



UK Research
and Innovation

Driving the Electric Revolution

2020 Annual Report

Published: April 2021



Contents

Welcome	4
Overview	5
Mission	5
Objectives	5
Funding	5
Collaborative Research & Innovation	6
Overview	6
People	8
Delivery Team	8
Programme Board	10
Advisory Group	11
Knowledge Transfer Network (KTN) Partners	11
The role of KTN	12
Industrialisation Centres	13
Communications and Engagement	13
KTN's support for Driving the Electric Revolution	13
Information Provision	14
Challenge Benefits & Evaluation	15
High Skilled Jobs	15
Key Gaps in the Supply Chain	15
Export Revenues and Market Share	15
Wider/Social Impacts	15
Funded Projects	16
UKRI support	16
Equality, Diversity & Inclusion	17
Annex 1	18
105895: Accelerating the UK E-Machine Preformed Winding Supply Chain	18
105894: High-T Hall	18
105891: SLOGaN M4 – Short Loop Optimisation of Gallium Nitride Materials and Major Manufacturing Modules	19
105896: Automated Dynamic Testing of Magtec Power Controllers	19
105900: Integrated Optical Sensor IGBT Module	20
105899: Die on Heatsink	20
105902: QUIET – Quietness Understanding in E-drive Technology	20
105903: STREAMLINED	21

Contents

105904: LAW (Lightweight Aluminium Windings).....	21
105901 HiCap.....	22
43016: High Volume E-Machine Stack Manufacture.....	22
43784: MABEL – Optimising through Life Cost of Industrial Gas Processing.....	22
55544: Enhancing UK Engineering Skills to Drive the Low Carbon Economy.....	23
57574: Propulsion system to expedite the development of eVTOL technology.....	23
57890: Assessment of technical and commercial feasibility of a novel low-cost and ultra-efficient electric drive technology for Drone Delivery Systems.....	24
59007: Modular electric vehicle powertrain for small delivery vehicles – “e-power-arm”.....	24
61334: Immersion-cooled power components and modelling.....	25
63530: Design Development of an integration solution to utilise spare capacity in transport systems to provide local energy supplies in dense urban centres.....	25
66091: Additive Manufacturing for Electric Motors.....	26
77130: UK-Alumotor.....	26
75543: Industrialisation investigation for Wavedrives’ radical magnetically geared electric actuator.....	27
75557: PMD Rim Drive Propulsion Technology Manufacturing in the Marine Market.....	27
75678: RIFT 10-30 kW EV motor – Manufacturing Readiness and Supply Chain development (RIFT-MaRSC).....	28
75835: REAP – Rare-Earth Extraction from Audio Products.....	28
76003: M-PowerD – Manufacturing PSJ GaN Power Devices in the UK.....	29
76019: Improved Loss Modelling of SMC Components.....	29
76169: GaNSiC.....	30
76341: Development of Coil Winding and Magnet Assembly Manufacturing Processes for a Ferrite Based Permanent Magnet Generator.....	30
76399: SOCRATES – SilicOn Carbide tRAnsistor Trench process.....	31
77743: SiC-MAP.....	32
77777: Development of PEMD for Nuclear Coolant Systems.....	32
77801: Moto – Supply-chain Talent Accelerating Revolution (Moto-STAR).....	33
78366: CoolSync.....	33
78550: Recovery of Gallium from Ionic Liquids (ReGalL).....	34
78600: Design for manufacture of integrated e-hubs for agricultural vehicles.....	34
79321: Development of a PEMD supply chain for Off-Road vehicles.....	35
79839: WIND Electric Revolution (WINDER).....	35
80731: Trench Clustered Insulated Gate Bipolar Transistor Manufacturing Process Capacity and Productivity Improvement.....	36
81035: Conmotator: Advanced, Integrated Machines for Efficient Manufacture & Operation.....	36
81136: EV-Join.....	37

Welcome

2020 brought a significant change to the world in which we live. The impact of the Covid-19 pandemic resulted in changes to life as we know it and how we go about business. As a Challenge, we have responded in line with the needs of the community based on the significant number of conversations we had, changing competition plans, funding extra work and creating new community events that have become a staple in the weekly diary. Whilst this is great news that we have been able to serve in this way, it is the contributions, enthusiasm and true innovative ability of the UK community that has delivered results in such trying times – thank you.

Driving the Electric Revolution is delivering the objectives set out by the UK Government in relation to the Industrial Strategy Challenge Fund (ISCF). Overseen by UK Research and Innovation (UKRI), Driving the Electric Revolution is bringing together the UK's Power Electronics, Machines and Drives (PEMD) community in addition to establishing best in class industrialisation facilities. It must be understood that, although PEMD manufacturing is not new to the UK, technological and environmental disruptions will have an impact on existing markets as well as emerging companies.

In 2020 the UK Government, driven by the Prime Minister, published *The Ten Point Plan for a Green Industrial Revolution*¹: **Building back better, supporting green jobs, and accelerating our path to net zero.** This vision of the work needed to tackle climate change over the next decade provides a framework for funding decisions to be made from and provides a path to delivery on the UK's net zero commitments. Driving the Electric Revolution is tightly aligned to these ambitions through delivery of offshore wind, Electric Vehicles, Zero Emission Aviation and future energy vector deliver (nuclear & hydrogen). Building on this must be used to catalyse the fundamental net zero industry that is PEMD as we build back better after the Covid-19 pandemic that dominated 2020.

2020 posed many challenges to the world as a whole and the PEMD community is no exception. But businesses significant progress has been made in:

- Continued growth of engagement across all sectors and across the full technology range represented by the Challenge catalysed by the "Engage with..." webinars hosted by the Knowledge Transfer Network (KTN).
- Delivery of the "Accelerated Supply" collaborative research and development activities resulted in



14 projects involving 33 different partners and investment from UKRI of around £6.7 million.

- Delivery of the "Industrialisation Centres", a £33 million competition, with a winning consortium collecting most of the UK's PEMD community to deliver specific industrialisation equipment for the sector to complement existing open access facilities.
- In response to the Covid-19 outbreak the launch of "Catalysing Green Innovation: Advancing PEMD Supply Chain" collaborative research and development activities with investment from UKRI of up to £5 million for three to nine month projects with a total project cost of up to £500,000.

As we look forward to 2021, Covid-19 is still with us though light is visible with the deployment of vaccines and continual development in this space. I hope this year provides better opportunities for networking, growing this fantastic community and delivering on the Government's ambitions for net zero and robust and resilient UK supply chains in this hugely important area. 2021 also sees COP26 being hosted in Glasgow, Scotland where it will be chaired by the UK's Rt Hon Alok Sharma who has a huge role to play in bringing the world together to tackle climate change.

The time is now to work together across sectors, across industry, and research to deliver on the opportunity. We must make a difference to the world in which we live using the technology passionately invested in by the PEMD community that has the power to realise net zero hopes.

Will

Professor Will Drury
Challenge Director

1. <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>

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 from traditional internal combustion businesses into PEMD supply chains.

Funding

- During 2020 Driving the Electric Revolution invested around £45.7 million in funding of which around £12.7 million was invested in collaborative research and innovation projects.
- £33 million was invested in setting up the National Driving the Electric Revolution Industrialisation Centres (DER-IC). Awarded to Newcastle University with flow-down from them to a national collaboration of partners. This funding is reflected in the regional allocation shown in Figure 1.

Funding across the collaborative research and innovation projects has supported 31 SMEs across the UK with 36% of the Driving the Electric Revolution research and innovation funding being provided to Micro and Small companies.

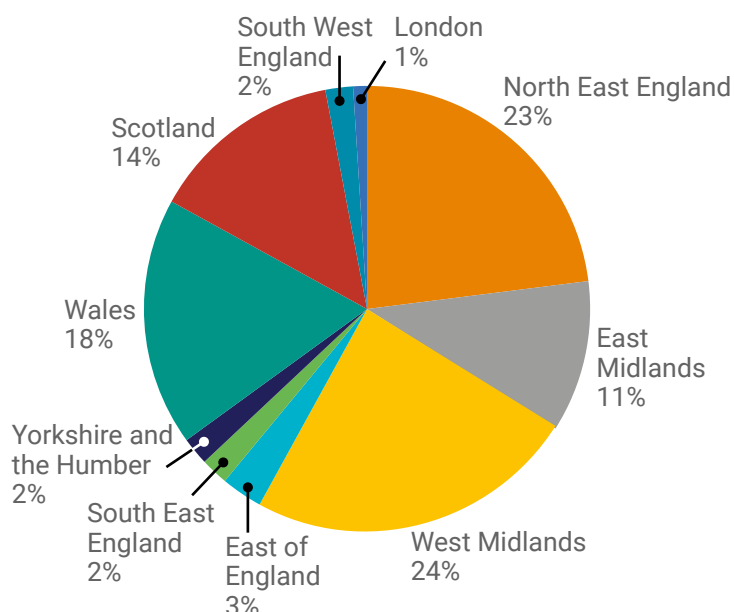


Figure 1

Organisation Type	Grant Award	% of Total Grant Award
Large	£1,895,469	15%
Medium	£3,211,720	25%
Micro/Small	£4,612,776	36%

76% of the Challenge's collaborative Research & Innovation funding has been allocated to industrial partners, 11% to Research Technology Organisation (RTOs) and 13% to Academic institutions. A breakdown of the funding allocated to each of these is shown in Figure 2 below.

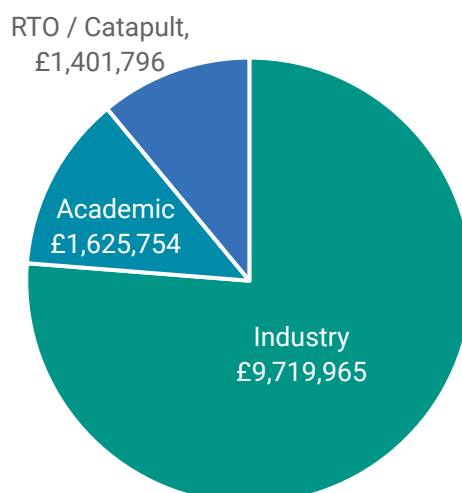


Figure 2

The collaborative Research and Innovation projects funded to date have an average of 2.6 partners per project.

Total Funded Projects	Total number of Participants	Average number of Partners per Project
40	104	2.6

Collaborative Research & Innovation

Overview

- Driving the Electric Revolution has committed funding from three separate competitions:
 - Accelerated Component Supply Chain Development
 - Catalysing Green Innovation
 - Business-Led Innovation in Response to Global Disruption
- In 2020 Driving the Electric Revolution committed £12.7 million of funding to highly innovative and collaborative projects in the PEMD space.
- Full project details can be found on <https://gtr.ukri.org/> or [downloaded here](#).

The Driving the Electric Revolution Challenge was able to fund seven high scoring but unfunded project applications from Innovate UK's ***business-led innovation in response to global disruption*** competition. These projects, all less than £50,000 and to be completed within seven months, covered a broad range of PEMD technologies and applications.

A list of all the projects funded is available at [Annex 1](#).





“The funding **Driving the Electric Revolution** made available in 2020 enabled the CSA Catapult to focus on supporting eight UK SMEs across seven separate proposals with a total project value of £3.4 million. In the **Catalysing Green Innovation** competition, if all the projects we support are successful, this would leverage around £2.5 million public sector funding of SME R&D projects within the next calendar year. **Driving the Electric Revolution** has been vital in allowing us to help a number of SMEs access short-notice research funding programmes providing immediate support to help them through the Covid-19 pandemic.”

Martin McHugh
CEO, CSA Catapult

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 outreach.

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.

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 UKRI in September 2019 from a large public sector organisation in the Thames Valley and Hampshire area. During this period Lorna worked primarily on 'digital transformation projects – enabling business with IT'.

Lorna is a proactive Equality, Diversity & Inclusion (ED&I) Advocate. She acts as team representative at events within Innovate/UKRI and external events. Lorna is a member of the BEIS Project Delivery Network and UKRI Employee Engagement Working Group.



Sennaya O'Connor
Project Support Analyst

Sennaya joined UKRI in March 2020 from working previously for The Department for International Trade (DIT) in London. During her time at DIT, she worked within the Digital, Data and Technology area where she began her career in Project Management.





Katy Sutherland
Impact & Performance Manager

Katy Sutherland is Impact & Performance Manager for the Driving the Electric Revolution Challenge and is an active ED&I Advocate member within the UKRI working group.

Born and raised in Inverness, Scotland, she started a career in finance obtaining a first-class honours degree at Edinburgh Napier University. Katy recently qualified as a Chartered Certified Accountant with the Association of Chartered Certified Accountants (ACCA). Previously undertaking finance roles, Katy most recently worked at global investment bank Morgan Stanley before joining the world of engineering with the Driving the Electric Revolution Challenge in May 2020.

Katy has always been a champion for equality, diversity, and inclusion – receiving double prize recognition at her 2014 graduation for her dissertation discussing the ‘glass ceiling’ in the finance sector.



Martyn Cherrington
Innovation Lead

Martyn joined Innovate UK in 2017 and the Driving the Electric Revolution team in 2019. 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.



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. Prior to 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.

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.

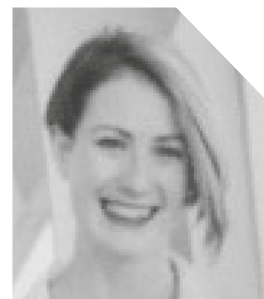
Hristo holds a master’s degree in international Banking & Finance, as well as an Advanced Diploma in Accounting and Business from the Association of Chartered Certified Accountants (ACCA) and is currently sitting final exams to become a member of the association.



Dawn MacGregor
Communications Business Partner

Dawn joined UKRI in June 2020 as a Senior Communications Manager for the ISCF where she 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.



Programme Board

The Programme Board provides a key component of the ISCF Programme governance and assurance structure. The Board supports and makes recommendations to the Challenge Director, the ISCF Steering Board, and UKRI, on matters of



Dr Ian Campbell
Senior Responsible Officer

Until his departure from Innovate UK in November 2020 Ian was the Programme Board Chair and acted with the full authority of the Delivery Partners. He was accountable for the challenge programme, in decisions overarching delivery, including strategic and tactical, financial and non-

financial, within delegated authority. He was also the Interim Executive Chair for Innovate UK: the operational head of the organisation, responsible for driving the UK's technology and innovation strategy.



Guy Woolley
ISCF Governance Director

Guy 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, and then Director for Major Programmes Governance at Innovate UK.



Dr Samantha Francis
EPSRC Representative

Samantha is a Deputy Director for the Research Base for Engineering and Physical Sciences Research Council (EPSRC). Responsibilities include leadership in Engineering, ICT, Managing the Portfolio and Research Infrastructure portfolios.



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 Queen's Awards for industry.

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.

Ashley Roberts OBE²
BEIS Representative

Ashley was head of automotive innovation and technology policy in the Department for Business, Energy and Industrial Strategy, and a member of the Automotive Council. He played an active role in developing the Government business cases for Driving the Electric Revolution.



Nigel Pargiter
BEIS Representative

Nigel is Acting Deputy Director for the automotive sector at the Department for Business Energy and Industrial Strategy. 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.



Mark Scully
External Board Member

Mark is responsible for leading on the Aerospace Technology Institute technology strategy for advanced systems and propulsion. Mark has held several positions in aerospace but also in automotive and energy sectors.



2. Ashley Roberts was in post January to July 2020. Tony Pedrotti succeeded Ashley Roberts on an interim basis July to November 2020. Nigel Pargiter succeeded Tony Pedrotti on a permanent basis from November 2020.

Advisory Group

External Advisory Group members as at December 2020

- Philippa Oldham – Co-chair
- Dr Graham Bruce – Co-chair
- Guy Blundell
- Professor Matt Boyle OBE
- Professor Bill Drury
- Dr Derrick Holliday
- Paul Jarvie
- Professor Geraint Jewell
- Professor Mark Johnson
- Dr Steve Lambert
- Will Leonard
- Phil McGoldrick
- Professor Barrie Mecrow
- Professor Nigel Schofield
- Mark Scully
- Professor James Widmer
- Dr Tom Wildsmith
- Professor Jan Godsell
- Sarah Mlundira
- Dr Felix Langley
- Vicki Edmonds

Knowledge Transfer Network (KTN) Partners



Dr Paul Huggett

Knowledge Transfer Manager (KTM) – Electronics

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.



Dr Sven Knowles

KTM – Electronics Systems

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.



Simon Buckley

KTM, Low Emission Mobility

Simon is the KTM for Low Emission Mobility. He has ten years of experience in developing electric and hybrid vehicle technology and energy storage systems.

Natasha Sim

Events Manager

Natasha organises all KTN events within the Built Environment, Energy and Transport communities. Natasha holds a Professional Diploma from the Chartered Institute of Marketing.



Raluca Ionescu

Marketing Manager

Raluca is a first-class graduate and is passionate about developing effective social media strategies, increasing brand awareness and working in challenging but collaborative environments.



Knowledge Transfer Network (KTN) Partners

The role of KTN

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.

Other clients include the Department for Digital, Culture, Media and Sport (DCMS), Department for International Trade (DIT), Ministry of Defence (MOD), Department for Business Energy and Industrial Strategy (BEIS), and the Foreign, Commonwealth and Development Office (FCDO).

KTN exists to connect **innovators** with new **partners** and new **opportunities** beyond their existing thinking - accelerating ambitious ideas into real-world **solutions**. KTN connects ideas, people and communities to **drive innovation that changes lives**.

With 200 staff across the UK, deep technical sector expertise, and over 43,000 organisations in its network, KTN are specialists in creating critical mass by convening innovation communities and traversing traditional sector boundaries to bring together innovation communities. 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.

Industrialisation Centres



The Driving the Electric Revolution Industrialisation Centres (DER-IC)⁴ are playing a vital role in bringing together a UK-wide network of over 30 academic, research and technology organisations. The network gives businesses the opportunity to develop manufacturing process technologies and industrialise the processes needed for PEMD scale up, whilst reducing risk by sharing expertise, technical advice and facilities.

Led by Newcastle University, four regional Centres in Scotland, the South West & Wales, the North East, and the Midlands will coordinate and build on the UK's national capability to deliver long term sustainable growth on the road to net zero. Together they will help businesses scale up the use of electric-powered vehicles and machines across a range of industries and transport systems to grow the UK supply chain.

The £28.5 million investment in new equipment will help develop existing centres and fill gaps in the UK's current capability. The investment will enable a competitive electrification supply chain to be built across sectors, including industrial, transport and energy. Procurement of the equipment will start in early 2021.

The new equipment consists of:

- a high power integrated electrical propulsion and powertrain accelerator at the Power Networks Demonstration Centre, University of Strathclyde.
- assembly lines for power electronics and electrical machines at the North East Innovation Centre, Sunderland.
- a high frequency coil manufacturing and magnetic test facility at the University of Nottingham.
- a power electronics reliability and failure analysis facility and an electrical machines winding centre of excellence at the University of Warwick.
- a wide band gap power electronics component industrial pilot line at Swansea University.
- a production line for recycled sintered magnets at the University of Birmingham.
- a prototype facility for ceramic and copper elements and subassemblies for integrated modules at the Compound Semiconductor Applications Catapult in Newport.

Communications and Engagement

The past year has seen the Driving the Electric Revolution community grow from 645 members in October 2019 to over 1,700 members and interest in the community remains strong. KTN has proved vital in attracting new entrants to the community and connecting businesses.

KTN support for Driving the Electric Revolution

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. Throughout 2020 KTN has extensively supported the Driving the Electric Revolution challenge by:

- Enabling 33 webinars for Driving the Electric Revolution to take place.
- Facilitating over 600 questions to presenting organisations.
- Making 100 introductions to presenting organisations.

4. <https://www.der-ic.org.uk/>

Information Provision

KTN has promoted and provided information about the Driving the Electric Revolution challenge to a targeted network of more than 2,400 unique PEMD focused individuals. This has included KTN's provision of:

- Direct community support for consortium building, collaborations, and assistance in project development.
- Taking all planned live events online, holding the weekly 'Engage with...' webinar series.
- Recordings and presentations from historic 'Engage With...' webinars.
- Provision of information about the Driving the Electric Revolution challenge to a targeted network of PEMD focused unique individuals.
- Driving the Electric Revolution Challenge newsletters.
- Driving the Electric Revolution Landing pages
 - www.ktn-uk.org/electronics/der-iscf-challenge/
 - www.ukri.org/our-work/our-main-funds/industrial-strategy-challenge-fund/future-of-mobility/driving-the-electric-revolution-challenge

The “Engage With...” series

KTN adopted an early Covid-19 mitigation strategy by taking all planned live events online and developed the weekly Engage with... webinar series to give leading companies a platform to present their:

- route to net zero
- PEMD journeys
- research activities
- technological challenges
- future supply chain requirements
- exploration of future opportunities for partnerships and collaborations

Feedback from these events has been positive with one participant commenting

“The ‘Engage With... series’ has been outstanding... it is obvious from the questions and feedback that they are very much worthwhile. I have learnt a lot from attending especially from the organisations in the PEMD supply chain that I know we will be following up”.

The “Engage With...” webinar series has remained popular with over 1,000 people taking part since they began in April 2020. The series attracts a diverse range of speakers with Belcan Engineering, ZeroAvia, Rolls-Royce and Agri Lincoln just some of the firms taking part.

Other activities

Other activities delivered by KTN that supported the Driving the Electric Revolution throughout 2020 included:

- **11 Feb** – Low Value, High Volume Competition CR&D Scoping Workshops in Derby
- **02 Apr** – Introduction to the Industrialisation Centres
- **30 Apr** – Covid-19 Impact Survey
- **21 May** – Preview of Driving the Electric Revolution: Catalysing Green Innovation competition
- **16 Jun** – Briefing of Driving the Electric Revolution: Catalysing Green Innovation competition
- **27 Aug** – Engaging a Diverse Workforce for the Future webinar
- **14 Sep** – Driving the Electric Revolution Skills Selection

KTN also provided direct support to the community for consortium building, collaborations, and assistance in project development.

Showcasing the challenge

After problems with the launch of the CGI competition in March, the winner's announcement went smoothly with UKRI providing support on the organisation's website and through social media. The social media posts were seen over 35,000 times and over 200 people viewed the web story. The projects themselves also received good coverage in trade press, with the UK-ALUMOTOR consortium securing a piece in the Engineer.

Driving media outreach

Working with the communications agency MSQ enabled the challenge to significantly increase its media outreach in the second half of the year with coverage rising from 13 pieces in August 2020 to 50 by December 2020.

Challenge Benefits & Evaluation

The Challenge will directly deliver a wide range of benefits here in the UK in the years to come. 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.

One benefit has been the growth of the UK PEMD community as a result of the Driving the Electric Revolution 'Engage with' series. With almost 3,000 people taking part over the last 12 months, the challenge has enabled KTN to connect 100 firms that may not have previously considered working together. Despite a difficult year Driving the Electric Revolution has successfully built and virtually connected the PEMD community to start linking up the UK supply chain.

An overview of the expected Challenge benefits are below:

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.

These will be cross sector jobs based in PEMD supply chains serving all Challenge focus sectors. These jobs will range from machine operators earning £35,000 to doctorate research and development engineers earning £150,000 plus annually.

During a turbulent year, where many jobs were put at risk due to Covid-19, we were delighted to hear a Driving the Electric Revolution funded project was able to bring staff back from furlough because of the Challenge's investment.

Filling key 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.

That said, we have funded projects to create collaborative working partnerships and create value chains that we previously unfeasible. The network outreach has provided visibility for many SMEs and promoted partnership working by introduction.

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 will be heavily automotive, energy and maritime driven, because of earlier and less regulated adoption and is expected to exceed £450 billion globally. 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.

Wider/social impacts

Supporting the delivery of government policy to meet climate change targets and industrial growth, the Driving the Electric Revolution Challenge directly addresses the need to be able to manufacture the new products required to meet enacted legislation. Increased rate of modern technology introduction, simultaneous development of technology and manufacturing process increasing 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 vehicle to enable governmental goals. PEMD exposure has become more readily recognised and is earning its well-deserved place in many reports, with its vital context in delivering climate change targets.

Funding projects

Work is now 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 will cover both financial and non-financial benefits including co-investment secured and job creation.

The Driving the Electric Revolution Challenge 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. Driving the Electric Revolution recognises the importance of the accountability of public spending and with that wants to celebrate project success and provide ongoing support during the funding period.

UKRI support

The ISCF Driving the Electric Revolution challenge is the UK government's most important intervention in the area of PEMD. Its success will not only secure supply chains and bring innovation into PEMD, but it will play a key role in enabling the UK to deliver against its aspirational net zero targets.

World-leading innovation needs to be driven by a world-class research base. Universities, through their collaborative business partnerships, have increasingly strong ambitions to rapidly translate their research into technologies that translate into industrial growth. Driving the Electric Revolution has an important role to encourage and enable this translation to happen faster, cheaper and more efficiently. Now that the challenge is well-established it has been very proactive to recognise the research excellence that universities have in fundamental science and engineering knowledge, research and skills in power electronics, drive systems, electrical machines and manufacturing to support innovation and build the foundations of supply chains.

Decades of government investment through the Engineering and Physical Sciences Research Council has helped to secure the UK's position as an academic leader in the field of PEMD – this has most recently been focussed on large critical mass centres, such as the Centre for Power Electronics hosted at University of Nottingham, the

Future Electrical Machines Manufacturing hub at University of Sheffield and the Centre for Doctoral Training in Sustainable Electrical Propulsion at Newcastle University. Driving the Electric Revolution is constructively harnessing the UK's world-leading academic research capability and enabling effective collaboration with industry through the Industrialisation Centres, which involve 21 universities with the network being led by Newcastle University. In 2020, Driving the Electric Revolution has also been proactive in pushing forward a PEMD skills agenda, by developing the entrepreneurial and business skills required for industry to collaborate with universities (and vice versa) that can ultimately benefit a diverse range of sectors from energy, agriculture, transport.

Over the past year we have seen how vital collaborative research and innovation can be to tackle real-world problems (such as Covid-19) and Driving the Electric Revolution is proactively engineering a solution to our net zero ambitions through translating academic excellence towards industrial innovation in PEMD.

Dr Andy Lawrence
Head of Engineering | Engineering and Physical Sciences Research Council

Equality, Diversity & Inclusion

As a Challenge we are passionate about embedding Equality, Diversity & Inclusion (ED&I) in everything we do and leading by example. Katy and Lorna both sit on the ED&I Advocate Working Group at Innovate UK and actively promote the importance of ED&I, ensuring it is considered at all stages of our Challenge outreach.

This year we committed to acting in an ethical manner, with integrity and transparency in both our business and personal dealings. Only by making this commitment and taking our responsibility seriously can we collectively use our influence and embed real change. The team has received high praise for their proactive ED&I approach and the impact they are having through successful engagement, acting as a lead for other Challenges.

A member of the Innovate UK ED&I Team commented *"Driving the Electric Revolution has been a proactive Challenge team in the ED&I agenda. From the Challenge Director to the entirety of the Challenge Team, ED&I has been a focus for all. I have had the pleasure of working with the Advocates in the Challenge who have been generous with their support and learnings to the wider advocate group. They have been an inspiration for other Challenges."*

Making a difference

We are contesting the norm and doing things differently here at Driving the Electric Revolution. As a team we feel so strongly about ED&I that, in August 2020, we delivered a webinar titled *"Engaging a Diverse Workforce for the Future"*. Focusing on ED&I and future talent discovery, the session was recorded and is available to [watch on YouTube](#).

The webinar prompted significant feedback and requests for follow on events, which we are looking at hosting. One attendee commented *"I've sooo appreciated the workshop this afternoon. It's ignited something in me I thought I'd lost!"*.

Speaking up

We realise discussing the topic of ED&I often feels uncomfortable because of a fear of saying the "wrong" thing. People might think it easier not to raise their concerns or challenge inappropriate language or treatment. But the truth is that ED&I conversations should to an extent be just that – challenging. It is everyone's responsibility to advocate and implement effective stewardship and responsibility supporting inclusive, collaborative, and creative environments.

In October 2020 [Will and Katy wrote an ED&I blog post](#) where they discussed what ED&I means to Driving the Electric Revolution and how it aims to make ED&I business as usual. The blog received positive feedback and promoted interest from fellow ISCF Challenges.

We are proud of our ED&I achievements during the year, but we have more work to do and appreciate this is an ongoing activity.

Annex 1

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

Description

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

The project extends 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 will be commissioned, followed by virtual and experimental validation.

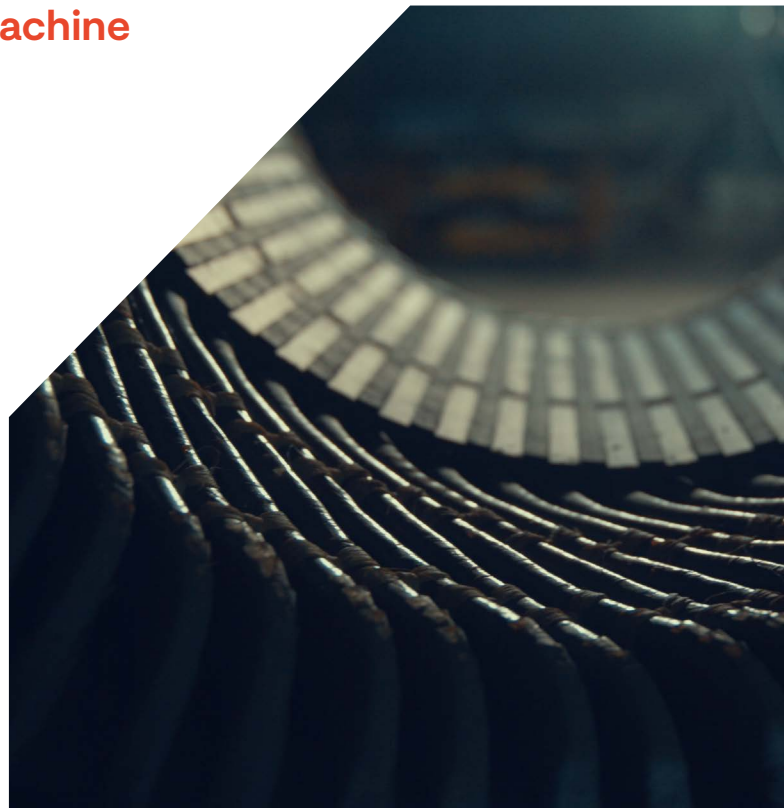
Funding & project size

Total project cost: £1,753,936

Driving the Electric Revolution Funding: £831,876

Consortia members

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



105894: High-T Hall

Description

Demonstration of an advanced Hall sensor, based on 2D graphene technology, for PEMD providing a bespoke packaging solution for an initial focus on the aerospace sector.

The focus is on Hall sensors, operating in high temperature environments, to accurately measure current to enable precise control electric motors and generators therefore increasing their operating efficiency.

Funding & project size

Total project costs: £1,273,559

Driving the Electric Revolution Funding: £629,159

Consortia members

- Paragraf Ltd
- Compound Semiconductor Applications Catapult Limited, Cardiff
- Rolls-Royce plc, United Kingdom
- TT-Aero Stanrew Limited

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

Description

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

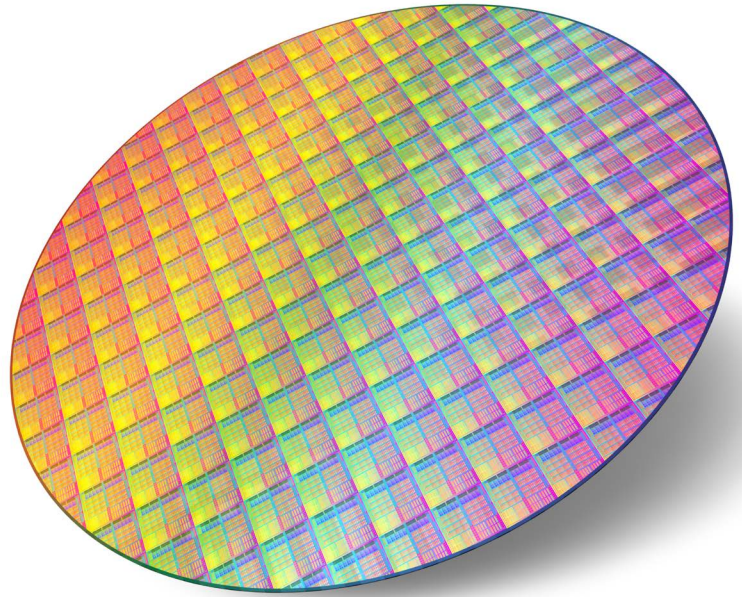
The complementary capabilities of the two industrial partners provide a route for a cost competitive, 200mm (8") Wide Band Gap (WBG) power electronics capability that can scale to meet the growing demands of the UK PEMD supply chain for WBG materials.

The process optimisation will be undertaken at Bristol University, with implementation and wafer mapping at NWF 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 & project size

Total project costs: £988,283

Driving the Electric Revolution Funding: £476,852



Consortia members

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

105896: Automated Dynamic Testing of Magtec Power Controllers

Description

The research project is developing radical innovation to improve the test process capability for electrical power controllers (drives). Delivery of robust solutions to adapt drives through data acquisition and feedback approaches into product design, developing predictive modelling and enabling scale up of production activity.

The partners are developing 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 (primarily aerospace and automotive) to significantly improve drive lifespan and efficiency for robust applications into primary and new market opportunities.

Funding & project size

Total project costs: £1,431,213

Driving the Electric Revolution Funding: £715,607

Consortia members

- Magnetic Systems Technology Limited, Sheffield
- Tioga Limited

105900: Integrated Optical Sensor IGBT Module

Description

This project is creating a new supply chain integrating optical sensing technology into the manufacturing processes for high voltage high power IGBT modules.

This project will realise a novel manufacturing method and a new supply chain to allow the integration of optical temperature sensors into high power high voltage IGBT modules to enable direct measurement of the individual component temperatures. Being based on actual temperature measurements, this will enable higher power energy efficiency in the system and longer operating life from the power modules”

Funding & project size

Total project costs: £388,234

Driving the Electric Revolution Funding: £194,067

Consortia members

- Dynex Semiconductor Limited, Lincoln
- 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 have a novel, patented, method for mounting several, small standard transistors onto heatsink plates that are immersed in a flow of liquid coolant. This project aims to improve power density and reduce controller weight still further by improving the thermal and transient electrical performance of this technology. The target for this project is to devise a transistor mounting method that will permit a complete 250kW motor controller with a power density of 100kW/l.

Funding & project size

Total project costs: £199,877

Driving the Electric Revolution Funding: £98,862

Consortia members

- YASA Limited, Kidlington
- Compound Semiconductor Applications Catapult Limited, Cardiff

105902: QUIET – Quietness Understanding in E-drive Technology

Description

This project, involving a partnership of ZF and Romax, seeks to test and develop simulation software that enables a “digital twin” approach with increased use of simulation as part of a design process is needed to identify potential e-NVH problems earlier this ambition to be realised.

There exists, in many market sectors, an increasing demand for lower audible noise and vibration (low noise, vibration and harshness - NVH) from electric drives. A successful project outcome will close a gap in the current UK motor supply chain - that of design-stage e-NVH analysis simulation software, for which the current players are all non-UK based.

Funding & project size

Total project costs: £997,352

Driving the Electric Revolution Funding: £498,676

Consortia members

- ZF, Solihull, United Kingdom
- Romax Technology Ltd., Nottingham

105903: STREAMLINED

Description

The advantage of high power density machines (achieved via increased speed) is the reduction of system weight for a given magnitude of power conversion, allowing compact designs. The UK has positioned itself as a leader in high power density traction motor design and development for vehicle propulsion. In order to reduce the size of these motors whilst increasing the speed and hence power density of the motors, composite elements and novel assembly processes are employed to meet the performance requirements.

These very high power density motors have typically been geared to niche, development volume applications. Demand for these technologies is increasing as the technology is adopted more widely, however there is currently no supply chain within the UK capable of meeting the required volumes efficiently and competitively. Existing supply chains are only capable of delivering low volumes of the required technologies, or high volumes of conventional, lower specification rotors.

The innovation within this project is the upscaling and adaptation of current production technologies to develop a flexible manufacturing process capable of manufacturing high speed permanent magnet radial rotors with composite sleeves, and composite axial rotor plates. The project will review and identify the most feasible solutions for all process steps, from initial machining of rotor shafts, assembly and grinding of the magnets, manufacture of the composite sleeves (radial rotors) or composite rotors (axial rotors), to final assembly and balancing.

Funding & project size

Total project costs: £714,693

Driving the Electric Revolution Funding: £355,277

Consortia members

- Lentus Composites
- National Composites Centre

105904: LAW (Lightweight Aluminium Windings)

Description

The partners are developing a winding machine for aluminium wires. The winding machine will be developed and provide 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 will develop the reduction in weight of e-Machines by 15%

without compromising performance by developing manufacturing processes for winding coils from alternative material.

Funding & project size

Total project costs: £659,734

Driving the Electric Revolution Funding: £326,857

Consortia members

- Aspire Engineering Limited, Taunton
- University of Warwick, United Kingdom
- Dana TM4 UK Ltd, Devon
- Hydro Aluminium Rolled Products Limited

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 thus, must be viable to economically manufacture in short lead times for low to medium volumes.

Funding & project size

Total project cost: £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 is closing 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 is improving 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 & project size

Total project costs: £ £897,796

Driving the Electric Revolution Funding: £445,517

Consortia members

- C.Brandauer & Co. Limited
- University of Warwick, United Kingdom

43784: MABEL – Optimising through Life Cost of Industrial Gas Processing

Description

MABEL is identifying and demonstrating innovations in electrical machine system design that can advance both 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 24/7 running of gas processing equipment is undertaken. Considering all aspects of the system including magnetic, mechanical, control system and power electronic design will enable an approach that optimises through life cost, opening up further market sectors for targeted exploitation.

Funding & project size

Total project cost: £966,567

Driving the Electric Revolution Funding: £679,518

Consortia members

- Turbo Power Systems Limited, Gateshead
- Newcastle University, United Kingdom



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

Description

Key to the UK being a world player in the PEMD industry is ensuring we have a workforce which is highly skilled in the areas of electronic power conversion and energy management. This project provided free and highly focused online technical training to employees of UK companies who wish to up-skill in power electronics. This project is aimed at maximising the use of time for employees to up-skill whilst they are required 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.

Funding & project size

Driving the Electric Revolution Funding: £49,722

Company 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 removes barriers and expedites 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. The most competitive solution will be selected and specified in detail.

Funding & project size

Driving the Electric Revolution Funding: £49,267

Company 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 as enabling technologies for the current and future of the Drone Package Delivery market with huge market growth anticipated by 2030. Camvertec has developed a novel drive technology with brushless operation and a fractionally rated converter, providing a robust, low-cost and low-maintenance drive solution, cutting the overall capital cost by 35-35%. 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. This project will scale 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 & project size

Driving the Electric Revolution Funding: £48,796

Company involved

- Camvertec Limited, Cambridge

59007: Modular electric vehicle powertrain for small delivery vehicles – “e-power-arm”

Description

This project is to perform design feasibility on simplifying the powertrain for lightweight Electric Vehicles. The aim is to create a power pack housed within the suspension arm of the vehicle, which we have titled “e-power-arm”. The objective is 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. The growth of home deliveries is already a trend, and the recent change in shopping habits will further enhance this sector, however it needs to clean its act up and stop using large delivery vehicles, by being offered a range of alternatives.



Funding & project size

Driving the Electric Revolution Funding: £41,490

Company involved

- Nedra Limited, Birmingham

61334: Immersion-cooled power components and modelling

Description

This project is 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 (HPC) systems into the mainstream.

Funding & project size

Driving the Electric Revolution Funding: £50,000

Company 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 is to develop product that safely connects electrically powered rail transport systems (DC traction) and electric road vehicles (EV), solar panels (PV). The application of our product would allow Transport Authorities, Rail Operators, Network Rail and Light Rail Operators the opportunity to reducing operational costs and provide infrastructure in support of the rise in demand for EVs.

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

Funding & project size

Driving the Electric Revolution Funding: £48,069

Company involved

- Power Supply Projects Ltd



66091: Additive Manufacturing for Electric Motors

Description

Design of the motors must consider the manufacturing methods available from the start, limiting the design choices available. Using Additive Manufacturing (AM) to produce these windings creates opportunities to rapidly prototype these 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.

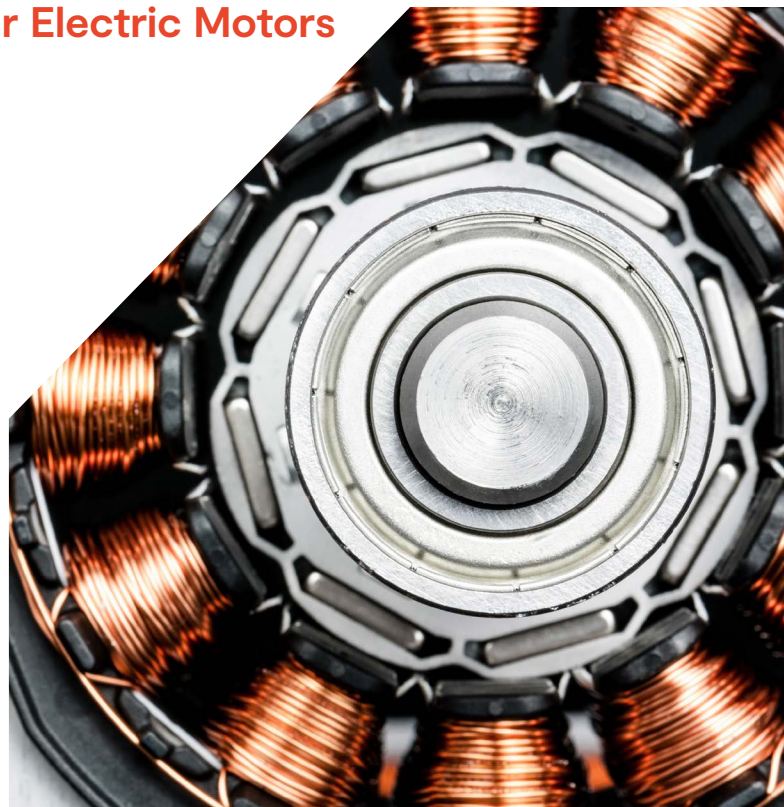
This project concentrated on manufacturing individual conductors which will then be connected to printed circuit board (PCB) end windings. High frequency motors require “litz” wire to produce low resistance windings at these high AC frequencies. This project will attempt to build “litz” wire with AM methods allowing for high copper densities within the motor whilst maintaining the benefits of using multiple small conductors to make up a larger conductor.

Funding & project size

Driving the Electric Revolution Funding: £47,314

Company involved

- Technelec Limited, Oakham



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 & project size

Total project costs: £497,790

Driving the Electric Revolution Funding: £331,743

Consortia members

- Ricardo UK Limited, United Kingdom
- C.Brandauer & Co. Limited
- Phoenix Scientific Industries Limited, East Sussex
- University of Warwick, United Kingdom
- Aspire Engineering Limited, Taunton
- Global Technologies Racing Limited

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

Description

WaveDrives has developed electric actuation technology, motivated by two decades' experience developing commercial robots and powered prosthetics. Inspired by the structure and performance of human muscle, their Sarcomere Inspired Linear Actuator (SILA), is more controllable and efficient than comparable technologies because its contactless transmission has no energy wasted due to friction.

In this project, WaveDrives and an interdisciplinary team from the University of Bristol have combined to industrialise SILA manufacture. The project will accelerate SILA industrialisation, seeding new avenues of scientific research and informing research-based education at the University of Bristol and provide knowhow on automation methods for potential UK exploitation in other high-tech magnetics applications. The project lies at the heart of establishing the UK as "a global leader in the manufacture of core technologies which underpin electrification".



Funding & project size

Total project cost: £224,751

Driving the Electric Revolution Funding: £176,205

Consortia members

- Wavedrives Ltd
- University of Bristol, United Kingdom

75557: PMD Rim Drive Propulsion Technology Manufacturing in the Marine Market

Description

Marine propulsion is a multi-billion pound industry undergoing a rapid change from direct drive diesel and petrol to electric. To support this change there is an urgent need for innovative electric propulsion systems. The technology that RAD has developed is safer (no external rotating blades), more robust to becoming entangled with debris and has minimal moving parts. Reducing product and manufacturing complexity and costs are critical if such a product is to fill this current gap in the marine UK PEMD market.

The team will target significantly reducing Bill Of Material (BOM) costs, improving manufacturability and enabling early life product monitoring of the PEMD element of the marine rim-drive hubless propulsion system. The work in this project is focusing on the <50kW market sector.

Funding & project size

Total project costs: £493,018

Driving the Electric Revolution Funding: £358,724

Consortia members

- Rad Propulsion Ltd
- Inetic Limited, Andover
- NCC Operations Limited, Emersons Green

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

Description

The RIFT 10-30 kW integrated machine and power electronics (RIFT-10) is an innovative approach to an ultra-efficient Electric Vehicle (EV) motor, bringing forward a unique range of advantages including: significant weight reduction (circa 50%); lower cost; plus other features that results 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 (DfM) advancements, reshoring the supply chain, and advancing the UK production capacity to be able to produce 300 units p.a. at a low production unit cost.

Funding & project size

Total project cost: £361,763

Driving the Electric Revolution Funding: £278,188

Consortia members

- Rift Technology Limited, Malvern
- University of Warwick, United Kingdom



75835: REAP – Rare-Earth Extraction from Audio Products

Description

Rare earth magnets based upon neodymium iron boron (NdFeB) are a key material in electric vehicles where they are used in drive motors, generators, power steering and in loudspeakers. Recycling of rare earth magnets presents a significant opportunity and REAP (Rare-Earth Extraction from Audio Products) aims to develop a recycling supply chain for the loudspeaker market. REAP will investigate ways of liberating rare earth magnets from automotive and consumer audio modules.

The quality, quantity, availability and value of the scrap will be determined for speakers from various sources and a calculation of value added to the scrap will be made. The short loop recycling processes which are being developed by Hypromag Ltd will have a significant environmental benefit compared to primary production of magnets.

Funding & project size

Total project costs: £256,144

Driving the Electric Revolution Funding: £174,745

Consortia members

- Hypromag Ltd, Tarporley
- European Metal Recycling Limited, Warrington
- University of Birmingham, United Kingdom

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

Description

This is a project builds capability in the UK to manufacture the world's first, low cost, high voltage GaN power transistors. The project aims to develop 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 & project size

Total project costs: £488,798

Driving the Electric Revolution Funding: £379,849

Consortia members

- Inex Microtechnology Limited, Newcastle Upon Tyne
- Compound Semiconductor Applications Catapult Limited, Cardiff
- University of Sheffield, United Kingdom



76019: Improved Loss Modelling of SMC Components

Description

Soft Magnetic Composite (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 thus 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 in order to provide a flexible loss prediction method. This will allow 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 & project size

Total project costs: £238,367

Driving the Electric Revolution Funding: £170,586

Consortia members

- SG Technologies Limited, Rainham
- Newcastle University, United Kingdom

76169: GaNSiC

Description

Project GaNSiC (Gallium Nitride Silicon Carbide) will develop a unique manufacturing process for electronic devices based on Compound Semiconductors (CS). Next-generation electronic devices will be based on technologies such as GaN and SiC which enable processing speeds up to 100x faster than silicon transistors.

GaNSiC will develop 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 CIL'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. It will enable 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.

Funding & project size

Total project costs: £287,644

Driving the Electric Revolution Funding: £206,934

Consortia members

- Custom Interconnect Limited
- Compound Semiconductor Applications Catapult Limited, Cardiff

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 has 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 key material, rare-earth magnets. GreenSpur, a Time To Act subsidiary, has 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 & project size

Total project costs: £499,999

Driving the Electric Revolution Funding: £365,865

Consortia members

- Time to Act Limited, Winchmore Hill
- University of Warwick, United Kingdom

76399: SOCRATES – SilicOn Carbide tRAnsistor Trench process

Description

SOCRATES will introduce 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 will define the critical semiconductor manufacturing processing steps required for introducing a disruptive SiC power MOSFET supply chain for automotive power electronics to the UK, aligned with the goals of the Driving the Electric Revolution initiative.

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 will revolutionise 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.

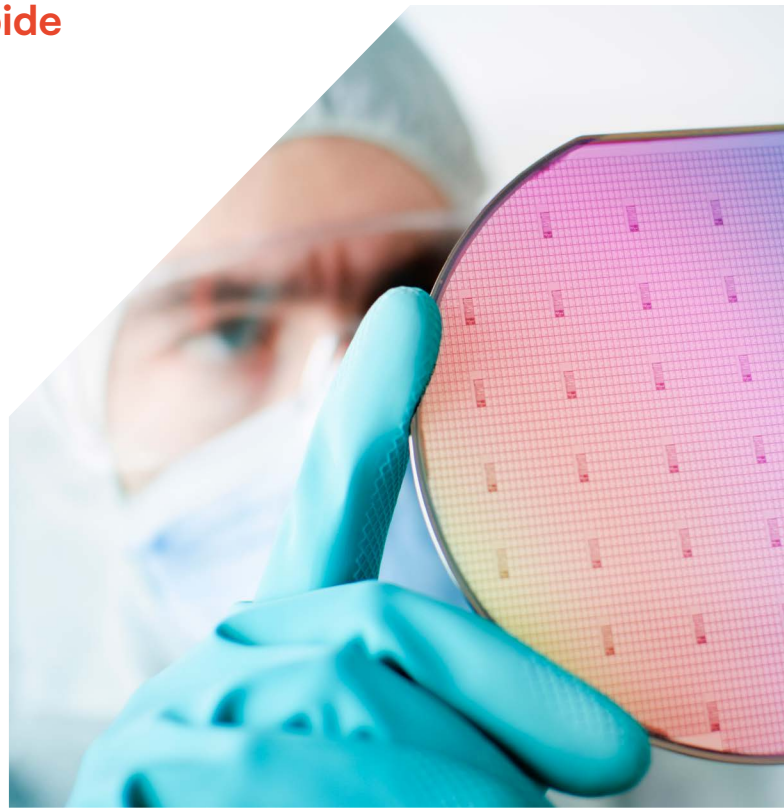
Funding & project size

Total project costs: £216,859

Driving the Electric Revolution Funding: £137,423

Consortia members

- SPTS Technologies Limited, Newport
- Swansea University, United Kingdom
- CS Connected Limited
- Newport Wafer Fab Ltd
- Compound Semiconductor Centre Limited, Cardiff



77743: SiC-MAP

Description

Silicon Carbide MOSFET Applications unlocked by PDK (SiC-MAP), takes a 1200V planar SiC MOSFET process and develops it further to include 1700V and 3300V capability. Once the 1700V and 3300V 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 1200V 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 (NPI).

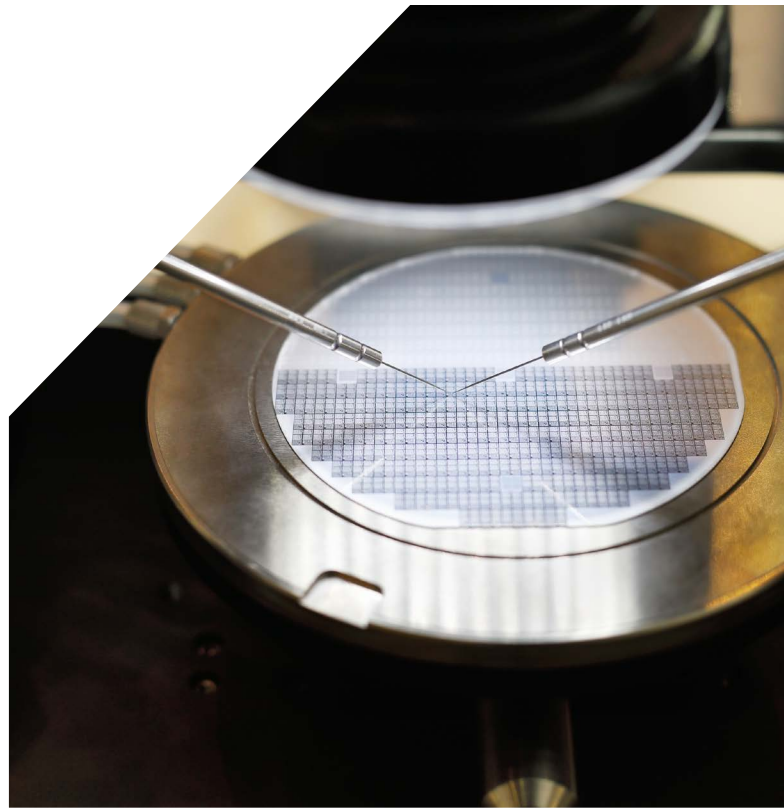
Funding & project size

Total project costs: £492,731

Driving the Electric Revolution Funding: £371,448

Consortia members

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



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 project includes 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 will support 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 & project size

Total project costs: £333,301

Driving the Electric Revolution Funding: £234,544

Consortia members

- Hayward Tyler Limited
- University of Sheffield, United Kingdom

77801: Moto – Supply-chain Talent Accelerating Revolution (Moto-STAR)

Description

As part of the automotive electrification challenge and industrial strategy, the potential advantages of electric two-wheeled vehicles – e-motorcycles and e-scooters – are well documented. The UK e-motorbike supply chain this project addresses is an emerging one: despite the existence of actual products and concepts, many aspects still remain to be addressed in the emerging supply chain for e-motorbikes. Through this project, the partnership seeks to develop a demonstration e-motorbike concept, based around a vision of a future supply chain. Based on aligned design and manufacturing processes that fully embrace the wider issues which are at the heart of Driving the Electric Revolution – sustainability, improved quality of life, and the future circular economy, both in the UK and beyond.

Funding & project size

Total project costs: £498,830

Driving the Electric Revolution Funding: £248,798

Consortia members

- ZF Automotive UK Limited
- University of Sheffield
- Romax Technology Ltd
- Royal Enfield UK Limited



78366: CoolSync

Description

This project is to develop an innovative GaN based rectifier cooling unit. For the data centre market, CoolSync offers energy and space savings on the datacentre floor (reduced costs) and an increase in power quality. The main technology objective is developing a solution demonstrating application understanding in UK PEMD supply chain to enable short-term commercial exploitation within approximately five years and to establish a robust foundation for longer term industrial engagement for a future generation of cooling techniques.

Funding & project size

Total project costs: £346,377

Driving the Electric Revolution Funding: £269,774

Consortia members

- Supply Design Limited, Rosyth
- Compound Semiconductor Applications Catapult Limited, Cardiff



78550: Recovery of Gallium from Ionic Liquids (ReGaIL)

Description

Recovery of Gallium from Ionic Liquids (ReGaIL) aims to develop a recovery process of Gallium from bulk sourced end-of-life (EoL) LEDs to supply the uptake of Gallium Nitride (GaN) semiconductors in power electronics, machines, and drives (PEMD).

The innovation is to create a circular sourced supply chain of Gallium in the UK. Building on established recycling methods and expanding it to encompass bulk sourced EoL LEDs. The recovered Gallium will then be used in new GaN transistors for PEMD, creating a sustainable supply chain, avoiding virgin mining, increasing the UK's supply chain resilience, and laying the foundation for establishing the EoL recycling process for PEMD.

Funding & project size

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

Rapid advances are being made in the world of agritech, which is itself driving demand for integrated electric hubs (e-hubs) to provide the speed, torque, efficiency and durability required. The project aims 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 will be available in a range of power outputs, and thus will facilitate scaling up and easy adoption by a multitude of vehicle and robot manufacturers.

The project will result in two power variants (at opposite ends of the power range) of the e-hub being manufactured. They will be dyno tested for efficiency and durability, then fitted to appropriate vehicles for preliminary confirmation of dyno results by means of agricultural field trials.

Funding & project size

Total project costs: £499,003

Driving the Electric Revolution Funding: £355,282

Consortia members

- Performance Projects Limited, Silverstone
- University of Lincoln, United Kingdom
- Printed Motor Works Limited
- Saga Robotics Limited
- Arwac Limited



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

Description

Perkins Engines Company Limited and the University of Nottingham are working together to improve capability in virtual process development (VPD) and virtual product validation of Power Electronics, Motors and Drives (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 & project size

Total project costs: £499,613

Driving the Electric Revolution Funding: £324,496

Consortia members

- Perkins Engines Company Limited, Peterborough
- University of Nottingham, United Kingdom

79839: WIND Electric Revolution (WINDER)

Description

This project is part of a plan to bring the manufacture of large generators for offshore wind to the UK. Magnomatics Pseudo Direct Drive (PDD(r)) combines a magnetic gear with a permanent magnet generator. The PDD is very efficient and very reliable with no meshing gear teeth.

Magnomatics will develop computer-based modelling software which can then be used to design robust PPRs including dynamic modelling of the pole piece loads to predict wear and possible erosion of the composite structure. These methods will be validated using the new test data from the ORE Catapult. A virtual product validation will be performed on concept designs ensuring the PPR

achieves the expected product lifetime of 25+ years. Wind turbine generator unit volumes could reach 800 units per annum therefore it would be essential to manufacture the PPR cost effectively. The AMRC, Sheffield, are providing input and support to Design for Manufacture of the PPR to achieve this.

Funding & project size

Total project costs: £468,882

Driving the Electric Revolution Funding: £363,460

Consortia members

- Magnomatics Limited, Sheffield, United Kingdom
- Offshore Renewable Energy Catapult

80731: Trench Clustered Insulated Gate Bipolar Transistor 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, 1700V Trench clustered IGBT (TCIGBT) manufacturing capability at Semefab in Fab 3 on 6 inch wafers. This will create a high current density, high performance component applicable to mainstream industrial drive, solar, wind farm and electric vehicle applications and create a platform for higher and lower voltage applications.

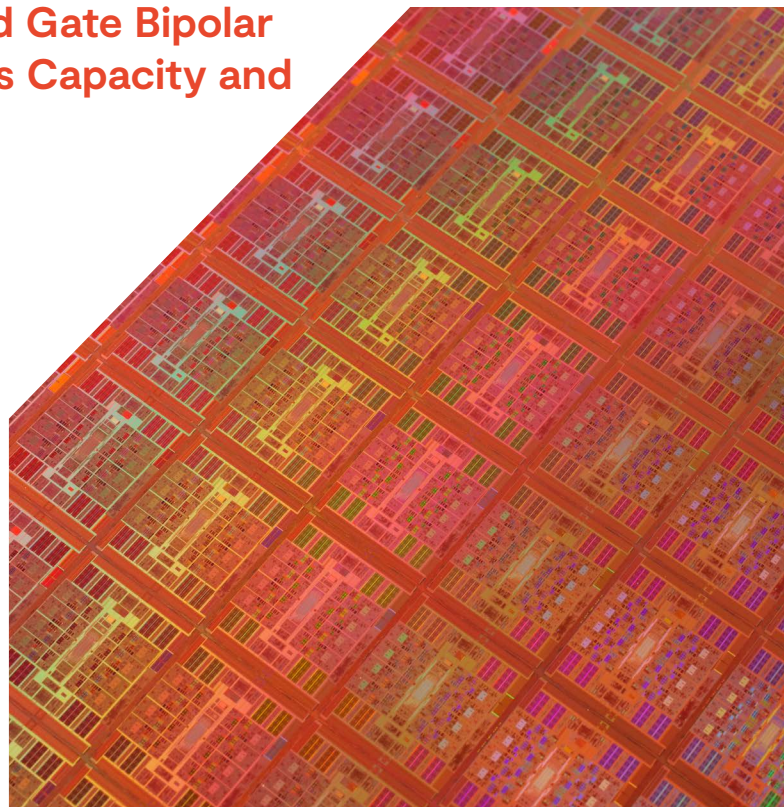
Funding & project size

Total project costs: £498,183

Driving the Electric Revolution Funding: £338,424

Consortia members

- Semefab Limited, Glenrothes
- University of Sheffield, United Kingdom
- Eco Semiconductors Limited, Leicester



81035: Conmotator: Advanced, Integrated Machines for Efficient Manufacture & Operation

Description

The 'Conmotator' project (combined convertor-motor to electronic commutator) project investigates and addresses the key 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 develops and tests 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 world class leader in this field.

Funding & project size

Total project costs: £300,213

Driving the Electric Revolution Funding: £195,107

Consortia members

- GE Energy Power Conversion UK Limited, Warwickshire
- University of Nottingham, United Kingdom

81136: EV-Join

Description

The EV-Join project will provide a user-friendly software tool that addresses major issues faced by companies developing 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 will enable reduced time-to-market, more efficient selection of joining process, increased productivity and reduction in repairs and scrap and reduced and potentially eliminated need for expensive and time-consuming post-weld Non-Destructive-Testing (NDT).

Funding & project size

Total project costs: £235,288

Driving the Electric Revolution Funding: £152,911

Consortia members

- Granta Design Limited, Cambridge
- The Welding Institute



UK Research
and Innovation

DER@innovateuk.ukri.org