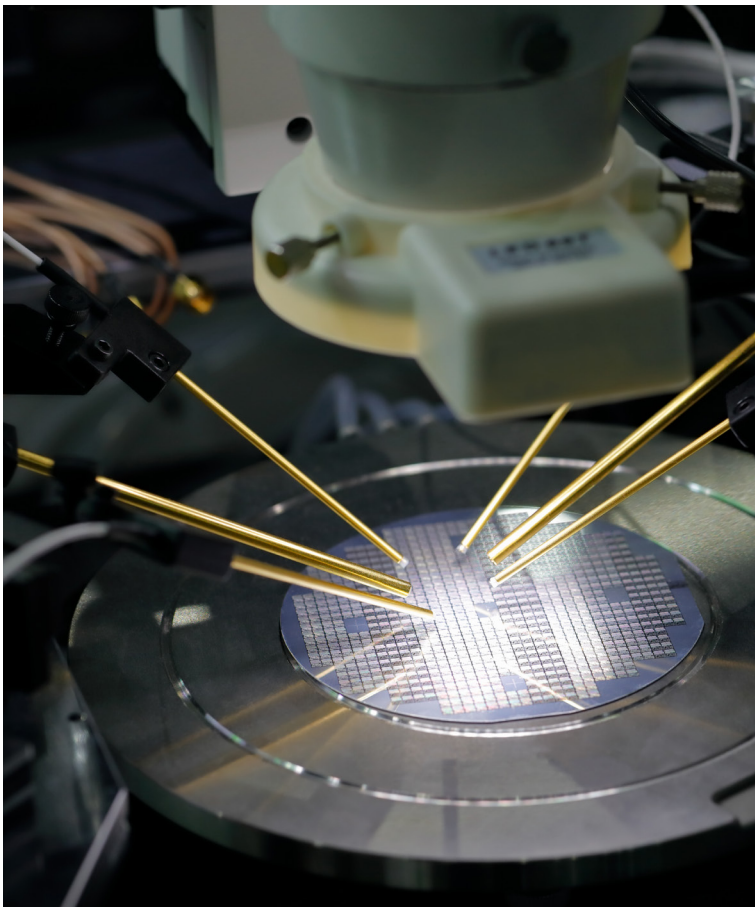
Total project costs: £216,859

Driving the Electric Revolution funding: £137,423

Consortia members

- SPTS Technologies Limited
- Compound Semiconductor Centre Limited
- CS Connected Limited
- Newport Wafer Fab Ltd
- Swansea University

77743: Silicon Carbide MOSFET Applications unlocked by PDK (SiC-MAP)



Description

The SiC-MAP project takes a 1,200V planar SiC MOSFET process and develops it further to include 1,700V and 3,300V capability. Once the 1,700V and 3,300V capabilities have been demonstrated, SiC-MAP will then go on to extract relevant electrical parameters from the fabricated SiC MOSFET's (including reliability) along with design and layout parameters, into a Process Design Kit (PDK).

Innovation lies in Clas-SiC's PDK which will initially enable customers to have 1,200V SiC MOSFET devices tailored to their specific requirements using established design elements, modules and processes which have had basic reliability proven. For the customer, this will de-risk and shorten the time to market for new product introduction.

Funding and project costs

Total project costs: £492,731

Driving the Electric Revolution funding: £371,448

Consortia members

- Clas-Sic Wafer Fab Limited
- Compound Semiconductor Applications Catapult

77777: Development of PEMD for Nuclear Coolant Systems

Description

In support of broader UK government objectives toward electrification and net zero carbon, nuclear is seen as a critical part of the government's plans for future clean electricity generation. This does not just cover the technology involved but the workforce behind it as well, providing an opportunity to re-train and re-skill oil and gas personnel to be able to support the growth of these alternative energy solutions throughout the supply chain.

This project included the design and supply of electric pumping machinery, forming part of the primary nuclear safety systems of upcoming Small Modular Reactors, with specific consideration for UK capability in low and zero cobalt metals.

This project focused on taking an initial conceptual design through to a theoretically proven drive system design specifically to target Small Modular Reactor Cooling Pumps.

The knowledge and experience acquired during this project will provide a framework to engage with UK suppliers on specific product designs facing the same issue, with the overall goal of establishing a motivated UK-based supply chain that is suited for future nuclear applications.

Funding and project costs

Total project costs: £333,301

Driving the Electric Revolution funding: £234,544

Consortia members

- Hayward Tyler Limited
- University of Sheffield

78366: CoolSync

Description

Project CoolSync combined state-of-the-art GaN technology with novel immersion cooling, theoretically more efficient than air in removing heat, to deliver high-efficiency power electronics in a small footprint.

CoolSync delivered a 220% improvement in power density, de-risked GaN entry into the supply chain, and developed know-how for high-density power systems. Furthermore, CoolSync helped identify gaps in the supply chain for the UK PEMD supply chain to exploit in the fast-growing segment.

The project focused primarily on data centre applications. Still, the resultant DC-DC, knowledge and testing infrastructure is suitable for other high-performance applications such as Aerospace, Automotive, and Industrial drives.

Funding and project costs

Total project costs: £346,377

Driving the Electric Revolution funding: £269,774

Consortia members

- Supply Design Limited
- Compound Semiconductor Applications Catapult

78550: Recovery of Gallium from Ionic Liquids (ReGaIL)

Description

ReGaIL was a 9-month project which aimed to:

- Develop a recovery process for gallium from bulk sourced end-of-life (EOL) LEDs (Figure 4).
- Supply the uptake of gallium nitride (GaN) semiconductors in PEMD.

The project delivered an environmentally benign process based on green chemistry that would promote the circular economy and the Waste from Electrical and Electronic Equipment (WEEE) Directive by delivering a process for the recovery of a strategic metal (like gallium) and provide a feedstock source for the remanufacture of gallium nitride (GaN).

The project sourced a range of failed LEDs and analysed their components to identify where GaN was to be found and in what quantities. It was found that the amount of GaN present in the LEDs varied considerably and was partly related to the LED's price.

The GaN containing components were segregated from the bulk material and processed by electrolytic recovery using a Deep Eutectic Solvent, also known as Ionic Liquid, to recover metallic gallium (Figure 5).

After gaining a knowledge of the structure and composition of the LEDs, a recovery plant was conceptually designed, and elevated level costed to help determine the economic viability of the process.

The project successfully demonstrated the technical feasibility of recovering gallium from GaN and found that its economic viability was strengthened by the recovery of other high value materials used in LEDs. It was also found that despite the failure of an LED, it was occasionally that only 1 LED chip in an array had failed and that, if replaced, the whole LED would become functional again. Several extensive reviews of gallium and gallium nitride have been published on the project's website and in various journals.

The consortium now seeks further funding to develop a pilot scale plant and take the concept to technology readiness level six.

Funding and project costs

Total project costs: £335,735

Driving the Electric Revolution funding: £265,111

Consortia members

- S2S Electronics Ltd
- E.C.Williams Limited
- Envaqua Research Ltd
- HSSMI Limited
- Institute of Materials Finishing
- Recolight Limited

78600: Design for manufacture of integrated e-hubs for agricultural vehicles

Description

The project aimed to drive the electric revolution by undertaking design for manufacture, integrating the motor, gearbox, brakes, and controller modules into a single unit designed specifically for AgriTech requirements. The product design aimed to be available in a range of power outputs and facilitate scaling up and easy adoption by vehicle and robot manufacturers.

Performance Projects led the design and development of the fully integrated OxDrive e-hub family. The initial range covers 0.8kW, typically used for swarm robotics, to 8kW, typically used for medium sized tractors. Both were dyno tested for efficiency and durability, then fitted to appropriate vehicles for preliminary confirmation of dyno results by means of agricultural field trials.

The OxDrive allows for the easy adoption of a compact, reliable, and efficient means of propelling a vehicle or robot. Enabling vehicle manufacturers to optimise vehicle layout and focus resource on their unique core technologies.

Funding and project costs

Total project costs: £499,003

Driving the Electric Revolution funding: £355,282

Consortia members

- Performance Projects Limited
- ARWAC Limited
- Printed Motor Works Limited
- Saga Robotics Limited
- University of Lincoln

79321: Development of a PEMD supply chain for Off-Road vehicles

Description

A project working to improve capability in virtual process development and virtual product validation of PEMD. Significant advancements in processes for assessment of lifecycle and embedded carbon, remanufacturing, refurbishment, and recyclability analysis of PEMD will be realised, supporting the development of the circular economy.

Funding and project costs

Total project costs: £499,613

Driving the Electric Revolution funding: £324,496

Consortia members

- Perkins Engines Company Limited
- University of Nottingham

79839: WIND Electric Revolution (WINDER)

Description

Magnomatics developed a pseudo direct drive (PDD®) that improves the efficiency and reliability of offshore wind technology compared to conventional direct drive and mechanically geared systems. It has a longer lifespan and generates energy at a lower cost than conventional methods because the PDD® does not have meshing gear teeth. A feature that improves the lifespan of the technology as it eliminates friction. This enhanced efficiency is also leading to price efficiencies in the market.

The WIND ER project provided vital information about the detailed behaviour of the PDD® generator. In particular, the detailed behaviour of the pole piece rotor was recorded. Armed with this information, Magnomatics has commercialised the product and secured an order from an engineering partner worth £1.6 million. This is enabling them to further develop the technology. Magnomatics is also seeing strong interest in the technology for other applications including rail, marine, aerospace actuation and propulsion.

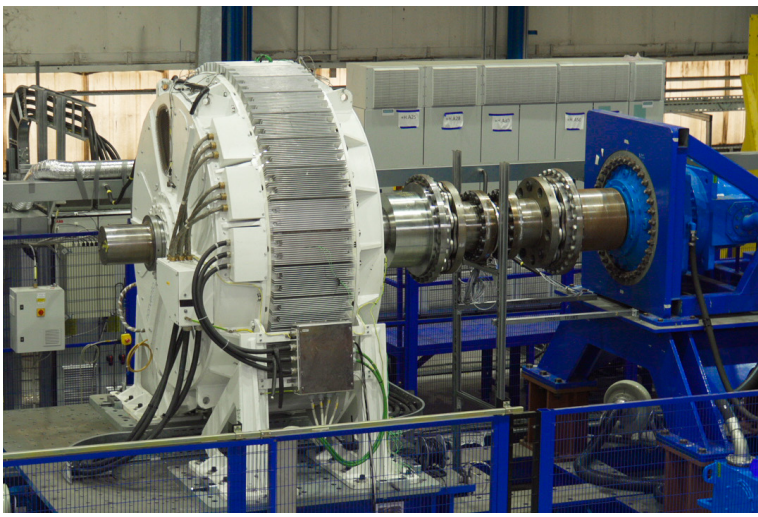
Funding and project costs

Total project costs: £468,882

Driving the Electric Revolution funding: £363,460

Consortia members

- Magnomatics Limited
- Offshore Renewable Energy Catapult



80731: Trench Clustered Insulated Gate Bipolar Transistor (IGBT) Manufacturing Process Capacity and Productivity Improvement

Description

The IGBT component is mainstream in PEMD switching semiconductor device applications. Semefab's application is based around establishing patented 1,700V Trench clustered IGBT (TCIGBT) manufacturing capability at Semefab in Fab 3 on six-inch wafers. This enables a high current density, high performance component applicable to mainstream industrial drive, solar, wind farm and electric vehicle applications and creates a platform for higher and lower voltage applications.

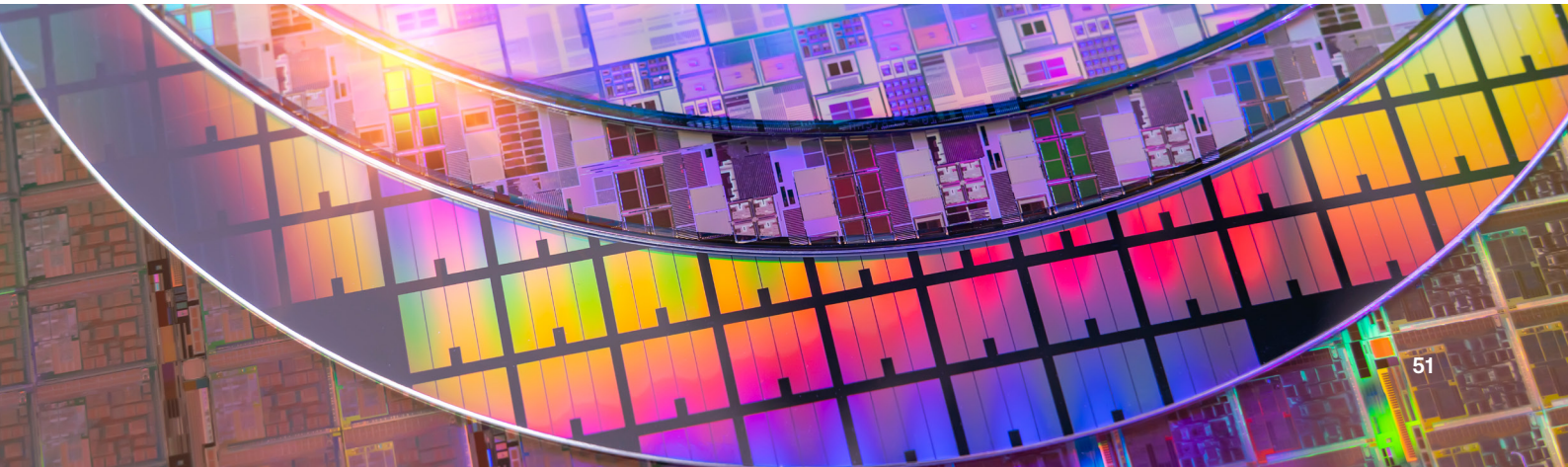
Funding and project costs

Total project costs: £498,183

Driving the Electric Revolution funding: £338,424

Consortia members

- Semefab Limited
- Eco Semiconductors Limited
- University of Sheffield



81035: Conmotator – Advanced, Integrated Machines for Efficient Manufacture and Operation

Description

The 'Conmotator' project (combined convertor-motor to electronic commutator) project investigated and addressed the main technological, integration and manufacturing challenges to allow the commercial exploitation of an integrated electrical machine where the power electronics and motor are contained within a single physical unit at the multi-MW level.

The project developed and tested the interfaces that bridge between existing motor and drive elements and investigates manufacturing/supply chain aspects related to megawatt scale integrated electrical machines to pave the way for full commercial exploitation, targeting the benefits at a worldwide market, placing UK industry as a world class leader in this field.

Funding and project costs

Total project costs: £300,213

Driving the Electric Revolution funding: £195,107

Consortia members

- GE Energy Power Conversion UK Limited
- University of Nottingham

81136: EV-Join

Description

The EV-Join project created a user-friendly software tool that addresses significant issues faced by companies developing electric vehicle (EV) systems such as calculation of production rates and costs to aid a user in selecting a production process, production line planning processes and manufacturing process understanding to achieve in service requirements.

With this, EV-Join has enabled:

- Increased productivity and reduction in repairs and scrap.
- More efficient selection of joining process.
- Reduced and potentially eliminated the need for expensive and time-consuming post-weld Non-Destructive-Testing.
- Reduced time-to-market.

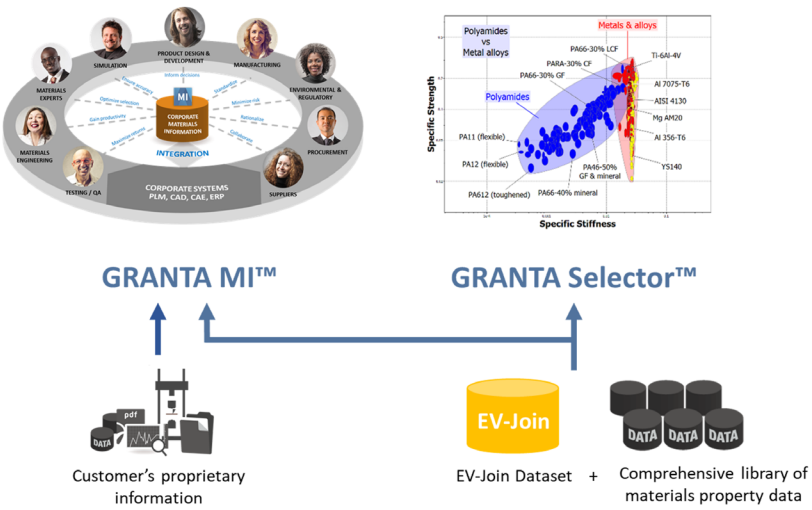
Funding and project costs

Total project costs: £235,288

Driving the Electric Revolution funding: £152,911

Consortia members

- Granta Design Limited
- The Welding Institute



Funding competition: Supply Chains for Net Zero

10004245: Advanced Sic based Solid State Transformer (ASSIST)

Description

Wide bandgap devices, such as SiC MOSFETs, enable realisation of high-performance power electronic converters. As the UK looks to address the challenge of meeting the increase in electricity demand that will take place with the widespread adoption of heat pumps and electric vehicles, power electronics will play a significant role to delivering solutions that provide the necessary flexibility for the electricity distribution network to meet that need.

ASSIST aims to establish a UK supply chain capability for higher voltage Silicon Carbide (SiC) devices at voltage and current ratings that are significantly differentiated from devices currently available on the market. The project will establish manufacturing readiness of the supply chain to create end to end capability that covers wafer fabrication, device packaging and power electronic converter manufacture.

Through ASSIST, high voltage, high current SiC MOSFETs will be implemented in solid state transformers. This will unlock a significant opportunity for a cost-effective and highly efficient compact solution, enabling higher power densities and improved transformer efficiency, resulting in lower losses and energy savings.

Funding and project size

Total project costs: £1,618,826

Driving the Electric Revolution funding: £1,093,472

Consortia members

- Turbo Power Systems Limited
- Alter Technology Tuv Nord UK Limited
- Clas-SiC Wafer Fab Ltd
- Compound Semiconductor Applications Catapult

10004737: Supply Chain Innovation Engineering for Net Zero (SCIENZE)

Description

SCIENZE is a £4 million project, incorporating five partners that are creating and safeguarding more than 150 high-value engineering jobs. Through the development of a supply chain that can feed into and exploit the new manufacturing capability, the project will create the capability in the UK for cost-competitive manufacture of automotive and power electronics products. As a result of the SCIENZE project, we expect to be able to provide up to 100,000 power electronics products by 2025 and to invest at least £4.5 million in follow-on investments.

Funding and project size

Total project costs: £4,039,635

Driving the Electric Revolution funding: £2,473,169

Consortia members

- McLaren Applied Technologies Limited
- Microchip Technology Caldicot Limited
- Newcastle University
- TT Electronics Integrated Manufacturing Services Limited
- TWI Limited

10005554: Enhanced Liquid Immersion Power Systems (ELIPS)

Description

The ELIPS project aims to establish a UK supply chain for immersion and GaN-based technology across PEMD sectors through a design-for-manufacture approach. Our aim is to create a collaborative value-chain capable of delivering power modules, bespoke immersion components and sub-assemblies, services, and intellectual property.

The partners aim to deliver high-efficiency PEMD products and services across multiple sectors, including Automotive, Aerospace and Renewable Energy. ELIPS will contribute to the development of energy-saving systems for data centre infrastructure thereby supporting a more sustainable growth in Internet of Things, SMART cities, data economies and industrial-automation. All of which are critical elements for the global net zero challenge.

The main outputs will be:

- Supply chain capability from design to delivery.
- Power modules for rack-based immersion and submersion technology.
- Integrated GaN power technology for systems integration.

Funding and project size

Total project costs: £3,380,350

Driving the Electric Revolution funding: £2,528,865

Consortia members

- Supply Design Limited
- Compound Semiconductor Applications Catapult
- Custom Interconnect Limited
- GSPK Circuits Limited
- Iceotope Technologies Limited

10008116: Secure Critical Rare Earth Magnets for the UK (SCREAM)

Description

Neodymium iron boron (NdFeB) magnets play a critical role in the fight against climate change as they are used in clean technologies such as wind turbines generators and motors in electric vehicles. As we transition to an electrically driven society then the demand for these materials will increase exponentially. The supply of these materials is geographically concentrated in certain parts of the globe and these materials have been identified as being of greatest supply risk compared to all other energy related materials by the EU.

The aim of SCREAM is to provide a UK based supply of these materials by recycling magnets from end-of-life scrap.

The SCREAM consortium will demonstrate two innovative paths to introduce scrap material back into the rare earth supply chain:

1. To scale up a process developed at the University of Birmingham, "Hydrogen Processing of Magnetic Scrap" from automotive, robotic, separator, loudspeaker scrap streams.
2. To produce a mixed rare earth carbonate for the rare earth supply chain.

The output of the project will be motors, loudspeakers and holding magnet applications containing recycled magnets. Visit www.scream-uk.com to find out more.

Funding and project size

Total project costs: £3,431,095

Driving the Electric Revolution funding: £2,434,319

Consortia members

- Hypromag Ltd
- Bowers and Wilkins Group Ltd
- European Metal Recycling Limited
- GKN Hybrid Power Limited
- Jaguar Land Rover Limited
- Mkango Rare Earths UK Limited
- University of Birmingham

10008142: Power Electronics Modules by Rapid Moulding (PE2M)

Description

In the future, aircraft will increasingly contain systems which are electrically powered, including actuators, under-carriages, and the engines. The electronics needed to power and control them will use silicon carbide (SiC) devices which operate at higher temperatures than conventional silicon devices.

Project PE2M will develop the technology and the UK based supply chain to manufacture the SiC modules required, by moulding using novel encapsulants. These cost effective encapsulants can withstand the high operating temperatures required, enable efficient cooling of the electronics, and permit the materials in the modules to be recycled at the end of their operational lives.

Funding and project size

Total project costs: £710,736

Driving the Electric Revolution funding: £524,056

Consortia members

- Ultrawise Innovation Ltd
- Bioniqs Ltd
- Custom Interconnect Ltd
- DZP Technologies Ltd
- HPM Limited
- The University of Warwick
- Tribus-D Ltd

10009442: Pre-packaged Power Devices for PCB Embedded Power Electronics (P3EP) UK Supply Chain Project

Description

The project P3EP develops a UK supply chain for PCB-embedded power systems with Gallium Nitride (GaN) devices. The P3EP supply chain will allow PEMD manufacturers to build converters with the highest power densities and it will enable UK power semiconductor companies to enter these markets.

Wide bandgap power devices such as GaN offer extremely high switching speeds and the possibility to significantly reduce system size. But this can only be exploited with new packaging and module construction methods which increase thermal transfer and reduce parasitic effects. The emerging technology of embedding power devices into the PCB has proven to be the most advanced way to achieve this goal. P3EP develops the complete supply chain in the UK.

Power systems with embedded wide bandgap devices based on the P3EP supply chain will deliver improvements in the weight, volume, efficiency, and power density of the converter. The importance of these aspects is especially true for automotive and electric aerospace applications, which were, the early adopters of this technology. While the UK has world-leading electronics manufacturing capabilities, there is currently no manufacturing line for embedded power electronics. Project P3EP will close this cap enabling the UK PEMD industry to deliver smaller, lighter, more reliable solutions in power electronics for a wide range of markets.

Funding and project size

Total project costs: £3,468,652

Driving the Electric Revolution funding: £2,537,842

Consortia members

- Pulse Power and Measurement Limited
- Cambridge Gan Devices Limited
- Cambridge Microelectronics Ltd
- Compound Semiconductor Applications Catapult
- RAM Innovations Ltd
- The Thinking Pod Innovations Ltd

10009813: A Flexible, Automated Stator Assembly Platform for Lightweight Electric Motors (FASA)

Description

The Edge Mobility Group is a British Tier 1 supplier of integrated motor and powertrain solutions for manufacturers of lightweight electric vehicles, with peak power outputs between 7 and 55 kW.

The objective of the FASA project is the development of an advanced manufacturing platform for the flexible, automated production of Edge Mobility's motors.

Funding and project size

Total project costs: £906,214

Driving the Electric Revolution funding: £691,874

Consortia members

- Edge Mobility Ltd
- iRob International Limited
- Newcastle University
- University of Warwick

10011291: Coil to Core – Supply Chain for Net Zero CO2 (COCO)

Description

This project will develop a UK PEMD supply chain that combines cost-efficient material supply and cold rolling of a new, high-strength, non-magnetic steel with patented lamination designs that can be mass produced. These laminations can then be stacked into novel rotor and stator sub-assemblies to support mass production of more efficient and more sustainable electric machines with wide-ranging applications across the transport, energy, and industrial sectors.

A significant portion of the project will be spent on the development of material supply and cold rolling processes to enable cost-effective fabrication of new high strength non-magnetic steels. Blank forming and joining processes to combine non-magnetic steel with electrical steel will be developed using latest joining technologies. Coating of the patented laminations will use novel insulation/adhesive coating materials, to enable automation of lamination stacking for novel rotor and stator sub-assembly designs supporting mass production of more efficient and more sustainable electric machine designs.

In the project the materials and process developments will be applied to the core of a unique AEM electric machine design that will be free of rare earth magnets and copper, validated with prototype motor high speed dynamometer testing.

The partners in the project provide the basis of a 'production ready' UK supply chain with a clear 'end to end' route to market for cost effective materials supply and cold rolling processing, lamination manufacture and rotor/stator sub-assembly, and electric machine production.

Funding and project size

Total project costs: £2,678,557

Driving the Electric Revolution funding: £1,808,767

Consortia members

- Advanced Electric Machines Limited
- Centre for Process Innovation Limited
- Coventry University
- Newcastle University
- Tata Steel Nederland Technology B.V.
- Tata Steel UK Limited

10012087: UK-Alumotor-2 for Low Carbon Vehicles (LCV)

Description

UK-Alumotor-2 for LCV will deliver a design for manufacture, supply chain and manufacturing processes alongside a digital twin. This will deliver the first iteration prototype motors of our proprietary sustainable motors, removing 12kg of rare earth-magnets per motor. The prototype motors will be performance tested, improving our understanding of this novel motor configuration, and proving its suitability for mass adoption in the light commercial vehicle market.

Development of alternative motor technologies that reduce the demand for rare earth magnets presents an achievable pathway to mass transport electrification in a manner which is both environmentally sustainable and economically advantageous.

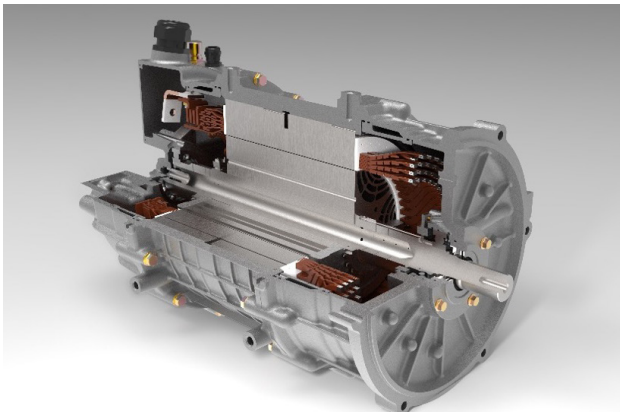
Funding and project size

Total project costs: £4,032,438

Driving the Electric Revolution funding: £2,532,242

Consortia members

- Ricardo UK Ltd
- Aspire Engineering Ltd
- C Brandauer & Co. Ltd
- Global Technologies Racing Ltd
- Phoenix Scientific Industries Ltd
- The University of Warwick



10012095: Differentiating UK capability – Reducing footprint and weight of high power, integrated PEMD

Description

Industrial sectors like marine, energy and infrastructure are turning to electrification technologies to meet their growing demand for electric power, and to enable reduction of greenhouse gas emissions.

Despite their scale, these marine and industrial applications often have significant space constraints that limit integrating new, electric microgrid equipment, like electric motors and advanced power electronics (PE), and new cleaner energy sources.

This project focuses on GE and its UK supply base differentiating on power density, applying novel production techniques and technology used in low voltage, high volume PE and applying them to high power applications. Fusing motors and PE designs in one integrated machine will have a transformative impact on system power density.

Funding and project size

Total project costs: £3,188,330

Driving the Electric Revolution funding: £1,990,098

Consortia members

- GE Power Conversion
- Dynex Semiconductor Limited
- University of Nottingham
- Warwick Manufacturing Group

10013674: Key commercial scale capacitor development for supply chain improvements for PEMD sector (KALEIDOSCOPE)

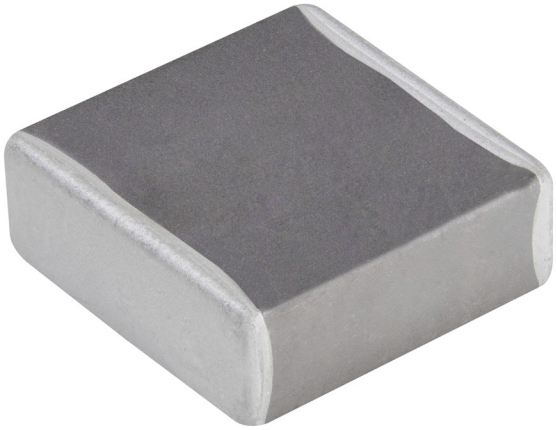
Description

Multilayer Ceramic Capacitors (MLCCs) are increasingly being demanded for emerging PEMD applications, where high-voltage and high-temperature demands can only be met by MLCCs.

Currently there are no ceramic-based solutions that can achieve this as any such part would be too expensive, composed of banks of capacitors. This demand is exacerbated by the current global shortage of MLCCs, and significant challenges associated with extracting necessary raw materials such as Palladium and Nickel.

To support EV manufacture and promote adoption, there is a need for MLCCs with high-temperature and high-voltage performance that are free of Palladium, Platinum, and lead.

Project Kaleidoscope aims to develop environmentally friendly, lead-free (non-toxic), high-energy density dielectrics and low-cost, electrode alloys. These approaches, combined with demonstration of MLCC production and performance, will enable our consortium to build UK-based supply chains for global supply of powders and pastes for printing ceramic dielectrics and electrically conducting electrodes for MLCCs.



Funding and project size

Total project costs: £754,563

Driving the Electric Revolution funding: £529,664

Consortia members

- Johnson Matthey Plc
- Gencoa Limited
- Knowles (UK) Limited
- University of Sheffield

Funding competition: Building Talent for the Future 1

10018142: Skills and talent insight platform for PEMD

Description

This project sought to:

- Further develop the labour market analytics platform Stratigens™.
- Identify existing locations for PEMD skills demand.
- Identify adjacent skills pools that could be accessed by companies needing to find talent to drive the electric revolution.

The project had a slow start. It found connecting with the PEMD community challenging and so they could only use data from job and CV scanning. But the PEMD aspect of Stratigens™ is now close to demonstration following continuation of the work.

The platform has an easy-to-use graphical PEMD skills taxonomy from online data. It has the potential to inform current industry needs, workforce demands and gaps as well as available talent. It will be used to inform PEMD businesses of details of relevant skills and talent pool as a paid service. The project also connected with the Electrification Skills Hub to understand mutual benefits.

Without funding from the Challenge, Talent Intuition would not have looked to expand their tool into the PEMD industry or had any knowledge of the area.

Funding and project size

Driving the Electric Revolution funding: £24,649

Organisation involved

- Talent Intuition Limited

10018277: E3x2

Description

The E3 Academy has operated with immense success for 14 years, delivering high quality graduates to a group of Tier one and SME companies operating in the PEMD space. It provides students with a scholarship through their undergraduate degree programmes as well as focused vacation training and an annual summer school where students build valuable networks from diverse industrial and academic backgrounds.

This project bought together the necessary collateral and present it in a truly compelling manner to companies in the PEMD space across multiple industrial sectors.

Funding and project costs

Driving the Electric Revolution funding: £19,925

Organisation involved

- E3 Academy

10018575: Promoting Opportunities for UNder-represented Communities in power Electronics, machines and drives (POUNCE)

Description

POUNCE aimed to produce material introducing PEMD sector to undergraduate engineers.

It also provided specific support for underrepresented communities, showcasing engineers, providing career and interview guidance through a workshop and short work experience placements.

The project was successful in supporting underrepresented groups at Aston University. Over 30 undergraduates from underrepresented communities attended the workshop with over 10 work placements organised. An oversubscription for work placements resulted in Aston funding additional placements with their own money. New material is now available for undergraduates at Aston University and more widely through UK Electronic Skills Foundation.

Without the funding from the Challenge the creation of the materials and the workshop would not have happened, nor would work placements have been organised for the undergraduates.

Funding and project costs

Driving the Electric Revolution funding: £24,984

Consortia members

- Aston University
- UK Electronic Skills Foundation

10018587: Power electronics packaging – Training and upskilling

Description

The project aimed to create and introduce a set of training modules. Designed to specifically addressing power electronics packaging for schools, colleges, universities, and industry at three levels: basic, intermediate, and advanced.

The funding allowed IMAPS-UK to develop, produce and pilot the course material with 150 people trained in 2022. They also created a video to support their outreach work for the course and raise awareness of PEMD.

Funding and project costs

Driving the Electric Revolution funding: £24,962

Organisation involved

- International Microelectronics Assembly and Packaging Society: UK Chapter (IMAPS)

10019981: Beyond ubiquitous – The role of wide bandgap semiconductors in electric aircraft

Description

Power electronics are crucial for enabling technology in a wide range of fields that are critical to the achievement of the net zero carbon agenda. One of the main challenges facing engineers is the realisation of carbon neutral aerospace. With the requirements for ultra-high efficiency, highly reliable power electronic systems that occupy a limited volume, being the critical challenge. These aerospace requirements provide a different challenge to those posed by electric vehicles and renewable energy integration.

For aerospace applications, the need for higher operating temperatures, the increased risk of lightning strikes and the enhanced cosmic ray flux mean that aerospace faces unique challenges that require different skills to other fields. These differences mean that concepts that are taught in conventional power electronics courses, both within academia and industry do not equip engineers with the unique skills required.

This project addressed that need by providing training for people working in the aerospace industry and has been designed specifically to ensure that the UK maintains its leading position in the electrification of aircraft. To date the project has provided teaching to 50 professionals working for a large multinational providing flexible, accessible, and targeted teaching material.

Funding and project costs

Driving the Electric Revolution funding: £24,952

Organisation involved

- Nascent Semiconductor Limited

10020386: Continual professional development – Refocusing talent into the PEMD sector

Description

This project aimed to:

- Combine online learning materials with live events.
- Develop a business case for sustainable development of ongoing training courses.
- Develop and deliver a low cost, scalable blended-learning course introducing low carbon transport technologies.

It successfully developed, piloted, and published the "Introduction to low emission road transport" course, including handbook with course materials.

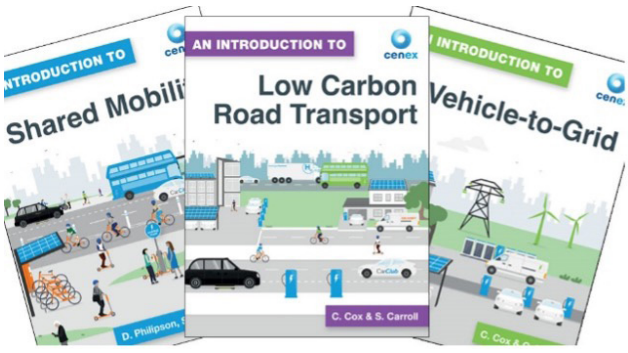
Without funding from the Challenge, the training material and course delivery would not have happened at the speed it did. The Centre of Excellence for Low Carbon and Fuel Cell Technologies now has a business model for becoming a training provider.

Funding and project costs

Driving the Electric Revolution funding: £24,966

Organisation involved

- Centre of Excellence for Low Carbon and Fuel Cell Technologies (Cenex)



10020638: POWering Engagement, Re-skilling, Education and Diversity for PEMD (POWERED-PEMD)

Description

The power electronics and related semiconductor industry is booming, with over 100,000 high skilled jobs in the sector in the UK. The project aimed to engage and train a new generation of apprentices and students to feed into the UK power electronics industry, technology and applications. Expanding the equality, diversity and inclusion of the sector was a crucial goal.

The project revolved around a unique range of innovative outreach methods, Continuous Professional Development, and training materials for a range of participants of all ages.

Content included:

- Hands-on workshops
- Interactive apps to market the PEMD sector
- Online web content
- Site visits for pupils and teachers to manufacturing facilities and semiconductor fabrication plants
- Taster courses

The unrestricted access programme exposed people of all ages to the total PEMD chip-to-module supply chain.

The content was advertised to an audience of 1.1 million Dragons' fans via videos on the big screen at home games. Taster sessions were also delivered to over 20,000 school children making the best use of the Dragon's strong community ties to reach diverse audiences and encouraging all children to engage with STEM subjects.

Funding and project costs

Driving the Electric Revolution funding: £24,990

Consortia members

- Swansea University
- CS Connected Limited
- Newport Wafer Fab Limited
- SPTS Technologies Limited
- WRU Gwent Stadium Limited

10020861: Transferring Power electronics Learning Across differeNt Technologies (TransPLANT)

Description

TransPLANT was an initiative to train experienced mechanical engineers so they can apply their engineering knowledge and experience to power electronics engineering. The project successfully developed a training course and marketed it to a targeted list of companies.

Lyra Electronics now expects to run six courses a year, with 10 students on each. This would not have happened without funding from the Challenge.

Funding and project costs

Driving the Electric Revolution funding: £25,000

Organisation involved

- Lyra Electronics Limited

10020870: PEMD sector skills DNA

Description

To define the skills gap in PEMD, the project team analysed millions of documents including:

- Adverts
- CVs
- Education curriculum documents
- Job specifications

The team used natural language processing and unsupervised learning techniques like Clustering and Topic Analysis on the body of text to analyse the existing insights.

The output from this project allows the Challenge to learn from the most important skills gaps which exist today, whilst focusing future phases on the most impactful interventions.

The project produced a shareable dataset highlighting the skills gap in the north-east and has showcased the skills gap with a new visualisation web portal.

Funding and project costs

Driving the Electric Revolution funding: £24,263

Consortia members

- The North East Automotive Alliance Limited
- Geek Talent Limited

10021161: DriveLAB teaching and training products – Developing and delivering a pilot stage to meet the needs of academic, SME and industry for the training of electrification topics

Description

Pilot development of DriveLAB Electric Motor Teaching System. Designed to address the UK skills shortage in Electrification Design and Manufacturing through the rapid delivery of training tools and teaching aids. This is an industry and academia-ready novel safe-voltage hands-on teaching toolkit. Organisations can gain rapid upskilling and hands-on experience whilst academia has an increased practical capability in electric machines.

The DriveLAB hardware and training provision was developed and showcased to a few training providers and resulted in enquiries and orders for training equipment from academia and industry. The creation of this training, provision would not have happened at this speed without the funding from the Challenge.

Funding and project costs

Driving the Electric Revolution funding: £24,946

Organisation involved

- FluxSys Limited

10021552: Boosting the readiness of university graduates for power electronics market

Description

The project aimed to establish a curriculum framework for power electronics, which is supported by industrial inputs and more recent knowledge. The project has helped to accelerate the response time to market, increase the availability of suitably skilled engineers and bring recognition to the power electronics discipline.

Funding and project costs

Driving the Electric Revolution funding: £24,898

Consortia members

- Sheffield Hallam University

10021553: Advanced Winding training System for Electrical Machines (AWSEM)

Description

AWSEM built on results from the Accelerated Supply Chain Collaborative R&D project on Advanced Hairpin Windings to develop an online training platform to drive the adoption of this technology within the UK PEMD supply chain.

The tool targets up-skilling in PEMD and includes easy to follow methods for design of hairpin windings, including online presentation of design guidelines that will be easy to update in the future as new knowledge is created and the field of knowledge evolves.

Funding and project costs

Driving the Electric Revolution funding: £24,928

Consortia members

- University of Nottingham
- Agile Manufacturing Power Systems Ltd

10021713: PEMD skills programme bootcamp

Description

This project continued the successful design and implementation of skills bootcamps focusing on the skills required for the design and manufacture of PEMD electronic systems.

This project laid the groundwork for a larger bootcamp which began in late 2022 and will provide PEMD specific engagement and outreach to enthuse a potential workforce at all levels and ages to help drive the race to net zero. Initially focused in the north-west, the project hopes to support further initiatives across the UK.

The project specifically addresses skills in the north-west and has focused on re-training those from non-PEMD backgrounds to enter the industry and has shown a dedicated effort to be inclusive and accessible to all learners.

Funding and project costs

Driving the Electric Revolution funding: £24,639

Organisation involved

- Tech Lancaster Limited

10021753: Web-based platform for training in thermal design of electric motors

Description

The project took the first steps towards the development of a comprehensive thermal engineering education tool targeted at electric motor developers and teaching institutions.

The web-based platform provides engaging, hands-on training to engineers in the PEMD workforce. By consulting with industry, the team came up with case study simulations and built these into a half-day training course for SMEs.

The project is currently in the process of obtaining feedback and refining the training before marketing it to a wider audience. Eventually it hopes to run 50 half-day courses a year.

Funding and project costs

Driving the Electric Revolution funding: £24,919

Consortia members

- Electric Cooling Solutions Ltd
- University of Nottingham

Funding competition: Building Talent for the Future 2

10033153: Manufacturing based power electronics design and manufacturing training courses

Description

The project aims to develop and deliver industry driven and compatible innovative courses and training programs to meet the needs of the UK power electronics industry and PEMD community.

Using virtual power electronics device technology, design and manufacturing based on the Synopsys Technology Computer Aided Design and Design-Technology Co-Optimisation tools in lectures and laboratories.

The course will tackle the lack of semiconductor trained staff in the UK and will enable the growth of the UK power electronics industry.

Funding and project costs

Driving the Electric Revolution funding: £102,342

Consortia members

- Semiwise Limited
- National Microelectronics Institute
- Synopsys

10033473: Scalable Delivery of Applied Power Electronics, Machines and Drives Training (SD-APT)

Description

SD-APT brings together a diverse collaboration of organisations with an established record of accomplishment in PEMD and large-scale skills intervention to create training bootcamps designed to meet the sector's skills gap challenge at scale.

Along with training content tailored for industry, the consortium will establish a mobile laboratory asset designed to support learners develop applied skills in the discipline.

The project aims to scale the UK's talent pool in PEMD to enhance its international competitiveness by:

- Helping to engage a new pipeline of talent for the future.
- Preparing the next generation of career ready PEMD graduates.
- Transitioning large volumes of experienced technicians and engineering staff.

The programme will have a strong focus on tackling EDI challenges through the creation of inclusive training content suitable for diverse learners.

Funding and project costs

Driving the Electric Revolution funding: £817,537

Industry funding: £103,495

Consortia members

- Coventry University
- Advanced Electric Machines Limited
- Drive System Design Limited
- FEV UK Limited
- FluxSys Limited
- GE Energy Power Conversion UK Limited
- North Warwickshire and South Leicestershire College
- Resume Foundation
- ZF Automotive UK Limited

10033186: Warwick ELectrification Deployment (WELD)

Description

WELD will use the University of Warwick's expertise in the field of PEMD to support four delivery strands:

- Design of an IP-free eMachine, with active parts manufacture, assembly and testing on campus for hands-on learning.
- Enhancing academic PEMD teaching provision.
- One-day industry workshops.
- Outreach in schools.

A portfolio of educational activities will leverage unique, open-access facilities to provide innovative hands-on training.

This training will upskill the existing workforce and support the pipeline of future talent, helping UK businesses to develop and scale new PEMD technologies and manufacturing processes.

Funding and project costs

Driving the Electric Revolution funding: £963,190

Organisation involved

- University of Warwick

10034501: Institute of Electrification and Sustainable Advanced Manufacturing (IESAM): Building Talent for Growth of north-east PEMD Supply Chain

Description

The formation of the IESAM to lead development of flexible, high-quality PEMD training will foster industrial innovation. It will do this by plugging the chronic skills gap across every training level and align the North-East Institute of Technology and major higher and further education college providers across the region. This comprehensive, coherent PEMD skills development will provide flexible, modular, blended programme design.

IESAM will be a blueprint for national expansion, through a multi-regional focused upscaling.

The proposed flexible delivery approach, enhanced by digital/online content, will be informed by industry and research, and aligned to the National Electrification Skills Framework and appropriate qualifications.

Funding and project costs

Driving the Electric Revolution funding: £999,980

Organisation involved

- Newcastle University

10033254: Practical power electronics, machines and drives for all

Description

Development of an innovative multidisciplinary practical training resource that provides relevant PEMD practical design exercises supported by dedicated laboratory activities, facilitating both hands-on and remote practical training.

It will feature bespoke, benchtop-sized, remotely accessible machine-and-drive sets, as well as an equipment loan scheme for further education colleges and higher education institutions. The project aims to liberate access to practical PEMD skills training at a national level and beyond, across multiple educational levels.

We envisage that this project will greatly contribute to bridging the skills gap currently existing in UK's PEMD industry.

Funding and project costs

Total project cost: £759,086

Driving the Electric Revolution funding: £672,092

Consortia members

- The University of Sheffield
- Matrix TSL

10034693: High Voltage PEMD Training Portal

Description

This project will deliver a training portal to enable PEMD engineers to design safe, reliable, and power dense high voltage electrical systems. The new training system will support engineers in safely extending product capability beyond what is catered for within existing standards as we move to direct current bus voltages of 800V and beyond.

Through the use of a subscription based, on-line portal, engineers will have real time access to training and design tools when they need it, instead of traditional classes, when knowledge is often forgotten by the time it is needed.

Funding and project costs

Driving the Electric Revolution funding: £48,412

Organisation involved

- AerospaceHV

10035999: Development of comprehensive and interactive training programme for thermal design of electric motors

Description

The need for specialist thermal engineering skills is increasing, and currently, the demand for this skill outstrips supply. Delivering a first-of-its-kind comprehensive thermal engineering education tool, targeted at electric motor developers and teaching institutions this project addresses the talent shortage in two ways:

1. Providing engaging, hands-on training to engineers in the workforce, equipping them with knowledge and tools for performing thermal analysis.
2. Improving the quality of thermal engineering education at teaching institutions for the next generation of engineers entering the workforce.

Funding and project costs

Driving the Electric Revolution funding: £49,394

Consortia members

- Electrical Cooling Solutions Ltd
- The University of Nottingham

10036353: ProtoEV 4 Skills

Description

Creating an accessible and innovative augmented reality (AR) app which uses gamification to train people in real world generative design and engineering. By building virtual electric go-karts the app will help grow the diverse talent pipeline for the PEMD sectors.

Targeted at underrepresented youth in Manchester and North Shields, the app will extend the national reach and engagement of The Blair Project's ProtoEV STEM Challenge.

The Challenge sees schools, youth clubs and college teams (age 11 to 19) transform used petrol go-karts into fully electric e-karts which they test and race to see which is the fastest and most energy efficient. Students gain hands on skills related to computer aided manufacturing, design for assembly, power electronics, electric motor, drives, and battery technologies aligned to the needs of the PEMD manufacturing and supply chains sector.

The AR app will enable diverse talent of all ages and abilities to disassemble and assemble virtual go-karts, make pre-determined modifications, interact with components, and receive audio-visual cues so they can learn at their own pace.

Funding and project costs

Driving the Electric Revolution funding: £49,976

Consortia members

- The Blair Project Ltd
- Fuzzy Logic Ltd

10036260: High-reliability Electronics for Robust Operation (HERO)

Description

HERO is a project to provide unique training for engineers working, or aspiring to work, in the development of electrical and electronic systems for high reliability applications, including aerospace and automotive.

The innovative teaching materials developed to support this learning will be designed specifically to ensure that the UK maintains its leading position in the electrification of aircraft and the development of high-performance electrical systems.

It is a continuation of the Driving the Electric Revolution funded project 'Beyond Ubiquitous' which focussed on this type of unique training specifically for the aerospace industry.

Funding and project costs

Driving the Electric Revolution funding: £33,845

Organisation involved

- Nascent Semiconductor Limited

10036124: Toward Building Skills and Awareness in Embedded Digital Control of Power Electronic Systems

Description

This project aims to set a curriculum framework in collaboration with the industry that can reduce the knowledge and skills gaps in Digital Embedded Control in Power Electronics.

The project will enable academia and industry to collaborate in the development of learning contents in emerging industries from levels six to eight to address industry skills needs.

The learning contents will be informed by industry and research. It will be easily comprehensible and encompass theoretical principles, simulation, hardware implementation, and industry and academic seminars.

Funding and project costs

Driving the Electric Revolution funding: £49,762

Consortia members

- Teesside University
- Sheffield Hallam University

10033545: Power Electronics Packaging Training and Upskilling 2

Description

Builds on a Power Electronics Packaging Training Course created in Building Talent for the Future 1 by:

- Adapting and completing the Intermediate and Advanced level modules.
- Establishing access to practical hands-on training facilities.
- Creating a viable accreditation for the training courses for schools, colleges, universities, and personnel involved in the design, manufacture, and testing of power electronics modules.

Funding and project costs

Driving the Electric Revolution funding: £32,812

Organisation involved

- International Microelectronics Assembly and Packaging Society (IMAPS UK)

10036549: Accelerating the Adoption and Benefits of Model-based Control in PEMD Applications

Description

Control algorithms are what operates many systems, and many applications work well with relatively basic control. However, for complex, multi-faceted systems, like an EV vehicle, advanced control offers significant benefits, such as greater range or extended battery life.

It does that by having control actions that maximise regenerative braking or minimise the rate at which the battery is charged or discharged during driving.

Advanced control strategies have been used widely in other industries but are rare in automotive or general electrical machinery applications. This project will develop training materials that will help UK PEMD organisations adopt advanced controllers.

Funding and project costs

Driving the Electric Revolution funding: £49,999

Organisation involved

- Industrial Systems and Control Limited

10034293: Building Training and Awareness Platform for Future Engineers in Power Electronics Market

Description

Creating a platform to increase awareness among students at Queen Mary University, London about the growing skills shortage in the UK and to encourage them into pursuing their careers in the power electronics sector. The project will fill gaps in the UK's workforce talent and training capabilities in power electronics and related PEMD areas.

This project will create and deliver industry-compatible technical course contents and materials and vocational training that will support skills, talent and training across the power electronics manufacturing and supply chains sectors across the UK.

This will inspire initial stages undergraduate students of the extensive and growing career opportunities in power electronics within several sectors within the UK PEMD industry.

Funding and project costs

Driving the Electric Revolution funding: £49,923

Organisation involved

- Queen Mary University, London

10035106: EV at Bridgwater and Taunton College (BTC)

Description

The aim of BTC's project is to support its staff in offering electric and hybrid vehicle repair training to students on their automotive apprenticeships and programmes. They are combining this with an outreach programme dedicated to encouraging more young people, young women in particular, into the area of PEMD skills. The project aims to reach and train 150 people each year by 2025.

BTC's rollout of this programme could be a trailblazer in the approach to addressing the EV skills shortage and will work closely with other training providers to share best practices and improve outcomes.

Funding and project costs

Driving the Electric Revolution funding: £49,933

Organisation involved

- Bridgwater and Taunton College

10034680: Industrial Cadets PEMD Pathway: Midlands and UK wide

Description

Providing a structure of targeted schools engagement to increase awareness of PEMD and will attract talent into the sector, as a vital part of the mission to challenge the skills shortage.

The project will take students through the different Industrial Cadets awards from one-day PEMD workshops to large groups through to intense mentoring programmes and PEMD apprenticeships.

Funding and project costs

Driving the Electric Revolution funding: £44,200

Organisation involved

- The Engineering Development Trust

10036462: Lotus Technical Training Centre (LTTC) PEMD

Description

LTTC PEMD will see the development and implementation of an HV system and PEMD training rig at the LTTC, and a course developed to use the rig for upskilling industry colleagues.

LTTC was set up to develop and deliver EV related training for Lotus' staff and the broader industry, who are facing similar challenges. The PEMD rig will enable significantly improved training delivery through hands-on learning, in which the PEMD components can be seen inside the broader system they operate within, and the interactions between system sections can be explored.

Funding and project costs

Driving the Electric Revolution funding: £49,880

Organisation involved

- Lotus Cars Limited

Funding Competition: PEMD Scale-up: Stand 1, adopting manufacturing best practice

10059595: Lignin low to add all other project thermal devices for automotive power electronics

Description

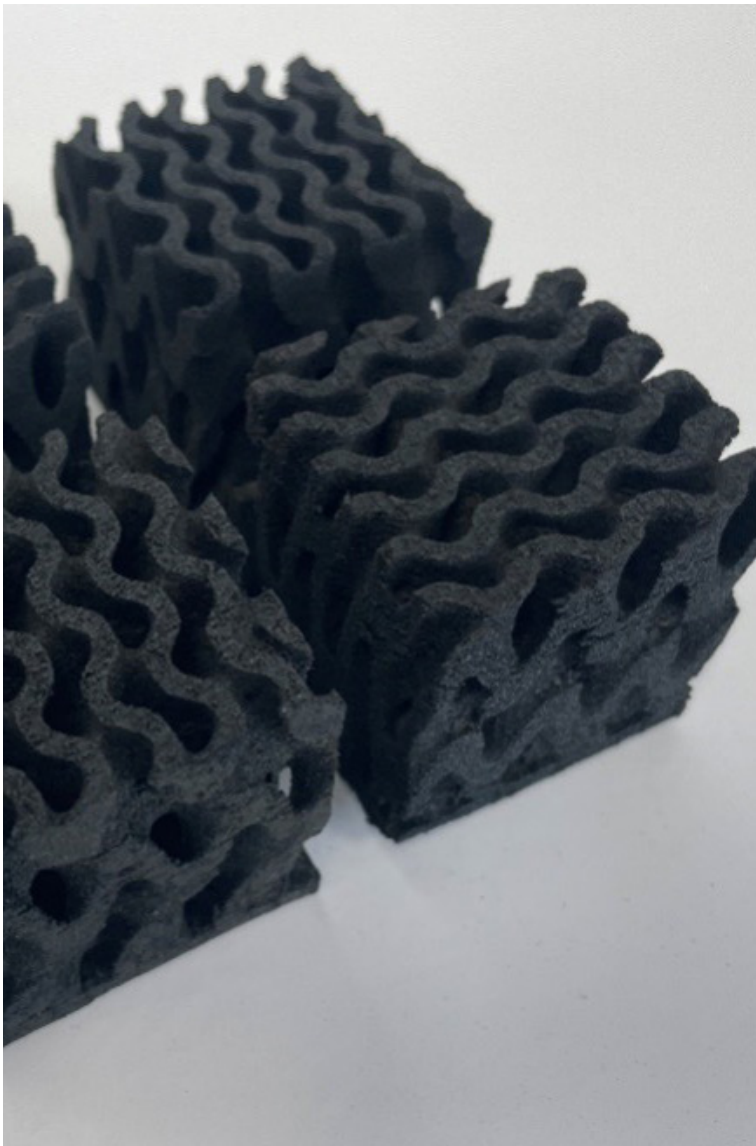
Carbon Forest Products is conducting a feasibility study to demonstrate the potential for the world's first 3D graphite heatsink for use in automotive thermal management systems. The project builds on previous research and development projects which proved that 3D printing of lignin via selective laser sintering could produce complex geometries with both thermally and electrically conductive properties for the static CPU server market. This project will also demonstrate the potential for scale-up of manufacture by adjusting existing machinery to facilitate faster additive manufacturing print times and using inexpensive lasers to create the desired result while producing less than 2% powder waste. CFP's material and process optimisation are well underway with the CSA Catapult identifying and providing target thermal performance and heatsink designs.

Funding and project costs

Driving the Electric Revolution funding: £312,861

Consortia members

- Carbon Forest Products Ltd
- CSA Catapult



10061373: POWERDRIVE: Novel POWER Module Architecture for cost Effective PEMD manufacture

Description

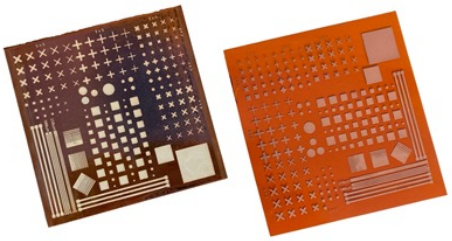
Project POWERDRIVE will enable a cost reduction of over 30% on equivalent power module circuits for a low to mid end range electric vehicle by removing components such as DBC (Direct-Bonded-Copper) or PCB (Printed-Circuit-Board), thermal interface materials and module metal plates. Simplifying the power module architecture will also provide more efficient and reliable devices. To achieve this, it will develop the use of directly print dielectric and conductive high temperature fired cermet pastes as additive processes to replace DBC/PCB processes and demonstrate suitability for power module production via wire bonding compatibility and power/thermal cycling. It will also look at replacing solder paste materials by evaluating both copper and silver die attach materials that can be printable directly on the cermet pastes. The project has successfully demonstrated first generation silver and copper die attach materials, based on Dycotec's nanomaterial synthesis capabilities to >50 MPa die shear strength, high performance thermal interface dielectric layers (>7.5 W/m. K) and printed copper and silver metallisation layers.

Funding and project costs

Driving the Electric Revolution funding: £315,212

Organisation involved

- Dycotic Materials Ltd
- CSA Catapult



Example evaluation test structures. LHS: Printed high thermal conductive insulator on aluminium substrate, over printed with Ag die attach layer RHS: Printed copper die.

10062816: Adopting best practice in manufacturing automation for scalable UK-based production of smart EV chargers

Description

Hypervolt is a UK-based manufacturer of 7-22kW smart chargers, undertaking all product development and manufacturing in house. Following an earlier manufacturing assessment, critical parts of the production process will be optimised using robotic automation to reduce costs and boost output.

Funding and project costs

Driving the Electric Revolution funding: £397,212

Organisation involved

- Hypervolt Ltd
- B.M Injection Ltd

Funding Competition: PEMD Scale-up: Strand 2, manufacturing process development

10055662: Superior Windings for Alternators and Generators (SWAG)

Description

McLaren Applied supplies high performance alternator products to the automotive, motorsports and aeronautical industries. The process for building these alternators is costly and labour-intensive, limiting product output and scalability. The project is to overcome this limitation by improving the stator winding process. This will entail an initial build of stators using new manufacturing techniques and detailed analysis via destructive and non-destructive testing to ascertain copper fill, performance, and production time variation. A machine wound stator has been built and is now being characterised and compared with a hand wound stator.

Funding and project costs

Driving the Electric Revolution funding: £429,821

Organisation involved

- McLaren Applied Technology Ltd
- University of Warwick
- PEREGRINE MLS LTD

10055939: Fast Agile Copper Turns and Robotic Magnet placement (FACTOREM)

Description

This project will develop manufacturing processes and techniques to optimise the production of low to medium volume electrical machines where the capital investment for higher volume machinery cannot be justified. The work will focus on the use of coil winding, magnet placement and rotor carbon fibre banding, selected as they offer the largest potential for cost reduction. The production processes will be designed to be reconfigurable across a wide range of product types.

Funding and project costs

Driving the Electric Revolution funding: £625,275

Organisation involved

- Magnomatics Limited
- University of Warwick

10059267: SOLEM-MO: Scalable Optimised Lightweight Electric Motor - Manufacturing Optimisation

Description

The objective of the SOLEM-MO project is to mature the technology & manufacturing processes required for the reliable & cost-effective serial production of ultra-lightweight electrical machines This will be achieved by the use of ultra-lightweight composite materials that offer enhanced freedom of design and design integration.

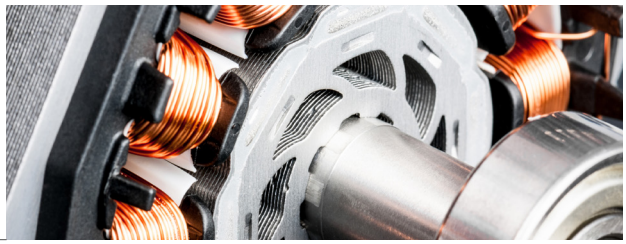
The project will deliver the manufacturing infrastructure and prototypes of an electric motor targeted at drone applications.

Funding and project costs

Driving the Electric Revolution funding: £619,306

Organisation involved

- Formtech Composite Limited
- Newcastle Uni



10059447: Scale-up of Coil Winding and Magnet Assembly Manufacturing Processes for a Rare Earth-Free Permanent Magnet Generator

Description

GreenSpur aims to produce a rare-earth magnet free generator for the 30kW to 6MW onshore wind market. This project will focus on developing flexible tooling to scale-up innovative manufacturing techniques for this generator developed through a previous project. The project deliverables will support the manufacture of generators of up to 1MW.

Funding and project costs

Driving the Electric Revolution funding: £382,227

Organisation involved

- Greenspur Wind Limited
- University Of Birmingham
- Hirst Magnetic Instruments Limited
- B.C. Electrical Techniques Limited

10061446: High Efficiency Electrical Machines enabled by a new UK Additive Manufacturing PEMD Supply Chain

Description

Developing the use of additive manufacturing (AM) in a new hybrid motor design with improved power to weight ratio of manufactured motors. The aim is to minimise any cost increase whilst creating a step forward in motor efficiency by the use of newly possible component geometries for improved copper losses within the motor. AM also enables rapid prototyping of new designs at significantly lower cost than the hairpin motor equivalent allowing for a step improvement in the iterative design process.

This project is focusing on the end application of High-speed compressors in markets similar like Hydrogen Fuel Cells for these motors as efficiency is key to improving range of a vehicle, so a small cost increase is a viable option for increased efficiency.

The project has progressed through the first design stages and completed the first application specific prints, with the project continuing with the AM Motor builds and in application testing to begin in the coming year.

Funding and project costs

Driving the Electric Revolution funding: £772,788

Organisation involved

- Technelec Limited
- University of Bristol
- Alloyed Limited

10061826: Project FCDC

Description

The project will produce a family of unitary DC-DC Converters for high volume production enabling the fuel cell, battery pack and traction motor of a large truck to share the HV bus with no need for a second DC-DC Converter in front of the battery. The FCDC DC-DC Converter is a state-of-the art Silicon Carbide design with an exceptionally powerful CPU capable of managing the constantly varying voltage and power demands of a dynamic system. Having a single DC-DC Converter enables major savings in terms of weight, size, and cost.

Funding and project costs

Driving the Electric Revolution funding: £162,648

Organisation involved

- Viritech Limited
- Manufacturing Technology Centre

10062336: Mag-Cure: A novel method for magnetically induced bonding and de-bonding of thermoset adhesives in the Automotive Industry

Description

Mag-Cure will result in a step-change for the manufacture of electric motors used in Electric Vehicles, by bringing to market a novel adhesive bonding technology allowing the rapid curing of adhesive systems (reducing production cost/time of production/removing bottlenecks), as well as providing a solution for end-of-life/quality control by ensuring the adhesive system is 'de-bondable'.

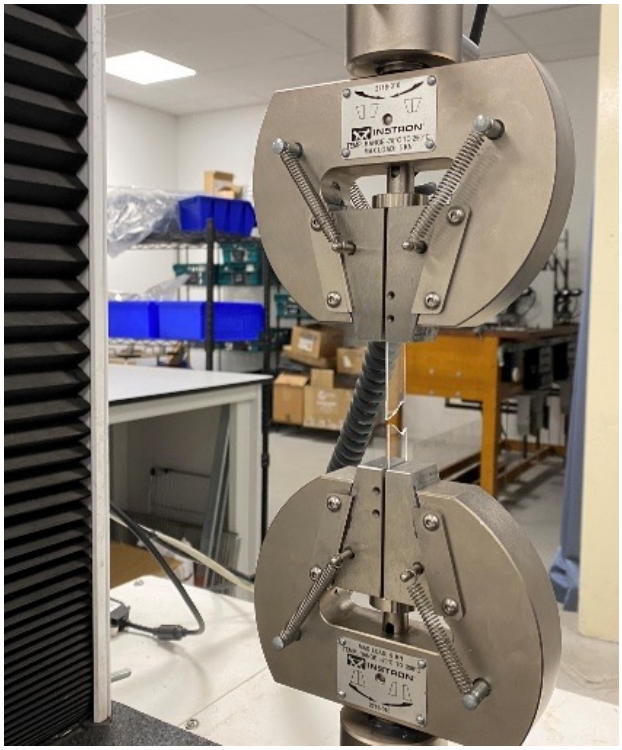
This is achieved through the novel application of curie nano particles (CNP) introduced to the adhesive system giving far greater control over the manufacturing and curing process.

Funding and project costs

Driving the Electric Revolution funding: £320,857

Organisation involved

- Expert Tooling & Automation Limited
- Impact Laboratories Limited



10062720: ELEGANT – Elevating GaN Technologies

Description

The objective of this project is to create a collaborative OEM to develop UK-based capability in the production of GaN power modules across multiple sectors, including Renewable Energy generation, EV Charging and Distribution Power management.

The main outputs will be:

- A supply chain capability from design to delivery.
- Power modules for Cabinet and rack-based modular Rectifier and Inverter Systems.
- Integrated GaN power technology that is scalable and modular for systems integration in wider PEMD applications.

Funding and project costs

Driving the Electric Revolution funding: £596,467

Organisation involved

- Supply Design Limited
- University Of Edinburgh
- GSPK Circuits Limited
- Custom Interconnect Limited

10062815: EB-eDrive

Description

Currently, UK EV drive manufacturing uses laser welding as a 'go-to' high-productivity joining process for copper and aluminium components. However, laser welding has shown many short comings, owing to the fundamental limitation of adsorption of laser energy into copper material, and thus greatly complicating the manufacturing processes of PEMD devices.

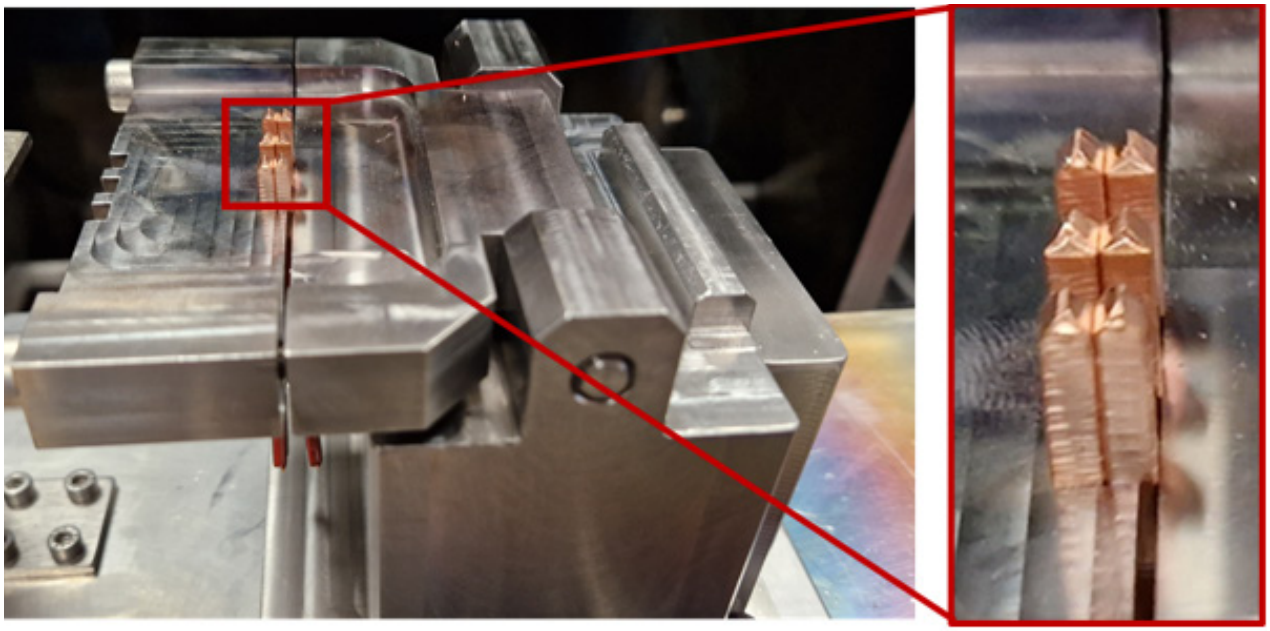
This project explores the use of electron beam welding as an alternative joining process. Preliminary test results show that Electron Beam Welding (EBW) surpasses the state-of-the-art quality specifications. These results generate significant process insights and are used for the EB-eDrive machine development, which is currently in progress. The team aims to validate the superiority of EBW in e-motor manufacturing in Q3 of 2024 with a full-scale demonstration.

Funding and project costs

Driving the Electric Revolution funding: £380,111

Organisation involved

- Aquasium Technology Limited
- Ford Technologies Limited



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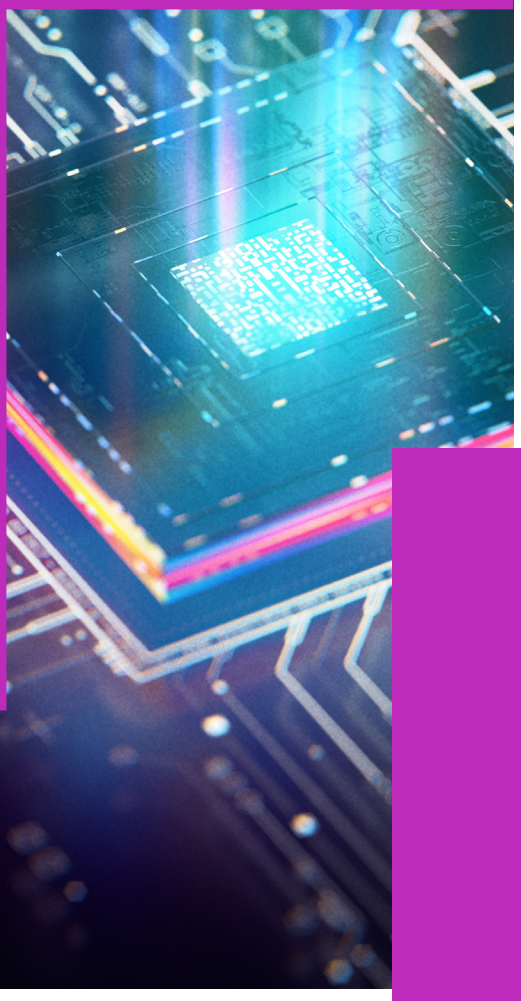

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