Delivered by Innovate UK

Driving the Electric Revolution

2022 Annual Report

Published: April 2023

Contents

Welcome 5
Challenge overview 6
Objectives 6
Delivery 6
Collaborative research and development (CR&D) grant funding 7
2022 overview 8
Collaborative Research and Innovation 8
Skills work packages 8
Magnets Report 10
The CLIMATES programme 10
People 11
Delivery Team 11
Programme Board 14
Advisory Group 16
Innovate UK Knowledge Transfer Network (KTN) Partners 16
The role of Innovate UK KTN 17
DER Industrialisation Centres 18
The Electric Revolution Skills Hub 19
Communications and engagement 20
Challenge benefits and evaluation 22
Equality, diversity and inclusion (EDI) 27

Annex 29
Funding competition: Accelerated Supply Chain 29
105895: Accelerating the UK E-Machine Preformed Winding Supply Chain 29
105894: High-T Hall 29
105891: Short Loop Optimisation of Gallium Nitride Materials and Major Manufacturing Modules (SLOGaN M4) 30
105896: Automated Dynamic Testing of Magtec Power Controllers 30
105900: Integrated Optical Sensor IGBT Module 31
105899: Die on Heatsink 31
105902: Quietness Understanding in E-drive Technology (QUIET) 32
105903: STREAMLINED 32
105904: Lightweight Aluminium Windings (LAW) 33
105901: HiCap 33
43016: High Volume E-Machine Stack Manufacture 34
43784: Optimising through Life Cost of Industrial Gas Processing (MABEL) 34

Funding competition: Business-led innovation in response to global disruption 35
55544: Enhancing UK Engineering Skills to Drive the Low Carbon Economy 35
57574: Propulsion system to expedite the development of eVTOL technology 35

57890: Assessment of technical and commercial feasibility of a novel low-cost and ultra-efficient electric drive technology for drone delivery systems 36
59007: Modular electric vehicle powertrain for small delivery vehicles - 'e-power-arm' 36
61334: Immersion-cooled power components and modelling 37
63530: Design Development of an integration solution to utilise spare capacity in transport systems to provide local energy supplies in dense urban centres 37
66091: Additive Manufacturing for Electric Motors 38

Funding competition: Catalysing green innovation 38

77130: UK-Alumotor 38
75543: Industrialisation investigation for WaveDrives' radical magnetically geared electric actuator 39
75678: RIFT 10 to 30 kW EV motor: Manufacturing Readiness and Supply Chain development (RIFT-MaRSC)) 39
75835: Rare-Earth Extraction from Audio Products (REAP) 40
76003: Manufacturing PSJ GaN Power Devices in the UK (M-PowerD) 40
76019: Improved Loss Modelling of Soft Magnetic Composite (SMC) Components 41
76169: Gallium Nitride Silicon Carbide (GaNSiC) 41
76341: Development of Coil Winding and Magnet Assembly Manufacturing Processes for a Ferrite Based Permanent Magnet Generator 42
76399: SilicOn Carbide tRAnsistor Trench process (SOCRATES) 42
77743: Silicon Carbide MOSFET Applications unlocked by PDK (SiC-MAP) 43
77777: Development of PEMD for Nuclear Coolant Systems 43
78366: CoolSync 44
78550: Recovery of Gallium from Ionic Liquids (ReGaIL) 44
78600: Design for manufacture of integrated e-hubs for agricultural vehicles 45
79321: Development of a PEMD supply chain for Off-Road vehicles 45
79839: WIND Electric Revolution (WINDER) 46
80731: Trench Clustered Insulated Gate Bipolar Transistor (IGBT) Manufacturing Process Capacity and Productivity Improvement 46
81035: Conmotator – Advanced, Integrated Machines for Efficient Manufacture and Operation 47
81136: EV-Join 47

Funding competition: Supply Chains for Net Zero 48

10004245: Advanced Sic based Solid State Transformer (ASSIST) 48
10004737: Supply Chain Innovation Engineering for Net Zero (SCIENZE) 48
10005554: Enhanced Liquid Immersion Power Systems (ELIPS) 49
10008116: Secure Critical Rare Earth Magnets for the UK (SCREAM) 49
10008142: Power Electronics Modules by Rapid Moulding (PE2M) 50
10009442: Pre-packaged Power Devices for PCB Embedded Power Electronics (P3EP) UK Supply Chain Project 50
10009813: A Flexible, Automated Stator Assembly Platform for Lightweight Electric Motors (FASA) 51

10011291: Coil to Core – Supply Chain for Net Zero CO2 (COCO) 51
10012087: UK-Alumotor-2 for Low Carbon Vehicles (LCV) 52
10012095: Differentiating UK capability – Reducing footprint and weight of high power, integrated PEMD 52
10013674: Key commercial scale capacitor development for supply chain improvements for PEMD sector (KALEIDOSCOPE) 53

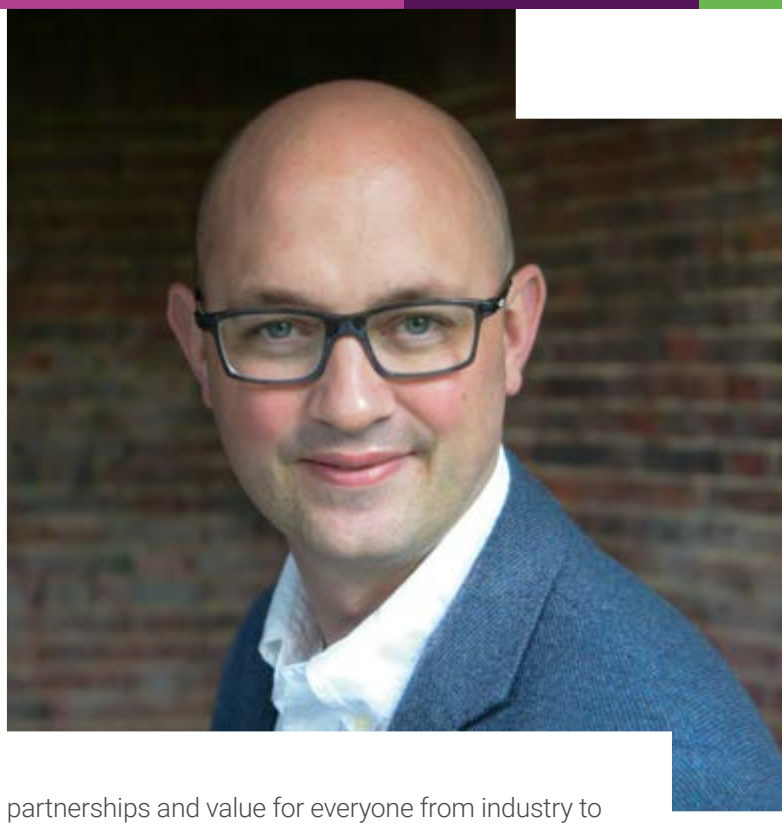
Funding competition: Building Talent for the Future 1 54

10018142: Skills and talent insight platform for PEMD 54
10018277: E3x2 54
10018575: Promoting Opportunities for UNder-represented Communities in power Electronics, machines and drives (POUNCE) 55
10018587: Power electronics packaging – Training and upskilling 55
10019981: Beyond ubiquitous – The role of wide bandgap semiconductors in electric aircraft 56
10020386: Continual professional development – Refocusing talent into the PEMD sector 56
10020638: POWering Engagement, Re-skilling, Education and Diversity for PEMD (POWERED-PEMD) 57
10020861: Transferring Power electronics Learning Across differeNt Technologies (TransPLANT) 57
10020870: PEMD sector skills DNA 58
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 58
10021552: Boosting the readiness of university graduates for power electronics market 59
10021553: Advanced Winding training System for Electrical Machines (AWSEM) 59
10021713: PEMD skills programme bootcamp 59
10021753: Web-based platform for training in thermal design of electric motors 60

Funding competition: Building Talent for the Future 2 60

10033153: Manufacturing based power electronics design and manufacturing training courses 60
10033473: Scalable Delivery of Applied Power Electronics, Machines, and Drives Training (SD-APT) 61
10033186: Warwick ELectrification Deployment (WELD) 61
10034501: Institute of Electrification and Sustainable Advanced Manufacturing (IESAM): Building Talent for Growth of north-east PEMD Supply Chain 62
10033254: Practical power electronics, machines and drives for all 62
10034693: High Voltage PEMD Training Portal 62
10035999: Development of comprehensive and interactive training programme for thermal design of electric motors 63
10036353: ProtoEV 4 Skills 63
10036260: High-reliability Electronics for Robust Operation (HERO) 63
10036124: Toward Building Skills and Awareness in Embedded Digital Control of Power Electronic Systems 64
10033545: Power Electronics Packaging Training and Upskilling 2 64
10036549: Accelerating the Adoption and Benefits of Model-based Control in PEMD Applications 64
10034293: Building Training and Awareness Platform for Future Engineers in Power Electronics Market 65
10035106: EV at Bridgwater and Taunton College (BTC) 65
10034680: Industrial Cadets PEMD Pathway: Midlands and UK wide 65
10036462: Lotus Technical Training Centre (LTTC) PEMD 66

Welcome



What a year 2022 has been. Driving the Electric Revolution announced the investment of over £20.5 million across 26 projects across the UK. The skills work we were so excited to get going is off the ground, with the Electric Revolution Skills Hub at Coventry and 28 projects now funded across the skills landscape.

Following the challenges that 2020 and 2021 threw at us all, it has been fantastic that in 2022 we could see so many of you and get back together in a face-to-face setting. The resilience shown by everyone, as I noted last year, has been truly inspirational. The drive and importance of our underlying mission to support the delivery of net zero is still at the forefront of our minds.

The Driving the Electric Revolution Industrialisation Centres (DER-IC[1]) continue to grow with equipment coming online in mid to late 2022 across most of the centres. The 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.

Impact from projects continues to amaze me. The effort, delivery, and outcomes from investments made by the Challenge and also the private sector is incredible. We've now realised over £95 million in co-investment, showing the importance of the investments we are making.

A sister activity, being delivered by Innovate UK called CLIMATES (Circular Critical Materials Supply Chains), was influenced by the work the Challenge has done over the past couple of years into rare earth elements and magnet supply chains. With the publication of the government's critical minerals strategy in 2022, now is the time for the UK to increase the resilience of critical mineral supply chains and explore new ways to recover and recycle these vital elements.

Through our cohort network we hope to continue to grow opportunities for companies to flourish and find new routes to markets they may not have considered before. The continued seamless work between the Innovate UK team and the team at the Innovate UK Knowledge Transfer Network (KTN) is delivering strong partnerships and value for everyone from industry to academia.

We have many great opportunities for 2023 as the work inspiring and involving everyone across the community picks up pace. We plan to look at what future opportunities will be and how we can continue to support the growth of this important industry.

As a team we have sadly said goodbye to Sennaya O'Connor, Katy Sutherland and Mark Urbanowski but are excited to welcome Nick Ansell, Mustaphis Koleoso and Hugh Falkner into the team. Over the next 12 months the whole team is looking forward to working closely with you all to support making power electronics, machines and drives a huge success here in the UK.

We look forward to more face-to-face events, outcomes from our projects beginning to be seen and an increase in engagement.

I wish you all the very best for 2023 and hope that, as a community, we can continue to grow stronger and more resilient supply chains in this exciting and important area.

Professor Will Drury
Challenge Director

[1] https://www.der-ic.org.uk

Challenge overview

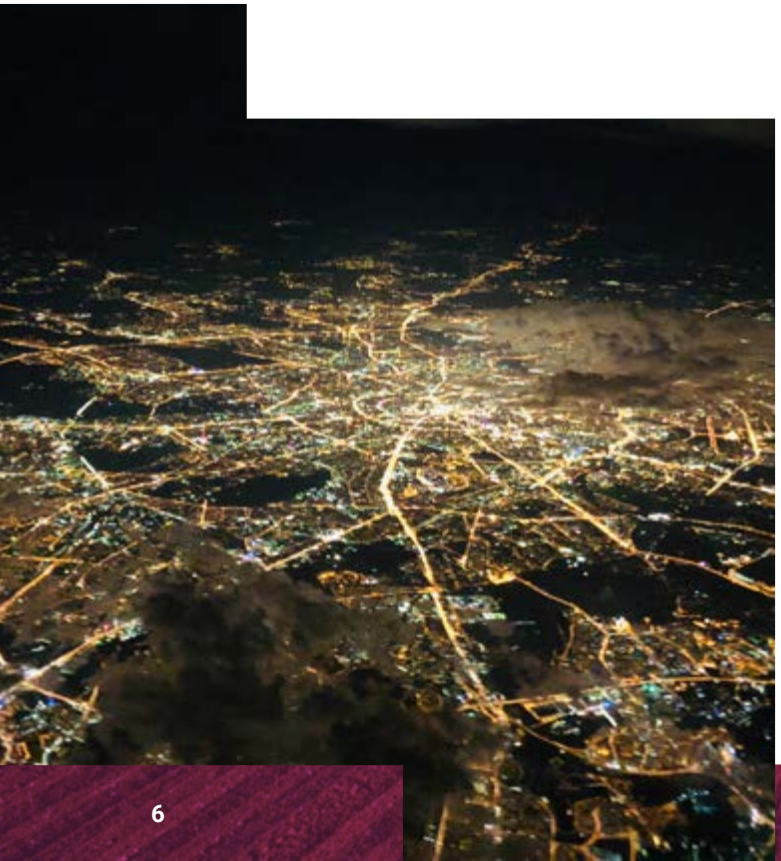
Mission

'Driving the Electric Revolution will be the catalyst to building **£5 billion more Power Electronics, Motors 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 don't 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 main areas of activity:

1. Industrialisation Centres

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

– Newport and Swansea

– Nottingham, Warwick and Birmingham

– Strathclyde

– Newcastle and Sunderland

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.

Collaborative research and development (CR&D) grant funding.

Grant funding from the Driving the Electric Revolution Challenge has been allocated to over 140 organisations collaborating on more than 80 projects.

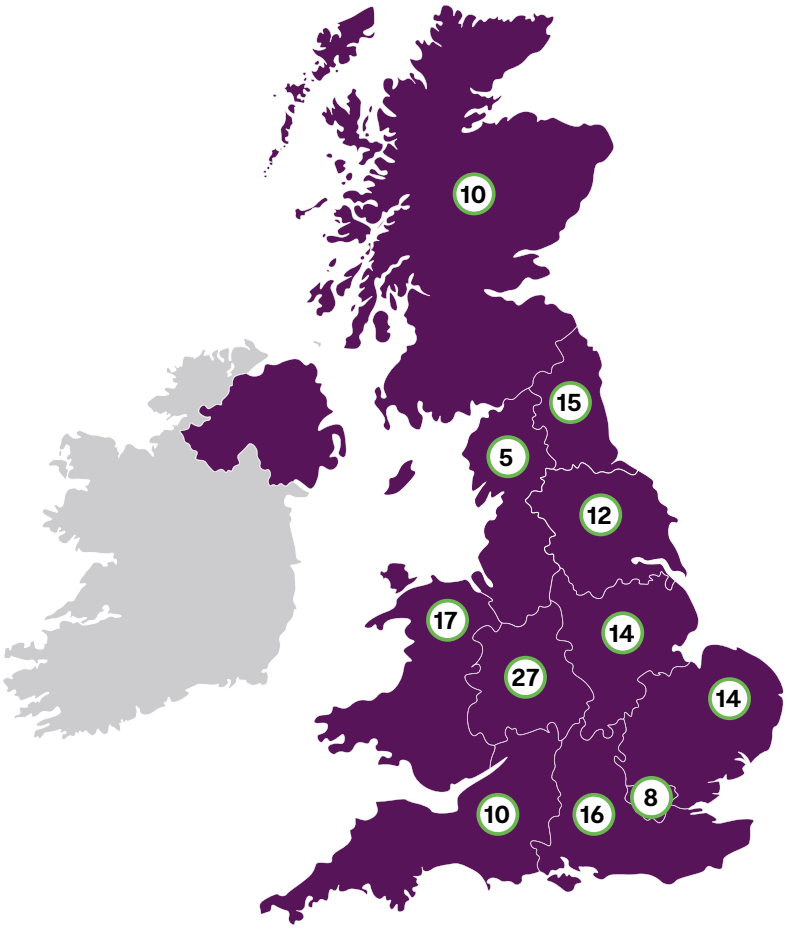
So far:

- 66.55% of the Challenge's funding has been allocated to industrial partners
- 9.62% to Research Technology Organisations (RTOs) or Catapults
- 23.82% to Academic institutions

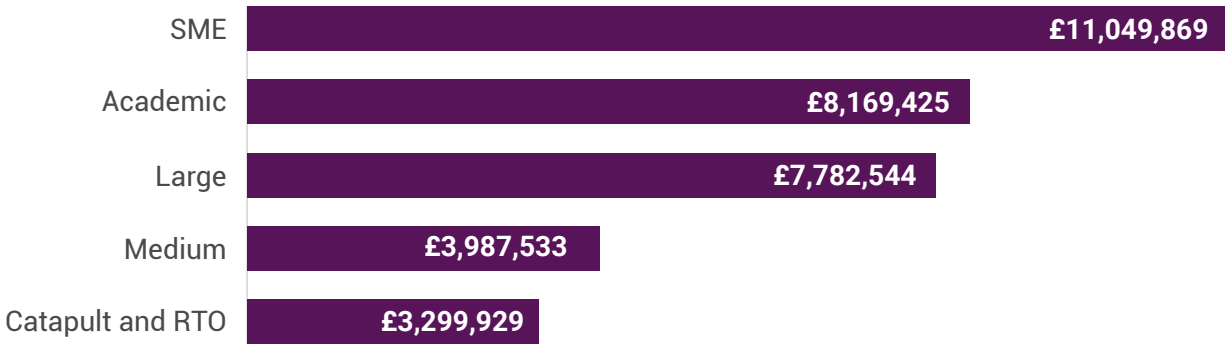
From the Challenge funding given to industry around 48% has been given to SME companies. A breakdown of the funding allocated to each of these organisations is shown in the graph below.

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.

The map shows the location of the organisations involved in projects funded by the Challenge.



Location of participants funded by the Challenge.



Amount of CR&D 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/

2022 overview

Collaborative Research and Innovation

We kicked off the year by announcing the winning projects from our flagship funding competition 'Supply Chains for Net Zero'. Announced in February 2022 it saw us provide over £16.5 million across 10 projects designed to build the manufacturing capability the UK needs to lead the green electric revolution.

Read details of projects funded through the Supply Chains for Net Zero competition in the Annex on page 48.

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.

Building Talent for the Future 2

The Building Talent for the Future 2 competition ran from 10 January to 3 February in 2022 with the winners announced in October. This competition, a follow-up to the 'Building Talent for the Future 1 competition', was designed to support skills and training across PEMD manufacturing and supply chains. It focused on the creation and delivery of new industry-focused:

- training course content
- materials for educators
- engaging information for outreach.

From this competition alone the Challenge is investing over £4 million across 16 projects to help address the skills shortage in the UK PEMD sector.

The purpose is to build awareness of PEMD and fill crucial gaps in the UK's workforce talent and training capabilities. Opportunities could include but were not limited to:

- schools' engagement
- apprenticeships and internships
- upskilling and reskilling of existing workforce
- technical courses and vocational training
- undergraduate, postgraduate and continuing professional development (CPD).

Undergraduate Award

The Undergraduate Award (the Award) launched in collaboration with the UK Electronic Skills Foundation (UKESF). It was designed to enable companies working on PEMD technology to connect with the most capable students from the UK's leading universities in a low-cost, low-risk way.

The Award was designed to promote interest in PEMD technologies among engineering students and allow employers to connect with these students through a one-off summer work placement.

Students received:

- a one-off bursary of £1,000
- a paid summer work placement (minimum six weeks) with an employer in the PEMD sector at the end of the current year of study
- opportunities to learn more about PEMD, for instance by attending events like the Centre for Power Electronics annual conference.

Female award holders also receive paid-for student membership of the Women's Engineering Society for the duration of their degree course.

We had a high level of interest in the award from students at UK universities with over 50 people applying. From these four were selected to receive the undergraduate award in 2022.

To understand how we can better support businesses in this context an industry engagement session with industry ran in February 2023.

Find out more about the Undergraduate Award online.

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.

The STEM truck

The STEM truck was produced by the Blair Project, after a contribution from the Challenge, to undertake hands on outreach for teenagers, who would otherwise have little extracurricular exposure to STEM.

A team of diverse student volunteers from Manchester University's School of Physical Sciences and Engineering, under the expert supervision of experienced electrical and mechanical engineers from 3D 360 Ltd converted a second hand 3.5 tonne van into a STEM truck.

The truck has been designed to conduct schools and public outreach activities and has raised awareness of career opportunities arising from the need to accelerate the electric revolution to tackle climate change.

In 2022 the STEM truck and its on-site workshops and labs brought electrification to life in a way that was relevant, fun and engaging. Across Manchester, London, Leeds and Sheffield they:

- engaged with 23 schools, colleges and youth clubs in Greater Manchester and London
- exhibited at 11 careers fairs, science festivals and community festivals
- reached over 8,200 underrepresented young people.

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 2022 the pilot boxes engaged 750 young people and 17 business and led to 4,500 interactions with people at events like Cenex LCV. The boxes will formally launch in early 2023.

Magnets Report

The supply security of rare earth permanent sintered magnets, and the rare earth raw materials that these contain, is a strategic area for the UK. These high-performance permanent magnets are used in many applications including wind turbines, electric motors for electric vehicles, MRI machines, consumer electronics and military machines.

The market supply is currently dominated by China, and accelerated moves towards electrification will increase demand over the coming years. There is a strategic and economic imperative to diversify supply to secure the materials and components needed to realise national decarbonisation and electrification strategies.

Innovate UK KTN's Chemistry & 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.

You can read the UK supply chain opportunity in materials for permanent magnets report online.

The CLIMATES programme

The magnets report led to Innovate UK KTN undertaking further investigations for Driving the Electric Revolution. These included exploring the opportunities around magnet supply chains and rare earth materials. The recommendations from the work influenced the creation of the CLIMATES programme.

Run by Innovate UK the £15 million CLIMATES programme will:

- help deliver new techniques for separation
- build a portfolio of projects looking at alternatives, reducing overall demand
- grow international collaborations with allied nations
- improve public awareness of the importance of the critical materials
- unlock private investment to grow the sector
- build on the Critical Minerals Strategy, published by the UK government in July 2022.

The vision for the CLIMATES programme is to enable the UK to increase its supply chain resilience within critical minerals.

People

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

Delivery Team

Will Drury

Challenge Director

Will joined UKRI in January 2020 from engineering and environmental consultancy Ricardo where he was Global Technical Expert: Power Electronics and Head of Electronics & 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. 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'Oreal.

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.

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.

Hannah Gibson
Innovation Lead

Hannah is part of Driving the Electric Revolution, Transforming Construction, and the Digital Engagement teams. She supports the Building Talent for the Future projects, and companies across the Driving the Electric Revolution cohort to maximise skills and training opportunities in the PEMD sector. Before joining UKRI, Hannah specialised in future skills and innovation at the Construction Industry Training Board. Her role involved building relationships with industry stakeholders and understanding the major issues for the construction sector, and working with industry, parliamentarians and policy makers to effect change in the construction skills arena. A Royal Academy of Engineering Policy Fellow, Hannah has previously worked in Public Affairs and Engagement for Alzheimer's Society, Guide Dogs for the Blind Association and Deafblind UK.

Mark Urbanowski
Innovation Lead

Mark joined the Challenge in early 2020 with several years of consultancy and original equipment manufacturing experience in the automotive industry. Most recently he worked on the Dyson electric vehicle project, leading the Performance and Driveability attribute team. Before this he spent several years at the consultancy Ricardo as a driveline and transmission development and attributes engineer, consulting with automotive companies all over the world. He has a master's degree in mechanical engineering from the University of Southampton.

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.

Nicholas Ansell

Impact and Performance Manager

Nicholas joined the Driving the Electric Revolution Challenge as a Researcher in February 2022 and was promoted to Impact and Performance Manager in December 2022. 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.

Dawn MacGregor

Communications Business Partner

Dawn joined UKRI in June 2020 as a Senior Communications Manager for UKRI's Strategic Priorities team where she currently provides communications support to multiple challenges, including Driving the Electric Revolution. Before joining UKRI she worked at the Groceries Code Adjudicator and at the Financial Ombudsman Service.

Claire Lawrence

Executive Assistant to UKRI Challenge Fund Directors

Claire joined Innovate UK in 2019 as Personal Assistant to UKRI 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 promoted to Executive Assistant of 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 Driving the Electric Revolution Challenge as a Project Support Analyst in October 2022. 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. Mustaphis has an MEng in Chemical Engineering from The University of Edinburgh. His final project focused on droplet evaporation and associated energy conversions with potential uses including thermal regulation and printing for self-assembly. He is a mentor for 'Zero Gravity' an online platform that connects college students with a mentor based on their university ambitions.

Programme Board

The Programme Board is a major component of the UKRI Challenge Fund programme governance and assurance structure. The Board supports and makes recommendations to the Challenge Director, the Challenge Fund Steering Board, and UKRI, 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 Interim Chief Operating Officer at UKRI 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.

Nigel Pargiter

Business Energy and Industrial Strategy (BEIS) representative

Nigel is Deputy Director for the automotive sector at the Department for BEIS. With the Department for over 10 years, he previously held roles in Trade and EU Exit, Aerospace, and developing a scheme for energy cost compensation. Before this Nigel had an extensive career in the NHS and local government, where he held roles in economic development and sub regional strategies for regeneration.

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.

"Over the last 12 months the Driving the Electric Revolution Challenge has continued to deliver growth and impact in this technology sector which is vital for our overall net zero ambitions, and we have seen that growth and impact across the UK with the Challenge starting to look internationally.

A major part of this success is down to the way the community has responded and worked cohesively together. The Driving the Electric Revolution Programme Board meets with the Challenge team to provide governance, guidance, and support to enable the delivery of the overall Challenge objectives.

The commitment and engagement of the external members of the programme board has been fantastic, especially in these challenging times."

Guy Woolley

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 industry and academia the advisory group ensures the ongoing strategic focus of the Challenge and provides wider sectoral input.

In 2022 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

Innovate UK Knowledge Transfer Network (KTN) Partners

Dr Paul Huggett

Knowledge Transfer Manager, Industrial Technologies

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 KTN.

Dr Sven Knowles

Knowledge Transfer Manager, Industrial Technologies

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 KTN, he manages the Driving the Electric Revolution Challenge.

Matt Cliffe

Marketing Manager

Matt has worked in marketing and events roles for several years and is passionate about growing innovative communities and promoting sustainable electronics technologies.

Raluca Popovici

Knowledge Transfer Manager, Industrial Technologies and Manufacturing

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.

Anita Onwuegbuzie

Events Manager

Anita organises all Innovate UK KTN events within the Industrial Technology and Manufacturing community. She played a vital role in ensuring the success of Engage with Live in 2022.

The role of Innovate UK KTN

Innovate UK KTN sits at the interface of the public and private sector, working in close partnership with Innovate UK and UKRI to support businesses in their innovation journey, including identifying strategic goals and innovation pathways and delivering a rich annual portfolio of activities at regional, national and global level.

Furthermore, Innovate UK KTN create diverse connections to drive positive change by working closely with BEIS along with the:

- Department for Digital, Culture, Media and Sport
- Department for International Trade
- Ministry of Defence
- Foreign, Commonwealth and Development Office

Innovate UK KTN exists to connect innovators with new partners and new opportunities beyond their existing thinking, accelerating ambitious ideas into real-world solutions.

It connects ideas, people and communities to drive innovation that changes lives.

With 280 staff across the UK, deep technical sector expertise, and over 43,000 organisations in its network, Innovate UK KTN are specialists in making a significant impact by convening innovation communities and traversing traditional sector boundaries to bring together innovation communities. Innovate UK KTN has a wide geographical reach across the UK and extensive connections within the UK's industrial and research bases. This enables it to bring different communities together to generate cross-sector collaborations.

Innovate UK KTN 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 public sector.

Innovate UK KTN has promoted and provided information about the Driving the Electric Revolution challenge to a targeted network of more than 3,000 unique PEMD focused individuals.

Supporting funding competitions

During 2022 Innovate UK KTN undertook work on the promotion, release, and networking and collaboration between organisations for the two Driving the Electric Revolution competitions.

It supported the PEMD Scale-up competition with an Innovate UK KTN briefing tour hosted at the DER-IC centres in Strathclyde, Newcastle, Newport, and Nottingham. Innovate UK KTN also provided promotional support for the Building Talent for the Future 2 competition.

Investment readiness programme

The Driving the Electric Revolution Investment Readiness Programme 2022 was initiated to build on the 2021 cohort activity. The programme provided guidance and support activities to organisations that had received funding from Driving the Electric Revolution competitions.

The programme aimed to support the growth of these innovative businesses and accelerate the uptake of technology implementation from the competition.

The training programme ran from January to March 2022 and covered how to understand the investment ecosystem, including all the different types of investment in addition to giving business owners insights into an investor's perspective. The programme trained the organisations on how to compete for investment including:

- delivering an elevator pitch
- the due diligence requirements
- strategic business planning
- valuing their company

Once this training was complete, the programme concluded with a session where the participating organisations pitched live to investors.

From the initial cohort of 13 companies, three businesses were selected for the showcase day in London. In March 2022 each company delivered a live pitch and Q&A session to an online audience of investors.

Driving the Electric Revolution Industrialisation Centres

DER Industrialisation Centres

The Driving the Electric Revolution Industrialisation Centre (DER-IC) network's mission is to support growth of the PEMD supply chain in the UK. It does this by providing access to world-class design, manufacturing, test and validation capability across 30 universities and RTOs.

Established through £33 million of investment from the Challenge, including £28.5 million for capital equipment, the DER-ICs provide industry with open-access to capacity and capability and equipment to support development, prototyping and manufacturing process scale-up. This will enable industry to develop and launch new products in a cost-effective way, without disrupting existing production.

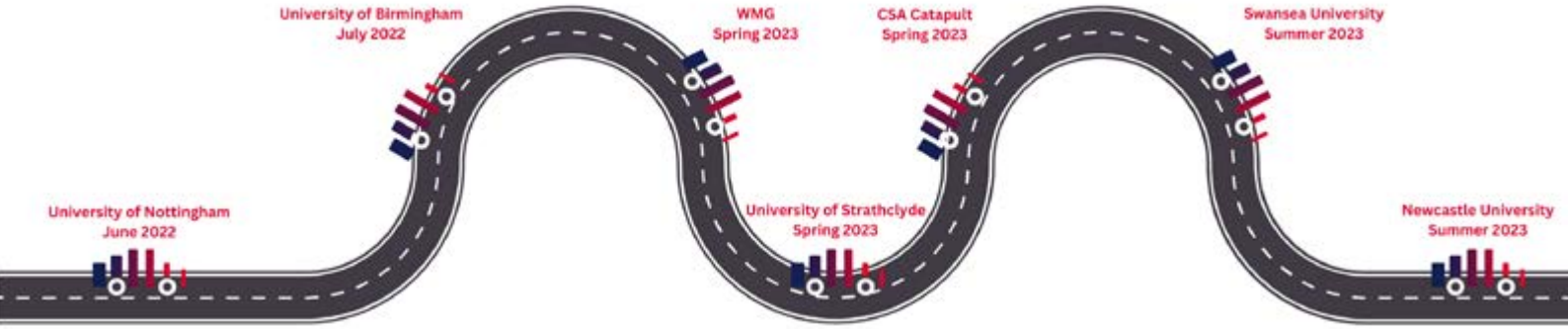
More information on the equipment and areas of expertise across the network can be found on the DER-IC website: www.der-ic.org.uk

> As the established DER-IC (south-west & Wales) for the Driving the Electric Revolution Challenge, we can help SMEs and large organisations take part in collaborative funding programmes and connect with UK supply chains.
>
> Building on our existing capabilities at the Compound Semiconductor Applications (CSA) Catapult, we've created a unique proposition. We've combined power electronics, advanced packaging and funding from the Challenge to provide customers with equipment that isn't available anywhere else in the UK, like a ceramic multi-material printer and a pure copper metal printer. Our leading-edge equipment, combined with our technical know-how and skills, is helping customers to engineer their products and get products to market quicker."
>
> **Martin McHugh :** *CEO, CSA Catapult*

Launched in March 2020, DER-IC is now in its third year. Significant achievements from 2022 include:

In addition to this existing expertise and open-access facilities, the Challenge has invested in new equipment to fill manufacturing supply chain gaps and shortfalls, including:

- megawatt-scale electrical system and propulsion testing for high-power, high-integrity PEMD at PNDC, University of Strathclyde
- assembly lines for power electronics and electrical machines at DER-IC north-east, Sunderland
- a high frequency coil manufacturing and magnetic test facility at the University of Nottingham
- a power electronics reliability and failure analysis facility, and electrical machine winding equipment to establish a Centre of Excellence at the University of Warwick and WMG respectively
- a wide band gap power electronics component industrial pilot line at Swansea University
- 3D additive packaging for high performance integrated power electronic devices at the Compound Semiconductor Applications Catapult
- a production line for recycled sintered magnets at the University of Birmingham



DER-IC launch timeline.

Electric Revolution Skills Hub

The Electric Revolution Skills Hub

Delivered by Coventry University on behalf of the Driving the Electric Revolution Challenge. The hub will connect PEMD training and education providers with employers and learners to help grow the workforce needed to build future net zero technologies.

The new online platform for the PEMD community aims to support the UK's workforce to develop the skills needed to deliver net zero technologies.

Investing in the future

Coventry University will use the £1 million funding to establish a platform connecting PEMD training and education course providers with employers and learners seeking to develop their skills.

With the platform designed to run for at least the next 10 years, the funding from the Challenge includes operational costs for the next three years.

The Electric Revolution Skills Hub

Although not delivering or creating training itself, the Electric Revolution Skills Hub aims to:

- be a library for all publicly available PEMD related training and its providers in the UK
- provide impartial information and guidance to the UK's PEMD community about training courses and educational materials
- work with training providers to display suitable courses within the platform
- actively engage with businesses of all sizes to direct them to suitable training
- listen to any industry about their PEMD training needs
- encourage the creation of content to address gaps in training needs
- actively promote equality, diversity, and inclusion for PEMD skills

Communications and engagement

The Driving the Electric Revolution community remains strong with over 2,500 members representing over 500 organisations from across the UK. Innovate UK KTN continues to be vital in attracting new entrants to the community and connecting businesses.

Innovate UK KTN's support for the Challenge

Innovate UK KTN 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 public sector.

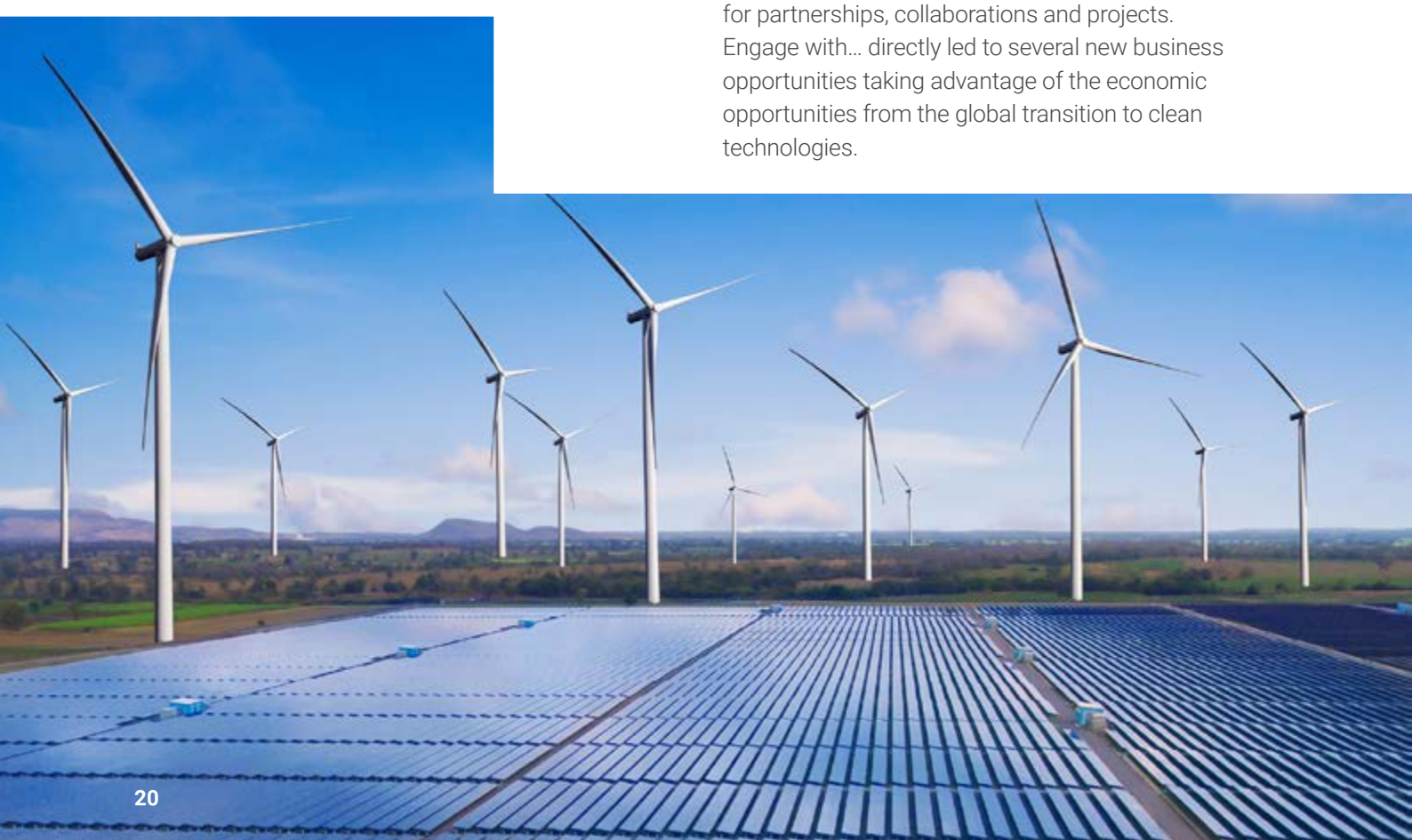
This year Innovate UK KTN promoted and provided information about the Driving the Electric Revolution challenge to a targeted network of PEMD focused individuals. This has included provision of:

- PEMD focused, cross sector weekly emails including funding opportunities
- Direct community support for consortium building, collaborations, and assistance in project development
- Live online events, including the weekly 'Engage with…' webinar series and Equality, Diversity and Inclusion events
- Repository of recordings and presentations from historic 'Engage With…' webinars
- Information about the Driving the Electric Revolution challenge to a targeted network of PEMD focused unique individuals
- Driving the Electric Revolution challenge newsletters
- Driving the Electric Revolution landing pages

The 'Engage with…' webinar series

Run by Innovate UK KTN on behalf of the Challenge the Engage with… webinars began in April 2020 at the very start of the COVID-19 pandemic. They enabled leading companies and organisations involved in PEMD to continue meeting, engaging and communicating.

Over a two-year period this Thursday afternoon session occurred 57 times and attracted 3,057 people, who asked 565 questions. It led to around 125 new introductions exploring future opportunities for partnerships, collaborations and projects. Engage with… directly led to several new business opportunities taking advantage of the economic opportunities from the global transition to clean technologies.



Once people began returning to work in early 2022, a drop in registrations numbers and attendance led to a review of the format. Now called 'Engage with Electrifying Interviews…' this revamped series sees Innovate UK KTN host a three minute conversation with someone in the PEMD sector.

We thank the presenters and attendees for making the 'Engage with…' series such a fabulous success. You can watch all the 'Engage with…' webinars online.

Out and about

With COVID-19 restrictions easing in 2022 the Challenge team took the opportunity to get out and about.

This included attending:

- Drives and controls
- Future Propulsion Conference
- Highways UK
- IET PEMD 2022
- Cenex LCV
- Materials Research Exchange

Engage with…LIVE!

Held in March 2022, Engage with… LIVE! took place at the end of the COVID-19 lockdowns to enable companies and organisations involved in PEMD to meet, engage and network face-to-face.

Organised by Innovate UK KTN the event gave leading companies and organisations an opportunity to meet, network and discuss opportunities to boost electrification and the adoption of clean technologies across industries throughout the UK.

The day was filled with great conversations about Driving the Electric Revolution and PEMD with over 275 people attending and more than 50 companies showcasing their involvement in the PEMD industries.

We especially enjoyed the discussions about collaborative future electrification opportunities in addition to the engagements within the exhibition area, the keynote presentation and panel discussions. Feedback from the event was overwhelmingly positive and generated strong support on social media, particularly on LinkedIn.

DER-IC events

The Industrialisation Centres had a busy 2022 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: www.discover.ukri.org/clas-sic-case-study/index.html

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

Challenge benefits and evaluation

The Driving the Electric Revolution Challenge's success relies highly on the investment made into funded projects through competitions, and with this the Challenge does not have a fund and forget attitude. We recognise the importance of the accountability of public spending and with that want to celebrate project success and provide ongoing support during the funding period.

The challenge is, and will continue to, deliver a wide range of benefits here in the UK. Although many of the benefits will be fully realised over the long term, early benefit recognition is clearly visible from successful Driving the Electric Revolution Challenge intervention.

Work is underway to gather data from established Driving the Electric Revolution funded projects to capture their success and impact directly derived from the Driving the Electric Revolution funding investment. This covers financial and non-financial benefits including co-investment secured and job creation.

An overview of the expected and realised Challenge benefits is below. So far nearly 100 participants across more than 40 projects have provided insights into the benefits and wider impact of their projects.

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

One benefit has been the growth of the UK PEMD community because of the Driving the Electric Revolution 'Engage with' series. With over 2,500 people taking part, the Challenge has enabled the Innovate UK KTN to connect 125 firms that may not have previously considered working together. Despite a difficult year Driving the Electric Revolution successfully built and virtually connected the PEMD community to start linking up the UK supply chain.

Producing highly skilled jobs

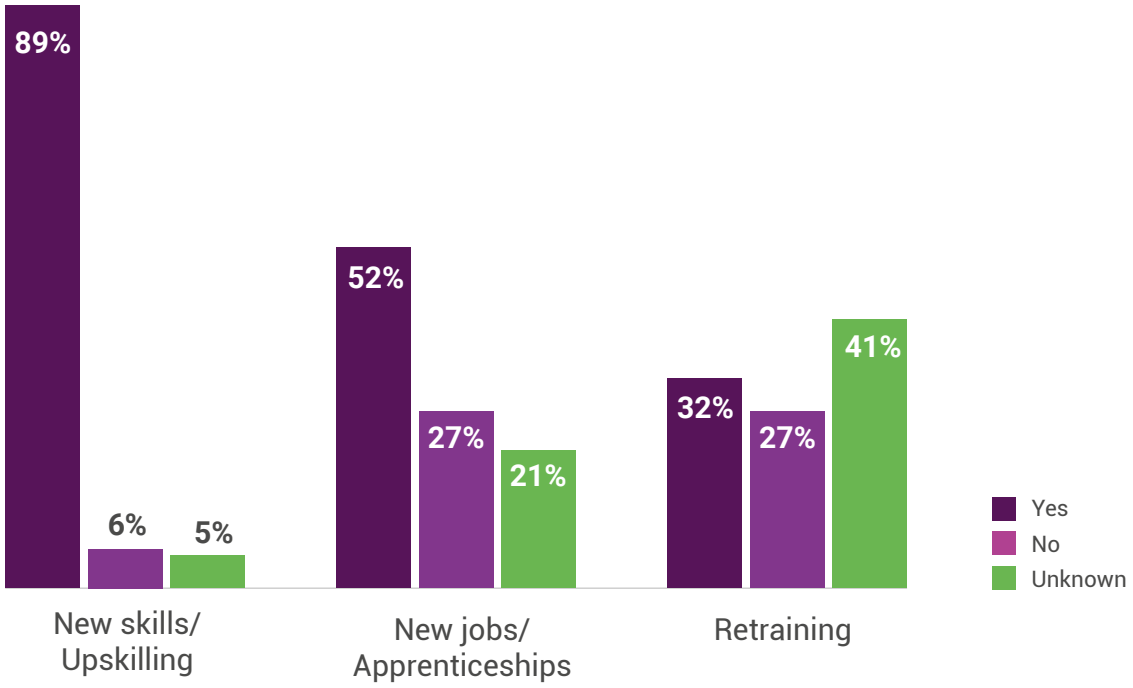
Targeted at onshoring, training, retraining and upskilling existing and new businesses, exploiting collaboration between UK academia and UK businesses. There are currently around 30,000 highly skilled workers associated with internal combustion engine supply chains in the UK today. With the shift to the electrification of vehicles, the Challenge seeks to retrain and repurpose a substantial proportion of these workers. This will enable them to work in PEMD supply chains in areas like mechanical, electrical, software, manufacturing systems and management.

Of the surveyed CR&D project participants, 89% highlighted that their project had led to better understanding and improved knowledge of new processes and technologies contributing in turn to new skills and upskilling amongst their workforces. Complimenting this, from interviews conducted with participants of BTFTF Cohort 1, 82% said that their project targeted either new skills development, upskilling or both. 52% of CR&D respondents said that their project had resulted in new jobs or apprenticeships in either R&D or manufacturing.

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. These jobs range from machine operators to doctorate research and development engineers.

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

Has your project resulted in any of the following?

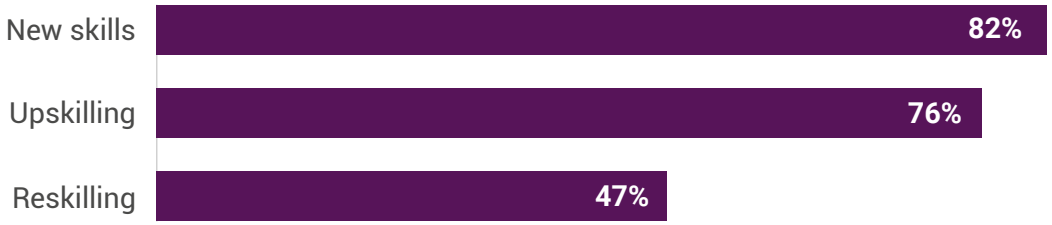


While only 32% of participants said that their project has facilitated retraining into PEMD, we expect this figure to evolve over time as 41% responded that this outcome is still an unknown.

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 BTFTF1 cohort who believe their project targeted new skills, upskilling or reskilling to some degree



Filling crucial gaps in the supply chain

Developing a unique national coordination of activity across the UK PEMD sector, the Challenge has facilitated successful collaborative working relationships where previously this networking opportunity would not have taken place.

In doing this, we have funded projects which create collaborative working partnerships and developed value chains that were previously unfeasible. The network outreach has provided visibility for many SMEs and promoted partnership working.

Participant feedback concerning cross-sector collaboration has been overwhelmingly positive. 93% of surveyed respondents said that their project had enabled new cross-sector or end-to-end supply chain linkages.

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. Many had previously not worked with one another before collaborating within their initial project consortium.

The same applies for end-to-end linkages within supply chains. Where the projects facilitated new relationships between upstream and downstream SMEs, which were then harnessed either through direct collaboration or sub-contracted work. We expect these figures to increase and eventually translate into real-term quantifiable added value over the coming years.

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

Increasing export revenues and market share

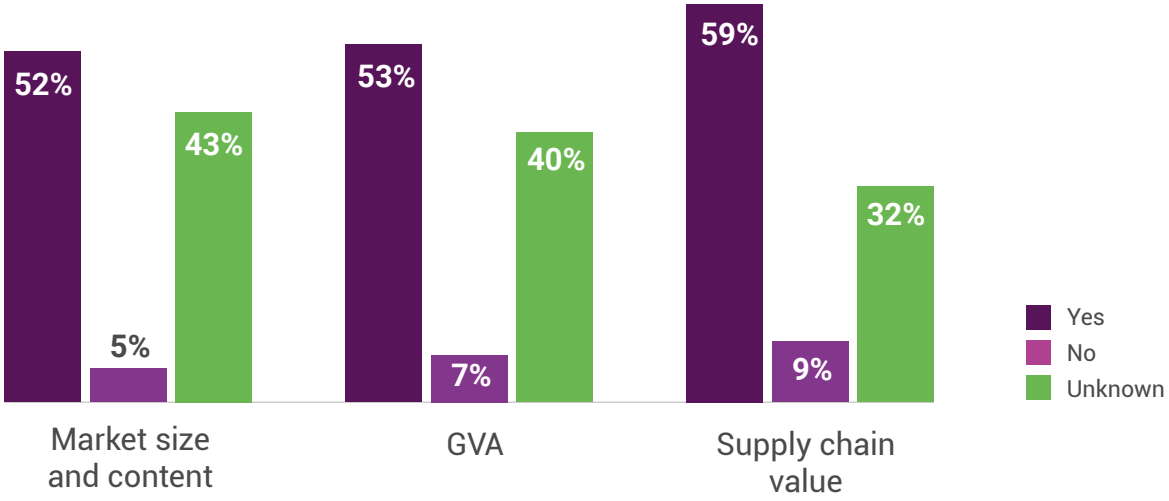
Latest estimates suggest that by around 2050 PEMD will be worth over £2,000 billion globally, of which Europe would consume £700 billion. In 2025 the PEMD demand is expected to exceed £450 billion globally and will be heavily automotive, energy and maritime driven, because of earlier and less regulated adoption. With support from 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.

As things stand, 52% of surveyed participants said that their project has had an impact on the market size and content of the UK PEMD ecosystem. This is supported by a similar response rate (53%) amongst participants concerning Gross Value Added (GVA) as a project outcome.

This is further reinforced across supply chains, as 59% of participants have said that their project had resulted in some degree of added value across end-to-end supply. Be it from reduced costs (time, material, or labour) or increased value (as resulting from new or improved products, capabilities or processes).

Only 5% of respondents explicitly outlined that their project has had no impact on the UK PEMD market size or content. 43% said that this outcome is still unknown, suggesting that such impact is pending longer-term exploitation.

Has your project has had an impact on the market size and content of the UK PEMD ecosystem?

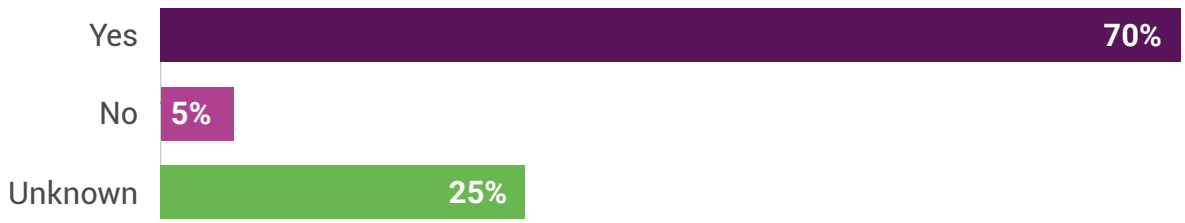


Wider and social impacts

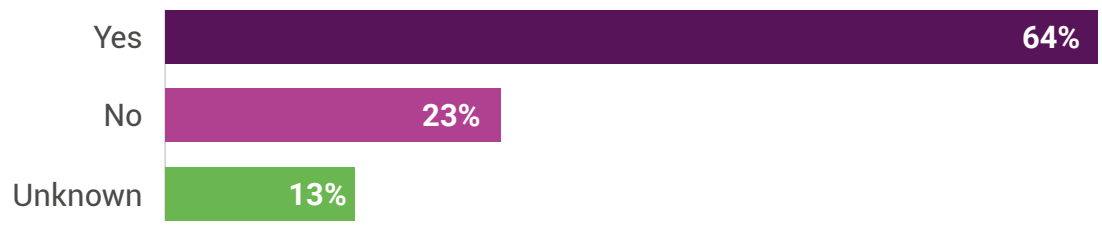
Surveyed CR&D project participants recognise the importance of PEMD in delivering a net zero future. 70% of respondents were able to demonstrate that their project is having an impact on decarbonisation, through EV innovations or other means. 25% responded with an unknown, as while inherently their project links to electrification and by extension decarbonisation, impact is reliant on project exploitation which has not yet come to fruition.

Elsewhere, 64% of participants said that their project has resulted in local impact in some form or other. Responses were varied, with participants citing local supply chain linkages, local recruitment, new infrastructure, agglomeration, for example as benefits to the local area. This was seen in pockets across the UK ranging from South Wales and the south-west of England to the Midlands, 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?

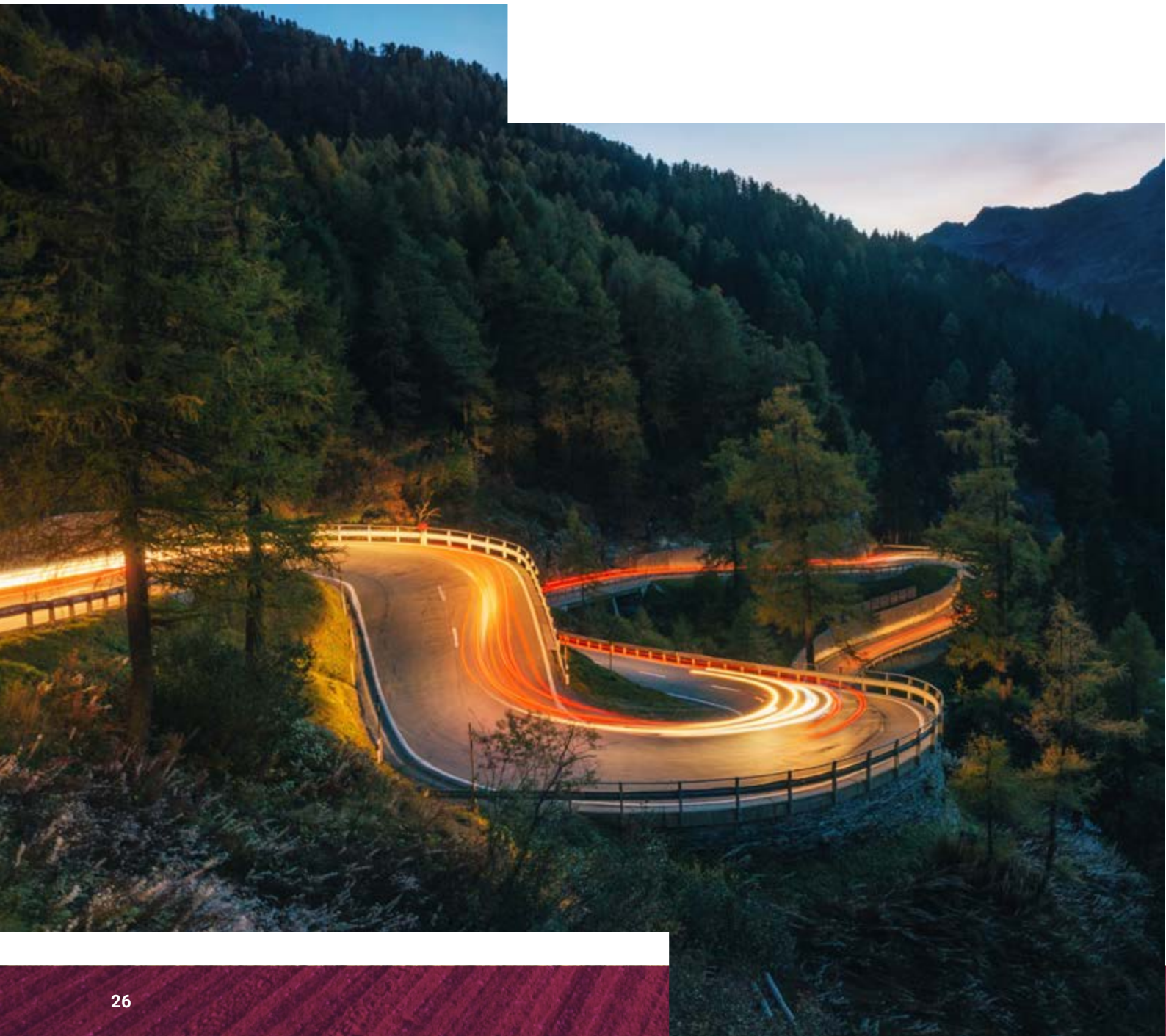


Supporting government policy

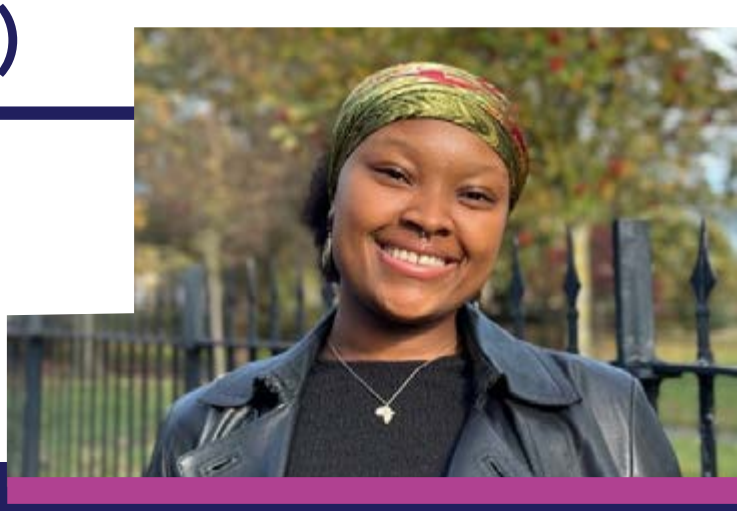
Supporting the delivery of government policy to meet climate change targets and industrial growth, the Challenge directly addresses the need to be able to manufacture the new products required to meet enacted legislation. A higher rate of modern technology introduction, simultaneous development of technology 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. PEMD exposure has become more readily 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 £15 million Innovate UK CLIMATES programme off the ground.



Equality, diversity and inclusion (EDI)



At the beginning of 2022 we rounded off our EDI webinar series that began in 2021. Over four months we explored collective solutions to EDI issues across and highlighted the importance of EDI across the workspace. The series was a follow-up to the 'Engaging a Diverse Workforce for the Future' webinar held in 2020.

The series attracted people from a wide range of ages with almost 100 people joining across the four sessions. Although we were disappointed with the number of people who attended, we were pleased to have more female participants joining the webinars compared to the 2021 session. Going forwards we're aiming to find ways to assess engagement levels across the Driving the Electric Revolution community as a whole to improve attendance at Challenge led events.

Although our public facing work to promote EDI reduced this year, we've been working to further embed EDI into everything we do as a challenge. We've created a diverse list of speakers to suggest potential panellists for externally held events and help us ensure we have an equal split on panel sessions we put together.

Supporting interns

Lorna Thomas, our Project Manager, responded to a call UKRI made for volunteer mentors to support the 10,000 black interns (10kBI) scheme. The scheme helps black students and graduates realise their potential with paid internships across finance, technology and 25+ other sectors. Lorna was one of three Innovate UK staff who agreed to support one of the 20 placements offered by UKRI to the 10kBI scheme in 2022.

Lorna maintained regular contact with her intern, Chantelle, throughout the placement and remains in touch with them now, long after the placement completed. Here Chantelle tells us about her internship.

My name is Chantelle, and I am an international student from Botswana studying Financial Mathematics at the University of Leeds. I interned remotely with UKRI over the summer as a Portfolio Intern through the 10,000 black interns programme.

My internship was nothing short of incredible. From the first to the last day, it was a learning experience. From attending the Net Zero Showcase to University visits, I learned the significance of the various work and its interconnection, which shows the positive impact UKRI is doing and working to achieve in the future. I loved meeting and working with the various teams, as well as learning more about the roles they were doing. Everyone was friendly, always eager to assist and made me feel like I was part of the team from the start. Their critical and supportive feedback helped me realise my full potential and boosted my confidence in the workplace. I worked on some challenging tasks like data analysis of portfolios and a case study which helped improve my critical thinking, writing and analytical skills. It was fulfilling to know that the work I was doing was a building block in creating a positive impact to the team.

The mentorship experience that I was provided was really beneficial since it helped me realise and celebrate the accomplishments that I had achieved throughout the internship, which was sometimes difficult to recognise because I was working remotely.

Prior to the internship, I was conflicted about the type of work I envisioned myself doing once I finished my degree. My mentor taught me the value of performing work that you love or enjoy, which helped me break out of my shell and pursue positions that I pictured myself working in and loving rather than following a route defined by forces other than myself.

I am now in my last year of university, hoping to pursue a master's degree, and I am also working with the university, leading walks across Yorkshire and promoting health and wellness to students and staff.

Developing our team

We've also worked hard to support individual team members in developing their skills. Lorna Thomas stepped up as Programme Manager for six months, whilst Nicholas' work as our Researcher enabled him to develop the skills required for the Impact and Performance Manager role. We've also sought out talent from a wide range of sources, like the Innovate UK graduate scheme. We asked Nicholas and Mustaphis to tell us their stories.

Mustaphis Koleoso

Innovate Graduate Scheme to Driving the Electric Revolution

Joining Innovate UK (IUK) last year as part of their Graduate Scheme seems like a distant memory now. I felt like I was in good company as a Chemical Engineering graduate considering that over half the cohort had engineering degrees.

My year on the Graduate Scheme consisted of two six-month placements in the post-award and Lending Operations teams with the latter including a brief secondment with IUK Health & Life Sciences team.

I had opportunities to lead project and competition delivery, facilitate workshops, prepare high quality research and reports and was consulted upon regularly for my problem-solving skills. Some of my favourite experiences were helping project participants navigate COVID-19 related travel restrictions and developing tools to ensure accuracy of finance requests and payments from customers.

Although I enjoyed my time in operational teams, I'm excited to now be working in a team that focuses on the delivery of technical projects helping the UK reach its net zero ambitions.

I look forward to the rest of my time with Driving the Electric Revolution and all the learning that will come with it!

Nicholas Ansell

Researcher to Impact and Performance Manager

I initially joined the Driving the Electric Revolution Challenge in February 2022 as a Researcher for a six-month data-gathering project. My early role focused on capturing the benefits and outcomes of closed funded Collaborative Research & Development (CR&D) projects. This involved measuring and evidencing the impact and exploitation of the various completed projects across the Challenge's portfolio.

My first month in the job ended in March with the 'Engage with Live event'. Bringing over 250 representatives of the PEMD community together it was the perfect platform for me to meet members of the Challenge community and see first-hand, what projects were achieving.

When the opportunity to be the Impact and Performance Manager for the Challenge came up I was excited at the possibility of applying to become a permanent member of the team.

The team have been highly supportive in developing my skills so far and I'm looking forward to continuing my work with the team, partner organisations and project participants.

From my perspective, coming from a social science background has worked in my favour. I'm able to ask questions and get projects to explicitly draw the link between their funded innovations and the wider societal benefits.

I'm excited to be able to oversee the trickle down of benefits from past, present and future projects as the challenge moves into its delivery phase.

Annex

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
- Motor Design Limited
- GKN Hybrid Power Limited
- University of Nottingham

105894: High-T Hall

Description

The vision for this project was to develop and provide a supply chain for high 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 up 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
- Compound Semiconductor Applications Catapult
- Rolls-Royce plc
- Aero Stanrew Limited

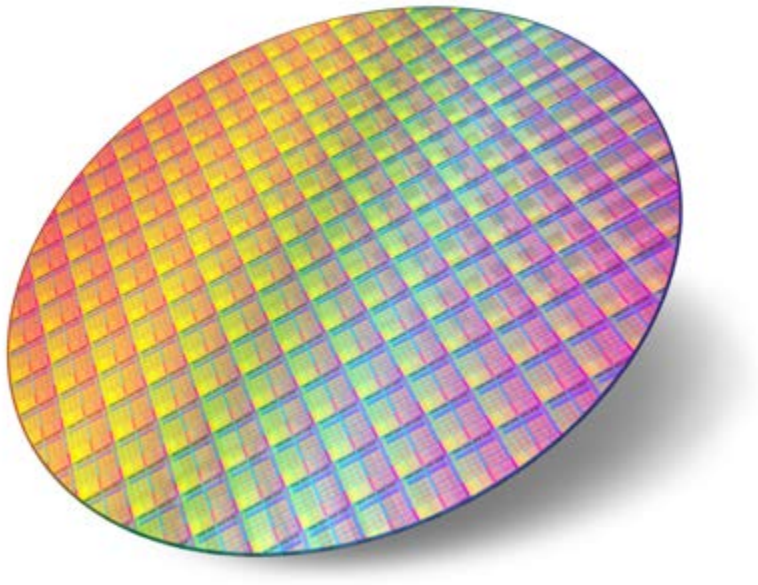
105891: Short Loop Optimisation of Gallium Nitride Materials and Major Manufacturing Modules (SLOGaN M4)

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
- University of Bristol
- Newport Wafer Fab Ltd

105896: Automated Dynamic Testing of Magtec Power Controllers

Description

The research project developed a radical innovation to improve the test process capability for electrical power controllers (drives). Allowing the delivery of robust solutions to adapt drives through data acquisition and feedback approaches 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 (mainly 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 chip thermal data to enable improved module design, more accurate thermal models, and therefore better 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.

Using thermal modelling, and experimental trials, the sensor layout and manufacturing methods, for the integrated module were reviewed and optimised. This included establishing annealing and calibration processes. Based on the selected methods, prototype samples were built, and tested, to demonstrate the 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 aren't 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.

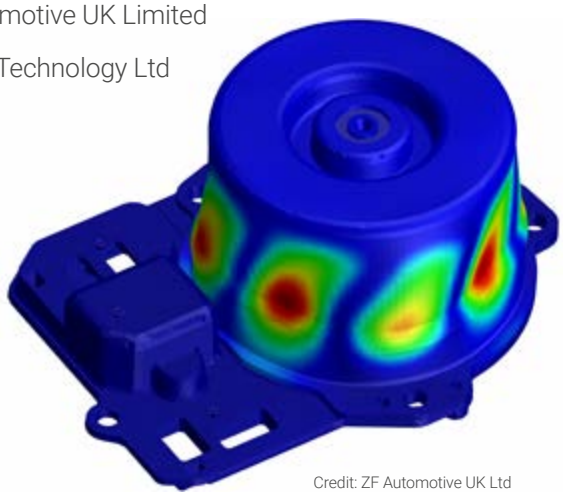
Funding and project costs

Total project costs: £997,352

Driving the Electric Revolution funding: £498,676

Consortia members

- ZF Automotive UK Limited
- Romax Technology Ltd



Credit: ZF Automotive UK 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 new 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
- National Composites Centre
- High Value Manufacturing Catapult

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 is becoming lower. The project achieved a reduction in weight of e-Machines by 15% 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
- Integral Powertrain Limited
- Compound Semiconductor Applications Catapult

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.

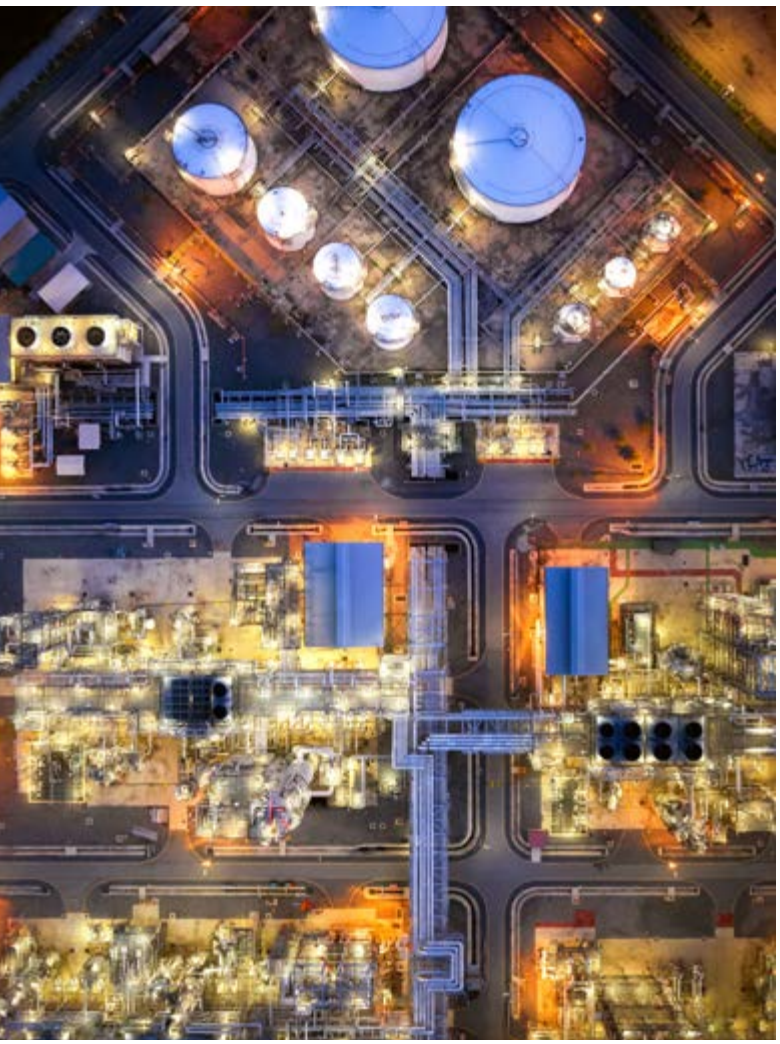
Funding and project costs

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.

Opportunities are being exploited to improve the performance, and ultimately the value proposition, of high value systems used today in direct drive, oil free applications where constant running of gas processing equipment occurs. Considering all aspects of the system including magnetic, mechanical, control system and power electronic design enables an approach that optimises through life cost, opening further market sectors for targeted exploitation.

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 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 a real size, fully optimised and characterised prototype design with its performance and economics quantified with respect to cost, size, reliability and efficiency.

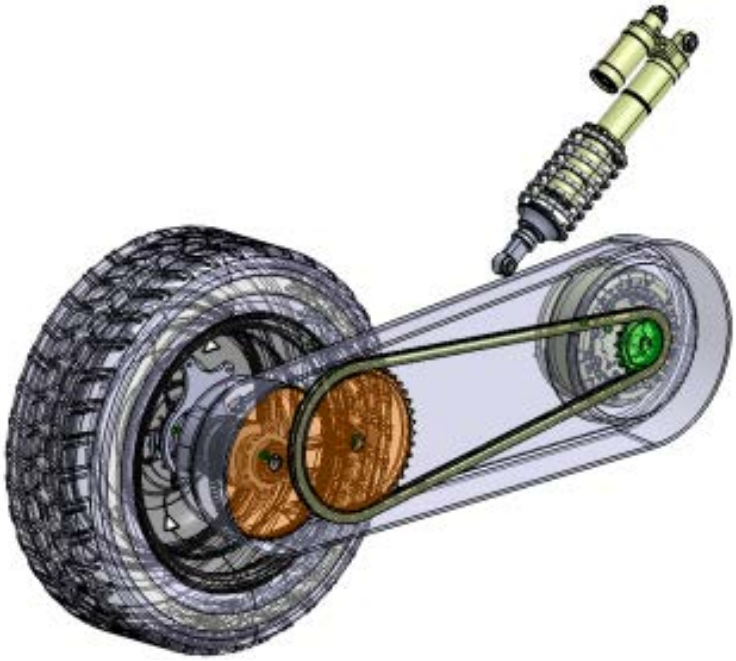
Funding and project costs

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 AM manufacturer for series production.

Funding and project costs

Driving the Electric Revolution funding: £47,314

Organisation involved

- Technelec Limited

The 'Litz' wire created.

Funding competition: Catalysing green innovation

77130: UK-Alumotor

Description

UK-Alumotor is developing a dedicated supply chain to manufacture a patented electric motor/generator which will exploit UK-based high-value manufacturing technology. The e-machine is leveraging specialist material, transferring technology developed within the aerospace & motorsports sectors, together with commodity materials. The design makes use of aluminium & iron, rather than copper and rare earth metals. This provides the UK supply chain with competitive advantage to fulfil the growing market demand for traction e-machines during the next decade and beyond.

The lifecycle impact of the product will be considered throughout the supply chain. Using widely available, and recycled, metals within the e-machine will reduce the lifecycle impact of the e-machine compared with permanent magnet-based motors.

Funding and project costs

Total project costs: £497,790

Driving the Electric Revolution funding: £331,743

Consortia members

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

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 making design for manufacture advancements, reshoring the supply chain, and advancing the UK production capacity to be able to produce 300 units per year at a low production 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 process wholly 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 3x 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 an iron powder that can be compressed into component parts. Each individual iron particle is magnetically isolated from its neighbours' reducing losses. The use of SMCs has the potential to offer cheap high performance electric motors compared to laminations.

In this project, academic loss modelling capability is combined with component pressing expertise to provide a flexible loss prediction method. This allows motor designers to confidently design low loss high efficiency electrical machines and promote a dynamic UK supply chain with an improved 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

Project GaNSiC developed a unique manufacturing process for electronic devices based on compound semiconductors. 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. The COVID-19 pandemic highlighted this dependency and vulnerability to disruption. Particularly in terms of the supply of critical raw materials, such as rare-earth magnets. For these reasons, it is of strategic importance that the UK develops 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

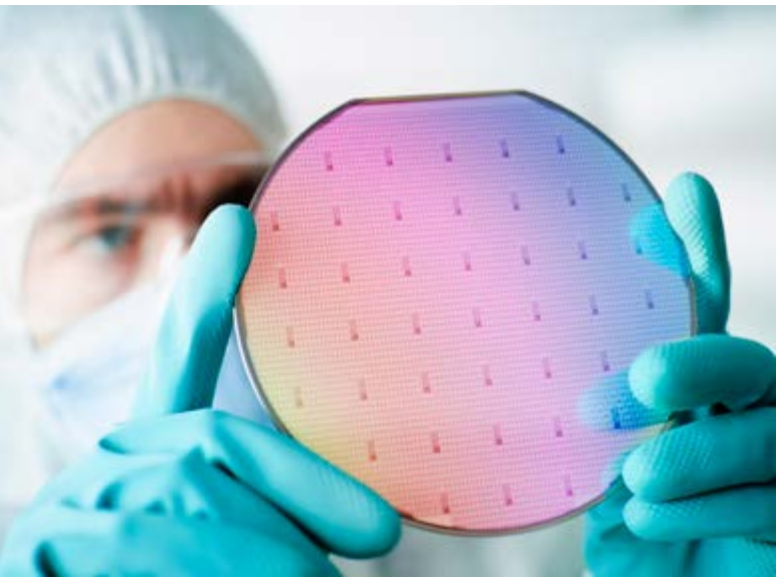
Consortia members

- 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

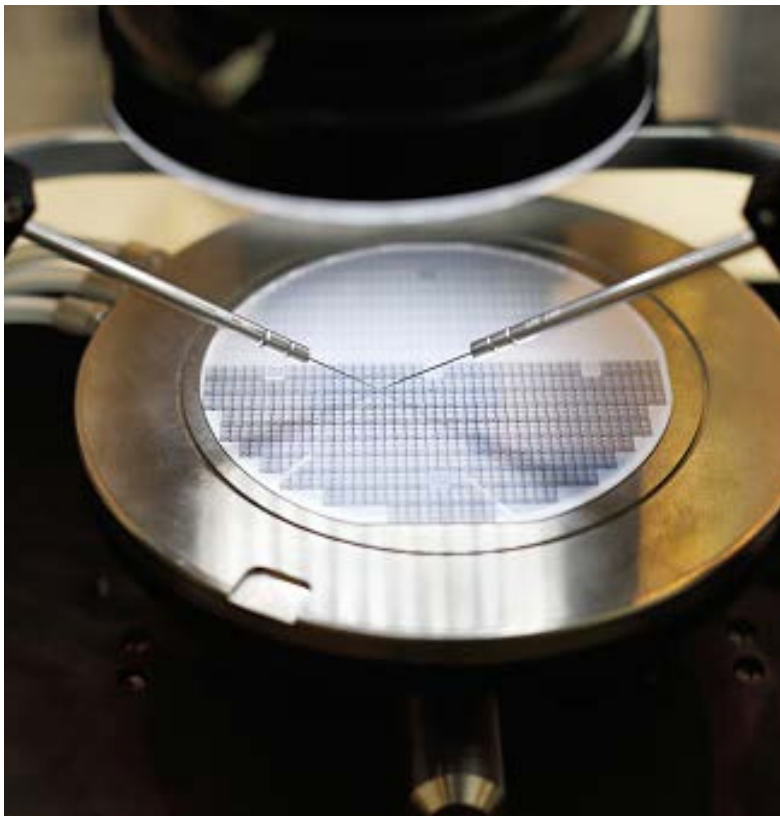
- SPTS Technologies Limited
- Swansea University
- CS Connected Limited
- Newport Wafer Fab Ltd
- Compound Semiconductor Centre Limited

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 drive.

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.
- 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.

After gaining a knowledge of the structure and composition of the LEDs, a recovery plant was conceptually designed, and high 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 one LED chip in an array had failed and that, if replaced, the whole LED would become functional again. A number of 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
- HSSMI Limited
- Envaqua Research Ltd
- E.C.Williams Limited
- Recolight Limited
- Institute of Materials Finishing

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, brake 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
- University of Lincoln
- Printed Motor Works Limited
- Saga Robotics Limited
- ARWAC Limited

Credit: Kirsty Edmonds at Silverstone Park

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® doesn't have meshing gear teeth. A feature that greatly improves the lifespan of the technology as it eliminates friction. This enhanced efficiency is also leading to price efficiencies in the market.

The WINDER 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.

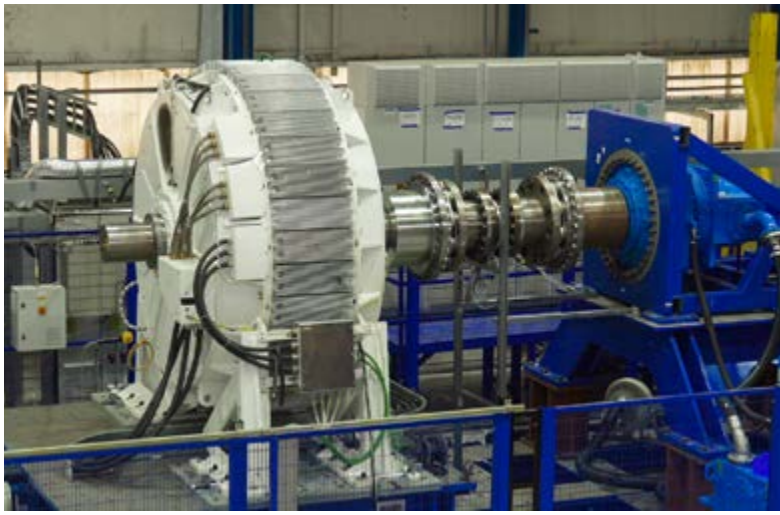
Funding and project costs

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 three 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.

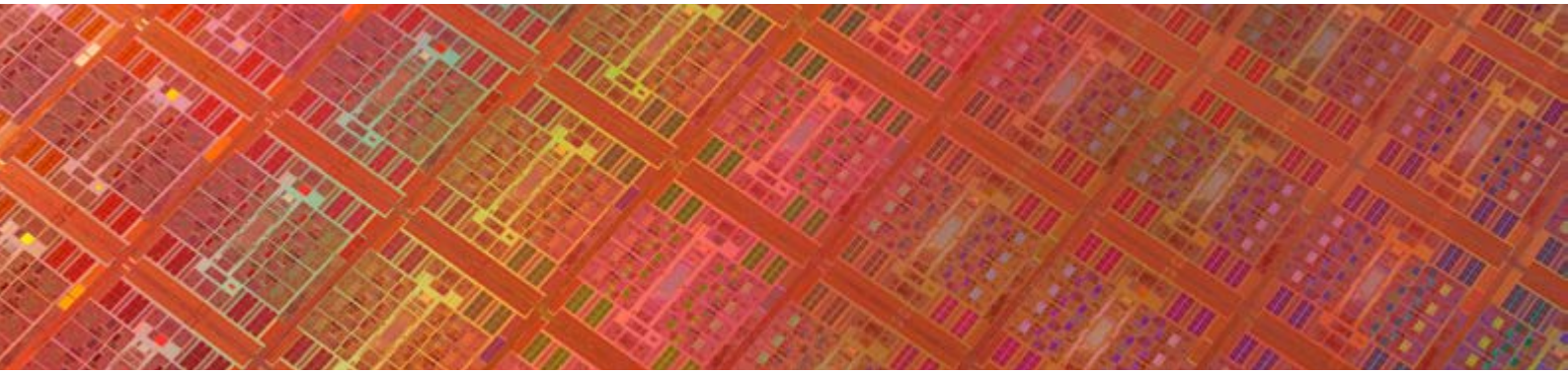
Funding and project costs

Total project costs: £498,183

Driving the Electric Revolution funding: £338,424

Consortia members

- Semefab Limited
- University of Sheffield
- Eco Semiconductors Limited



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 major 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:

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

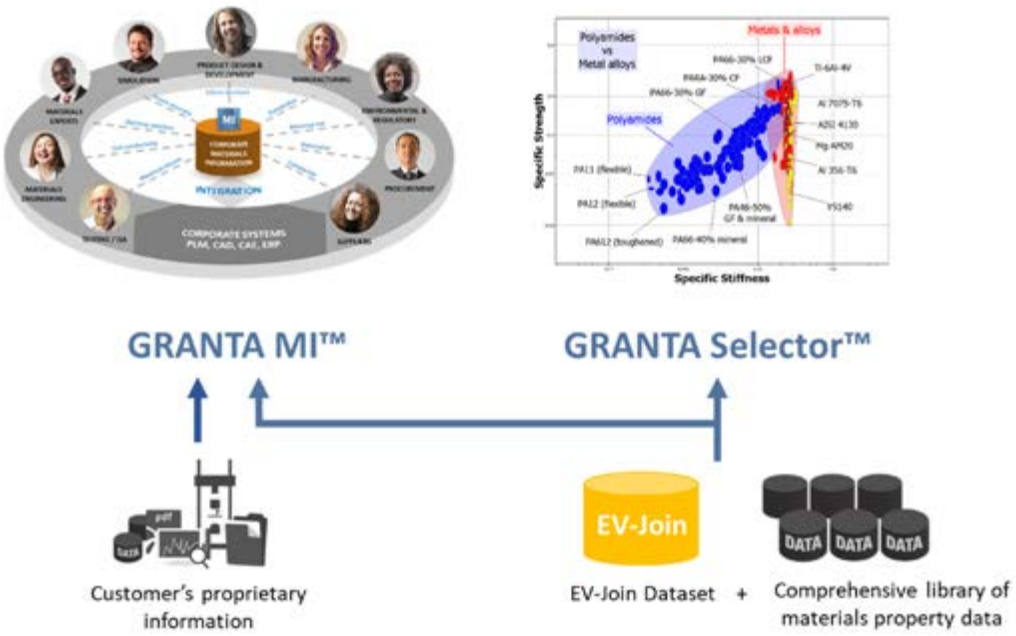
Funding and project costs

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 central 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.

The realisation of high voltage, high current SiC MOSFETs through ASSIST will transform the proposition for Solid State Transformer to realise a cost effective and highly efficient compact solution to that unlocks this significant opportunity.

Funding and project size

Total project costs: £1,618,826

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

Consortia members

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

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

Description

The SCIENZE Project is a £4 million project, incorporating five partners that is creating and safeguarding more than 150 high-value engineering jobs. The project will create the capability in the UK for cost-competitive manufacturing of automotive, power electronics based products by developing a supply chain that can feed into and exploit the new manufacturing capability. If successful, the SCIENZE project will result in the capability to supply up to 100,000 power electronics-based products by 2025 and follow-on investment of at least £4.5 million.

Funding and project size

Total project costs: £4,039,635

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

Consortia members

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

10005554: Enhanced Liquid Immersion Power Systems (ELIPS)

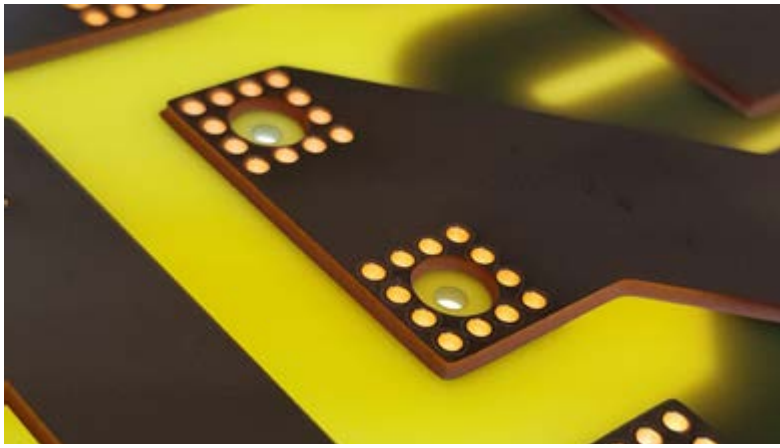
Description

ELIPS is a design-for-manufacture project aiming to build a UK supply-chain to deliver immersion and GaN-based technology across PEMD sectors. 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 energy-saving systems for datacentre infrastructure that will support 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
- Custom Interconnect Limited
- GSPK Circuits Limited
- Iceotope Technologies Limited
- Compound Semiconductor Applications Catapult

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

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

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 allow 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 reduced 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. These aspects are particularly important for automotive and more-electric aerospace applications, the early adopters of the technology. While there are world-leading electronics manufacturing capabilities in the UK, there is currently no manufacturing line for assembling 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
- The Thinking Pod Innovations Ltd
- Cambridge Gan Devices Limited
- RAM Innovations Ltd
- Cambridge Microelectronics Ltd
- Compound Semiconductor Applications Catapult

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

Description

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

The goal of the FASA project is to develop an advanced manufacturing platform that enables 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
- Newcastle University
- University of Warwick
- iRob International Limited

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

Description

The project aims to develop a UK PEMD supply chain that will combine cost effective material supply and cold rolling of a new high strength non-magnetic steel with mass production process innovations that can deliver patented lamination designs. 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 application across transport, energy and industrial sectors.

The project will focus on the development of material supply and cold rolling processes for cost effective supply of the new high strength non-magnetic steel. 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
- Newcastle University
- Tata Steel Nederland Technology B.V.
- Coventry University
- 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
- Phoenix Scientific Industries Ltd
- C Brandauer & Co. Ltd
- Global Technologies Racing 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 exasperated 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
- Knowles (UK) Limited
- Gencoa 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
- 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 and would have no knowledge of PEMD.

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 great success for 14 years, delivering high quality graduates to a group of Tier 1 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 will bring 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 highly 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 funding. 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 International Microelectronics Assembly and Packaging Society - UK Chapter (IMAPS-UK) 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

- IMAPS-UK

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:

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

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:

- taster courses
- online web content
- interactive apps to market the PEMD sector
- hands-on workshops
- site visits for pupils and teachers to manufacturing facilities and semiconductor fabrication plants

The open 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:

- job specifications
- adverts
- CVs
- education curriculum documents

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 number of 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 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 securing 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 semiconductors 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 track record 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 consortia 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:

- transitioning large volumes of experienced technicians and engineering staff
- preparing a new generation of career ready PEMD graduates
- helping to engage a new pipeline of talent for the future

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:

- one-day industry workshops
- outreach in schools
- enhancing academic PEMD teaching provision
- design of an IP-free eMachine, with active parts manufacture, assembly and testing on campus for hands-on learning

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's 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 cutting-edge 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 for specifically 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 early 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're 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

Notes

Delivered by Innovate UK

For more information contact:
DER@iuk.ukri.org

8708 March 2023