

The logo for DER (Driving the Electric Revolution) features the letters 'D', 'E', and 'R' in a stylized, white, sans-serif font. Each letter is composed of horizontal bars of varying lengths, creating a digital or circuit-like appearance. The 'D' has a semi-circular pattern of bars on its right side, the 'E' has a similar pattern on its right side, and the 'R' has a semi-circular pattern on its top right side.

DER

Driving the Electric Revolution Industrialisation Centres

Accelerating Power Electronics, Machines and
Drives Supply Chain Capability and Growth



UK Research
and Innovation

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DER-IC: Our Vision and Mission

Our Vision

To promote global recognition of the UK as a centre of excellence in Power Electronics, Machines and Drives Manufacturing Processes.

Our Mission

To provide a UK network of open access facilities, growing world-class design, manufacturing, test and validation capabilities.

Our Sectors

We work across 10 sectors to facilitate cross-sector collaboration;



Our Funder

DER-IC is part of the £80m Driving the Electric Revolution Challenge at UK Research and Innovation (UKRI). UKRI invested £33m (including £28.5m of capital equipment) to create a UK-wide network of PEMD capability operating from regional centres in Scotland, North East, Midlands and South West & Wales, led by Newcastle University.



Open Access Facilities

DER-IC provides open access to £300m+ of existing PEMD manufacturing equipment across our partner organisations.

Our project has received funding of £28.5m to install new state-of-the-art equipment to fill gaps in the UK's manufacturing capabilities.

Collaboration

DER-IC is a network of around 30 University and Research and Technology Organisation (RTO) partners, located across the UK. Each of our partners has a range of capabilities, specialisms and equipment.

DER-IC will draw on the expertise of our partner Universities and RTOs to support industry in strengthening PEMD capability, capacity and competitiveness.

Supporting the UK's Net Zero Goals

DER-IC will support the UK's transition from the internal combustion engine to electrification, across 10 sectors. Our capabilities align with Government targets to meet 2050 net zero goals. We will support with growing, upskilling and reskilling PEMD engineering talent to meet industry needs.

DER-IC Partner Locations

- 1 Advanced Manufacturing Research Centre (AMRC) – University of Sheffield
- 2 Centre for Process Innovation (CPI)
- 3 Compound Semiconductor Applications Catapult
- 4 Coventry University
- 5 CScnected
- 6 Loughborough University
- 7 Manufacturing Technology Centre (MTC)
- 8 Michelin Scotland Innovation Parc (MSIP)
- 9 National Composites Centre (NCC)
- 10 National Manufacturing Institute Scotland (NMIS)
- 11 National Physical Laboratory (NPL)
- 12 Newcastle University
- 13 Northumbria University
- 14 Nuclear Advanced Manufacturing Research Centre (NAMRC)
- 15 Offshore Renewable Energy (ORE) Catapult
- 16 PNDC
- 17 Swansea University
- 18 Teesside University
- 19 The University of Warwick
- 20 The Welding Institute (TWI)
- 21 University College London
- 22 University of Birmingham
- 23 University of Edinburgh
- 24 University of Glasgow
- 25 University of Manchester
- 26 University of Nottingham
- 27 University of Southampton
- 28 University of St Andrews
- 29 University of Strathclyde
- 30 WMG at the University of Warwick

(Map shown as a rough guide only)



PEMD Network Partners

A key strength of DER-IC is its network of Universities and RTOs across the UK, and their existing PEMD capabilities. Find out more about the following network partners' equipment and areas of expertise.



4 Coventry University

With a proud tradition of teaching and learning, Coventry University's world-class research and innovation aims to address real world challenges. Its research into future transport solutions takes place in the birthplace of the British motor industry and at the heart of UK manufacturing.

Coventry University will support DER-IC through its Centre for Advanced Low-Carbon Propulsion Systems (C-ALPS) and Institute of Advanced Manufacturing Engineering (AME). C-ALPS brings together academic expertise and state-of-the-art facilities in battery and supercapacitor cells, hydrogen fuel cells, e-motors and drives. AME is award-winning and combines research and training activities in a unique 'Faculty on the Factory Floor' initiative with expertise in metrology, digital processes and laser joining.

- Propulsion development cells
- Pre-compliance EMC chamber
- Device characterisation stations
- Advanced manufacturing and materials



1 Advanced Manufacturing Research Centre (AMRC) - University of Sheffield

AMRC is a world-class centre for research into advanced manufacturing technologies used in the aerospace, automotive, medical and other high-value manufacturing sectors.

Combining state-of-the-art technologies with expertise in design and prototyping, machining, casting, welding, additive manufacturing, composites, robotics and automation, digital manufacturing and structural testing has created a manufacturing resource far beyond anything previously available in the UK.

- Remote laser cutting cell
- Robotic winding cell
- Robotic fibre winding facility



5 CSconnected

CSconnected is the collective brand for a growing number of advanced semiconductor related activities in Wales, home to a unique community of academic institutions, prototyping facilities and global, high-volume manufacturing capabilities that collaborate across a range of research and innovation programmes.

- Power semiconductor R&D
- Power semiconductor design and test
- Equipment and processes for manufacture of power semiconductor devices



2 Centre for Process Innovation (CPI)

Born in the North East of England in 2004, CPI is an independent deep tech innovation organisation and a founding member of the High Value Manufacturing Catapult.

- High throughput formulation and automation equipment
- Advanced characterisation facilities
- Batch and roll to roll coating capabilities in slot die and screen printing
- Materials synthesis capability including raw materials and ability to develop recycling processes



6 Loughborough University

Loughborough University (LU) is an international leader in High Value Manufacturing (HVM) research, with a leading-edge PEMD research portfolio in the areas of control systems, energy systems and advanced materials and manufacturing. It works closely with industry through funded research and exploitation of cutting-edge technologies across aerospace, energy, marine, rail and automotive industrial sectors.

- Ultrasonic assisted bonding systems
- Advanced auto-lab electrochemical station
- Helios G4 PFIB UxX DualBeam Microscope



3 Compound Semiconductor Applications Catapult

The Compound Semiconductor Applications (CSA) Catapult's purpose is to deliver long-term benefit to the UK economy and accelerate UK economic growth in industries where applying compound semiconductors creates a competitive advantage and enables new products or end markets. Its vision is for the UK to become a global leader in developing and commercialising new applications for compound semiconductors.

- Power Electronics Lab - Design and characterisation of high performance devices and modules
- RF and Microwave Lab - Supports development of leading edge products in multiple sectors
- Photonics Lab - Supporting customer breakthroughs in optical sensitivity and beam control
- Advanced Packaging Line - Leading-edge package design and development including thermal optimisation



7 Manufacturing Technology Centre (MTC)

MTC is an independent Research and Technology Organisation (RTO) with the objective of bridging the gap between academia and industry. It has a wide range of state-of-the-art capabilities covering component manufacturing technologies, laser processing, advanced tooling and fixturing, automation, digital manufacturing and business transformation. These capabilities, coupled with teams of researchers and manufacturing engineers, provide a platform to develop and prove manufacturing processes and technologies in a low-risk environment - a catalyst for future growth of innovative, world-leading technologies.

- General manufacturing workshop
- National Centre for Additive Manufacturing
- ESA AM Benchmarking Centre and the ASTM Centre of Excellence
- Laser welding capability for dissimilar materials
- Metrology equipment (high accuracy CMMs, X-Ray CT, optical profilometry, full metallurgy lab)



8 Michelin Scotland Innovation Parc (MSIP)

MSIP is an ambitious joint venture between Dundee City Council, Michelin, and Scottish Enterprise focused on sustainable mobility and decarbonisation with a collaborative approach to achieve the goal of net zero. The 32-hectare site is a dynamic space that can adapt to all sizes of business. As well as large, flexible space, tenants have access to an innovation campus, a skills academy, business support and competitive green energy delivered from sustainable sources.

- **LOCATE powertrain test facility - a custom designed facility to support the development of heavy duty and niche vehicles with zero emission drivetrains. Operating from 2023**



9 National Composites Centre (NCC)

The National Composites Centre (NCC) is the UK's centre of excellence for the development and application of composite materials. The NCC specialises in identifying and solving challenging problems through the application of advanced design and simulation tools, expert knowledge of all kinds of composite materials and world-leading manufacturing facilities.

- **Open access technology testbed for advanced composites**
- **Two-ring braider**
- **Automated fibre placement**
- **Overmoulding technology**
- **Automated preforming cell**
- **Ultra high rate deposition cell**
- **Ceramic matrix composite (CMC) development facility**
- **High temperature resin transfer moulding**
- **Composite integrity verification cell**



10 National Manufacturing Institute Scotland (NMIS)

The National Manufacturing Institute Scotland (NMIS) is a group of industry-led manufacturing R&D, innovation and skills facilities operated by the University of Strathclyde and supported by a network of partners across Scotland. The group has a national mandate to create and deliver inspiring, sustainable and translational research and skills for all by accelerating innovation in the manufacturing community.

- **Industrial-scale superconducting windings machine**
- **Incremental near net shape forming and forging**
- **Materials science and residual stress characterisation**
- **Lightweight Manufacturing Centre**



11 National Physical Laboratory (NPL)

NPL is the UK's National Metrology Institute, providing the measurement capability that underpins the UK's prosperity and quality of life.

- **Future Factory for High Performance Electric Machines**
 - » Suite of traceable measurement capabilities
 - » Bespoke reliability tests on materials, devices and interconnects
 - » Custom semiconductor imaging equipment



12 Newcastle University

The Newcastle University Electrical Power Research Group provides academic excellence as well as innovative and industrially relevant electrification solutions. Multi-disciplinary teams in state-of-the-art laboratory and test facilities focus on the development of high-efficiency electric drives and advanced control of power converters. Research activity includes power switching device fabrication, wide bandgap semiconductor devices, advanced thermal management, switch control circuitry, advanced electric drives and control and design and prototyping of electrical machines. Additionally, the Group has expertise in energy storage and distribution, from transmission to end use.

- **Future electrical machines manufacturing**
- **Urban Sciences Building Battery Laboratory**
- **Design Unit - electrical and mechanical manufacturing and test equipment**
- **Smart Grid Laboratory**



13 Northumbria University

Northumbria University is a research-intensive, modern university with a global reputation for academic excellence. Its Electrical Power and Control Systems Research Group is internationally recognised and multidisciplinary, undertaking cutting-edge research in renewable energy (wind/wave/PV), power electronics, electric vehicles, battery charging, electric machine and drive, power system management and optimisation, advanced control theory and methods, autonomous driving, robotic systems, and artificial intelligence for engineering applications.

- **3D rapid prototyping service**
- **Structural integrity testing**
- **Environment testing (Portable X-Ray Fluorescence (XRF) testing)**
- **Surveying, scanning and construction capability**



14 Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC)

The Nuclear AMRC works with manufacturers in a host of quality-critical low-carbon sectors, to improve capabilities and performance along the supply chain. Core technology areas include digital engineering, controls and instrumentation, joining, machining and metrology.

Based at the University of Sheffield, the Nuclear AMRC is part of the High Value Manufacturing Catapult.

- **Equipment Qualification Laboratory, including shaker tables**
- **Advanced joining technologies, including K-TIG keyhole welding**
- **Large-volume gantry CMM**
- **Smart sensor and control development**
- **Manufacturing process verification**



15 Offshore Renewable Energy (ORE) Catapult

ORE Catapult is the UK's leading technology innovation and research centre for offshore renewable energy. ORE Catapult's National Renewable Energy Centre in Blyth, Northumberland, is home to the world's most comprehensive open access research, test, innovation and validation services to accelerate the deployment of new and innovative offshore renewable energy technology.

- **1MW Drivetrain test facility**
- **3MW Drivetrain test facility**
- **15MW Drivetrain test facility**
- **'e-Grid' grid emulation**





PNDC

As part of the University of Strathclyde, PNDC links into extensive research expertise and laboratories supporting the development of power electronics, high efficiency/high power conversion, electrical machines, condition monitoring and lifecycle analysis, superconducting machines and aero electrical resilient power systems. PNDC's unique facility supports integrated electrical system, sub-system and device testing utilising Power Hardware in the Loop (PHIL) capability and expertise, with an extensive supply chain network from component manufacture to systems integrators, enabling a testbed for supply chain development.

- Propulsion and powertrain accelerator



Swansea University

The Centre for Integrative Semiconductor Materials (CISM) is a £50m new facility at Swansea University's Bay Campus, bringing together semiconductor and advanced materials platforms and processes to deliver new technologies and products. The Centre includes a unique facility for wafer-level processing of Silicon Carbide Power Electronic Components.

- Advanced electron microscopy (TEM, SEM, FIB)
- Surface chemical analysis and multi-functional scanning probe
- Multi-wafer batch wet etch stations
- Advanced atomic layer, chemical vapour and molecular vapour deposition
- Component modelling and design suite
- Component stress and failure testing
- Thin film analysis (ellipsometry, spectrophotometry)



Teesside University

Teesside University School of Computing, Engineering & Digital Technologies has two key research centres - the Centre for Sustainable Engineering and the Centre for Digital Innovation. Some of the research activities are focussed on the decarbonisation of industry and society, using engineering approaches spanning the disciplines of electrical and electronic engineering, instrumentation and control engineering, chemical and materials engineering, civil engineering, computational mechanics, robotics, virtual reality, artificial intelligence, and biomechanics.

- Simultaneous thermal analyser



The University of Warwick

The University of Warwick's School of Engineering is home to the PEATER (Power Electronics Applications and Technology in Energy Research) Group, founded in 2005 to establish a world-class centre for research into power electronics, power semiconductor devices and applications in power systems, and power conversion. The Group carries out work in electrical energy conversion, centring on the developments in semiconductor switching devices. The developments in MOSFET and IGBT technologies have paved the way for new applications such as hybrid vehicles, electric aircraft, electric ship propulsion, wind turbines as well as the revolution in mobile phone and computing devices.

- Power electronics reliability suite
- Clean rooms for manufacture and packaging of semiconductor devices
- ISO class-8 packaging cleanroom
- Power and Control Systems Research Laboratories
- Chemical vapour deposition reactor



The Welding Institute (TWI)

TWI is a membership-based organisation helping individuals and companies to design, create and operate the best products possible. Descending from the British Welding Research Association (BWRA), TWI has grown into one of the foremost independent research and technology organisations, spanning innovation, knowledge transfer and problem resolution across all aspects of welding, joining, surface engineering, inspection and whole-life integrity management.

- EB welding
- LASER welding
- FRICTION welding
- NDT capability (PAUT, UT, XRAY)



University College London (UCL)

The Advanced Propulsion Laboratory (APL) is a product of the world-leading research and development from UCL's Electrochemical Innovation Lab (EIL), the Electric Propulsion Group (EPG) and Department of Mechanical Engineering. Based at UCL East, it will be a global centre of excellence dedicated to the decarbonisation of the transport sector, specialising in battery and fuel cells, power electronics, and electric vehicles.

- 100kW dynamometer
- Highly precise calorimeter
- Power electronic measurement equipment kits



University of Birmingham

The Magnetic Materials Group (MMG) at the University of Birmingham is the only UK research group focused on processing and recycling of permanent rare earth magnetic materials. The MMG is internationally recognised for its work on hydrogen processing of rare earth alloys and magnets which are used worldwide in the production and recycling of Neodymium-Iron-Boron (NdFeB) magnets. The Group has been in existence for over 45 years under the leadership of Professor Rex Harris, Dr Andy Williams and now Professor Allan Walton.

- Large scale recycling and production facility for Rare Earth Permanent Magnets
- Machining and finishing equipment
- Characterisation facilities for magnetic materials
- Bench scale magnet processing equipment



University of Edinburgh

The School of Engineering addresses diverse complex challenges across the entire field of engineering. Its Electrical Power Conversion Group has a long track record in electrical power technologies for renewable energy applications. This includes designing, modelling and testing electrical machine and power converters for some of the leading companies in offshore renewable energy.

- Electrical Machines Lab
- Power Electronics Lab
- High Temperature Superconducting Lab



24 University of Glasgow

The James Watt Nanofabrication Centre (JWNC) is a 1400m² cleanroom at the University of Glasgow which houses over £35m of state-of-the-art fabrication and metrology equipment. It is one of the leading centres of research and international collaboration in micro and nanofabrication technologies undertaking fundamental, applied and commercial research, and small industrial prototyping and production runs.

- James Watt Nanofabrication Centre
- B1505 power semiconductor analyser
- Characterisation equipment for power semiconductor devices together with a high temperature on-wafer probe station



25 University of Manchester

The eTransport research area at the University of Manchester (UoM) is concerned with the electrification of land, air and sea transport. It is focused on developing solutions that lead to more efficient, higher power density and lower emission systems achieved through the use of advanced materials, improved manufacturing processes and the development of new analytical methods. All technologies will make a strong contribution towards achieving the 2050 zero carbon target.

- MEA Aerospace Laboratory - IEPNEF
- National Grid High Voltage Laboratories
- Cryogenics test facilities



26 University of Nottingham

The Power Electronics and Electrical Machines Centre (PEMC) at the University of Nottingham is one of the largest groups of its kind worldwide, with over 170 researchers and 5,000 square metres of dedicated research and development space. The Centre hosts the UK-EAPF (UK Electrification of Aerospace Propulsion Facility) and the Future Factory for High Performance Electrical Machines. The PEMC research ranges from basic technology investigation to fully engineered advanced concept demonstrators, carried out in experimental facilities that allow realistic practical validation of novel components and systems.

- Future Factory for Advanced Electrical Machines
- Power electronics integration facilities
- Power electronics characterisation facilities
- UK Electrification of Aerospace Propulsion Facility



27 University of Southampton

The Faculty of Engineering and Physical Sciences (FEPS) at the University of Southampton undertakes internationally leading research in energy storage, electronics, high speed electric machine design, cryogenic and superconducting magnetic systems and system integration in the fields of electric vehicles, rail, aerospace, maritime and autonomous systems.

- Testbed for 100kW superconducting electric machines at 60-77K
- Electrochemical Engineering Laboratory
- Towing tank
- National Wind Tunnel test facility for aerospace and UAV testing



28 University of St Andrews

The University of St Andrews is renowned for its fundamental research in energy topics such as energy storage, sustainability and energy and ethics. The University has particular research strengths in low carbon technologies. Within its 'energy, environmental and sustainable chemistry' theme are topics such as materials for energy storage and synthetic fuels, solar energy, critical raw materials and pollution, which provide real solutions for today's world problems.

- Electron Microscope Facility
- Fabrication and Prototyping Facility
- Dry Room Laboratory



29 University of Strathclyde

The University of Strathclyde's Institute for Energy and Environment is one of Europe's leading and largest power systems and energy technology university research groups. The Institute is equipped with state-of-the-art experimental facilities to support its research and commercial activities, including the design, testing and real-time simulation of power electronic systems, demand site management and associated modelling for future smartgrid and micro-grids applications. These facilities are available for industrial use.

- Dynamic Power Systems and Aero-Electrical Protection Laboratory
- Power Electronics, Drives and Energy Conversion Laboratory
- Applied Superconductivity Laboratory



30 WMG

WMG is an academic department at The University of Warwick and is the leading international role model for successful collaboration between academia and the public and private sectors, driving innovation in science, technology and engineering, to develop the brightest ideas and talent that will shape our future, working with over 1,000 companies cross-sector. WMG is also a High Value Manufacturing Catapult (HVMC), driving growth and productivity by accelerating and de-risking innovation to deliver powerful solutions for industry. WMG HVMC leads on net zero mobility, with major roles in energy/electrification, eCAM, digital technologies and surface transportation.

- Winding Centre of Excellence
- Advanced Propulsion Research Laboratory
- Advanced Steel Research Centre
- Energy Innovation Centre, with battery materials scale-up line including mixing, coating and cell building and testing and characterisation including in use and abuse testing



DER Funded Equipment

Newcastle University

DER-IC North East is part of Newcastle University and is located near the International Advanced Manufacturing Park, Sunderland, the heart of the region's advanced manufacturing base. The Centre is equipped with DER-funded electrical machine and drives assembly lines, which are critical for the development of advanced manufacturing processes, and which are enablers for PEMD growth in the UK.

Electric Drives Line

Located within a cleanroom environment, flexible, industry-standard equipment enables custom packaging of silicon die, devices and circuitry, and surface mount circuit board manufacture and inspection, providing a platform for the development and scale-up of advanced manufacturing processes for highly integrated power electronic and drive systems. Specialist inspection and diagnostic equipment enables verification of manufacturing process quality.

Die packaging equipment

- Camalot Prodigy encapsulation material dispenser
- Kulicke & Soffa Asterion wire and ribbon wedge bonder
- Amadyne FAB1 pick and place die bonder
- AMX X-Sinter silver sinter press

PCB manufacturing equipment

- Europlacer EP710 solder paste screen printer
- Omron VP9000 solder paste inspection
- Juki RS-1R component pick and place
- Juki RS800 reflow furnace
- Omron VT-S530 optical inspection
- Nordson Dage Quadra 7 X-ray inspection

Electrical Machine Line

The electrical machine assembly line includes a range of flexible, automated assembly, and test and measurement equipment, providing an end-to-end platform for electrical machine manufacturing process development.

Manufacturing and assembly equipment

- 'Robopod' automated, robotic lamination stacking, magnet placement and adhesive dispense system, fully programmable to cater for multiple machine topologies
- Electrified Automation rotor and 'hot drop' stator insertion system
- Universal Balancing H100 rotor balancer
- Laboratorio Elettrofisico magnetiser

Test and measurement equipment

- Weissttechnik thermal shock, and combined temperature and vibration test-beds
- Marposs leak tester
- Marposs 400kW 12000rpm dynamometer



PNDC

DER-IC Scotland's new equipment will be housed at the PNDC at the University of Strathclyde. PNDC specialises in de-risking innovative MW scale technologies and architectures through test and emulation and has expertise in researching and advancing technologies through design, manufacture and verification at System, Sub-System and Component levels with full reconfigurability for industry.

Propulsion and Powertrains systems validation capability

- MW-scale innovation and testing using DER-IC funded MW rated dynamometers and MW-scale power supplies
- Brings additional HiL capability to existing multi-MW PNDC capability
- MW-scale test bed for machines and drives
- Complemented by partner capabilities at the University of St Andrews (hydrogen platforms), University of Edinburgh (semiconductor device and converter capability), University of Glasgow (semiconductor R&D) and NMIS (design & manufacturing)





The University of Warwick

The University of Warwick's DER-funded equipment will be located within the University's School of Engineering and WMG. The School of Engineering will house the new power electronics reliability and failure analysis facility. This facility will enhance the reliability of power electronics modules and allow the technology for reducing size, weight and cost to be better understood.

Power Electronics Reliability Suite

Power electronics reliability and failure analysis facility for high power WBG devices

- Scanning acoustic microscope
- Environmental chamber for reliability testing
- Industrial data logging equipment/HIL
- De-capsulation facility
- Power cycling facility
- Fibre bragg grading system
- Thermal camera

University of Nottingham

The University of Nottingham received funding for new equipment from DER that will be housed at the Power Electronics and Machines Centre (PEMC). The PEMC offers purpose-built laboratories for the Power Electronics, Machines and Control Research Group, the largest such group of researchers in the world, and sits at the heart of the University's commitment to establishing Nottingham and the East Midlands as a hub for the translation of net zero technologies from research bench to real world solutions.

Electrical drive test and characterisation facilities

- High power (5MW & 2MW) test cells
- Altitude environmental test cells (500kW)
- High speed test cells (up to 120krpm)
- Magnetic materials characterisation equipment
- Power supplies and energy storage emulation up to 3MVA
- Variable DC and variable voltage and frequency AC
- Test solutions for automotive traction, aircraft generators, actuators and propulsion systems



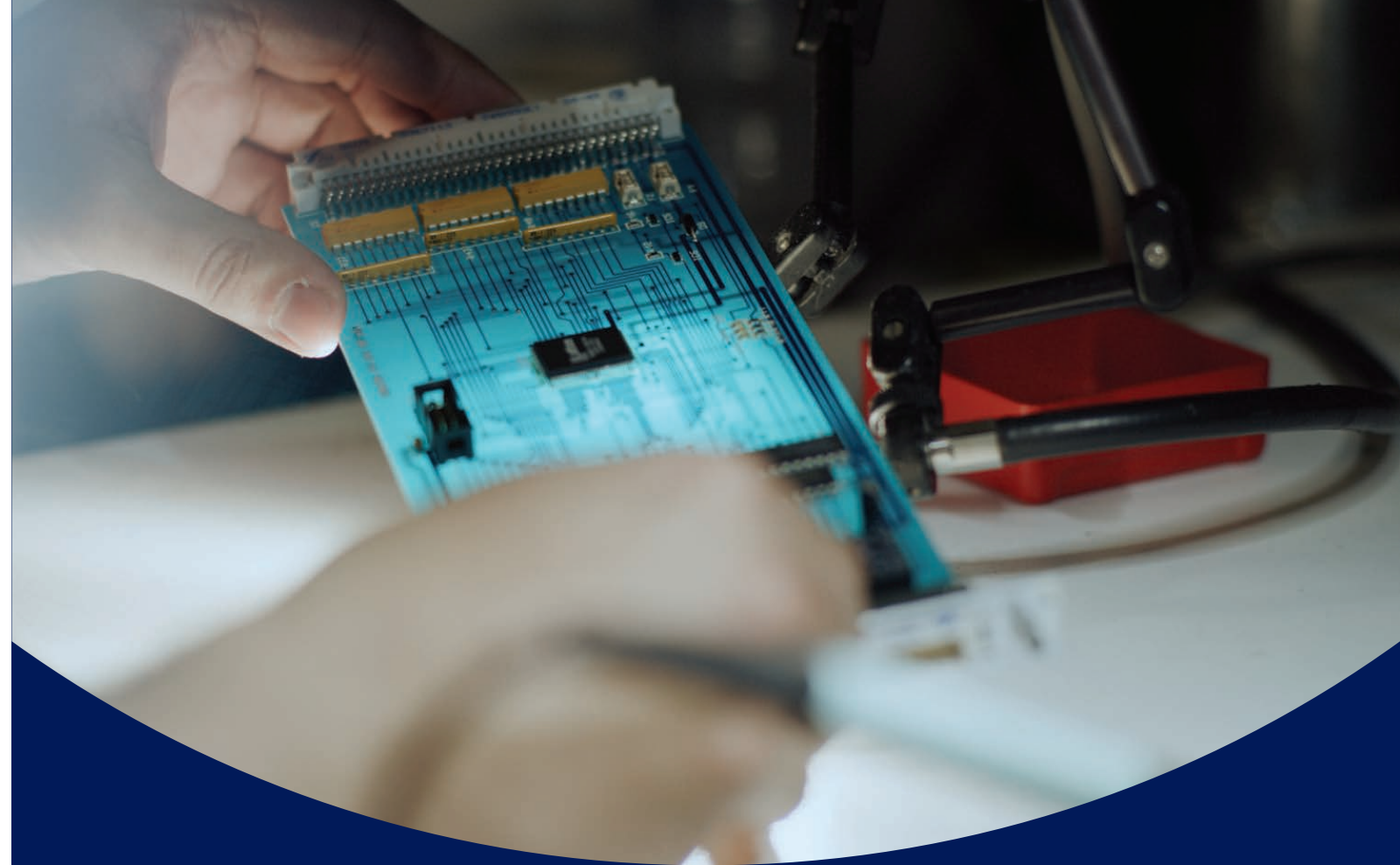
WMG

WMG is an academic department at The University of Warwick and is the leading international role model for successful collaboration between academia and the public and private sectors. The funding from DER will be used at WMG to install a new Winding Centre of Excellence, providing capability for UK based OEMs and SMEs to develop eMachine solutions using discrete hairpin windings.

Winding Centre of Excellence

Equipped to manufacture all types of windings at production quality, specialising in hairpin stators:

- Discrete hairpin winding and continuous hairpin winding
- Distributed winding and winding of synchronous wound rotors
- Concentrated windings for radial and axial flux machines
- Insertion robot for magnetised and unmagnetised magnets for rotor assembly
- Magnetiser, rotor assembly to hub, trickle impregnation, stator loading into housing and curing ovens
- In-process testing of electrical, thermal and mechanical effects



CSA Catapult

The CSA Catapult in Newport, Wales, is a recipient of DER-funded equipment, with a focus on materials and components. The new equipment will address supply chain challenges with high power density and high temperature device packaging.

The DER-funded equipment is as follows:

Lithoz CeraFab Multi 2M30

- Ceramic 3D printer for device package
- thermal optimisation

- Nabertherm ceramic debinder furnace - ceramic post process
- Nabertherm ceramic oxide oven - post process
- Nabertherm ceramic sintering furnace - high temperature ceramics
- CeraCleaning cleaning station

Digital Metal DM P2500

- Metal 3D printer (e.g. Copper)

- Metal Powder Prep. System PPS1000 - printing materials supply
- Nabertherm metal debinding oven - debinding process for package
- Nabertherm metal sintering oven - sintering process

Metrology and processing tools

- Instron tensile testing equipment - device quality check
- Matsuzawa fully automated Vickers micro hardness tester - device quality check
- M-Solv laser cutting/drilling machine - device processing for novel package design
- Engis lapping and polishing machine - device polish / lapping for preparation
- Archimedes Balance - density/volume measurement for 3D object



University of Birmingham

The University of Birmingham's DER funding has been used to construct a production line for recycled sintered magnets with an 'end-to-end' supply chain to enable a UK supply of recycled rare earth magnets from processed oxides. Currently, there is no capacity for sintered magnet manufacturing in the UK, and this new equipment provides a platform to secure a strategic supply of NdFeB alloy powder which can be fed into any part of the value chain from chemical, alloy production or directly into magnet manufacture.

Large scale recycling and production facility for REPM

- A range of advanced and highly unique equipment to enable the sensing, sorting, separation, purification and re-processing of rare earth permanent magnets. The equipment will include pre-processing equipment (cropping machines), a hydrogen reactor >2000 litres, powder processing unit including sieves, jet mill and blending system, magnetic aligning presses (uniaxial and transverse), pellet press and sintering furnace. The equipment can also be used to process primary rare earth cast alloys

Machining and finishing

- A range of machining and finishing equipment for REPMs including an EDM and grinding equipment

Characterisation facilities for magnetic materials

- This includes; 2 permeameters running up to 200°C, and 2 VSMs (to measure the hysteresis loops of solid and powdered magnetic samples), particle size analysis, 3-D magnetic scanner, kerr effect microscopy and chemical analysis equipment (ICP)

Bench scale magnet processing equipment

- This includes high velocity ball mills, glove boxes, pulse magnetiser, isostatic presses and sintering furnaces for sample sizes between 10-50 grams

Swansea University

Swansea University's Centre for Integrative Semiconductor Materials (CISM) has received a £5m investment from DER to create a wide band gap power electronics component industrial pilot line. The pilot line will also be part of CSconnected, the world's first compound semiconductor cluster based in South Wales. The new equipment will be housed in CISM at Swansea University's Bay Campus in bespoke ISO 5 and 6 Cleanrooms.

The pilot line will include:

- Advanced lithography - photo and nano-imprint
- Advanced etch - synapse deep dry etch
- Advanced deposition - dielectric and metal
- Backend - rapid thermal and laser anneal, wafer dice and grind



CASE STUDIES

Inverter Testing Facility at The University of Warwick

Innovative inverter testing equipment has been developed by Professor Phil Mawby and his team at The University of Warwick's School of Engineering following almost £900k funding from the Driving the Electric Revolution Challenge. The University's WMG Centre High Value Manufacturing Catapult (HVMC) also contributed £300k of funding.

The equipment has been designed to help speed up the development of electric vehicles (EVs) and reduce testing costs for British manufacturers. The facility was used for the first time by premium car manufacturer BMW to test a new power inverter.

Previously, car manufacturers tested inverters with motors at high-cost dynamometer facilities with concrete bunkers that contained high speed equipment failures. This newly designed equipment is smaller, less costly, easier to access and allows manufacturers to test components in isolation - i.e., the inverter - without the motor. This technology is also applicable to applications in other sectors.

BMW is one of the businesses behind @FutureBev, a project group made up of six partners including The University of Warwick and CSA Catapult, who have come together to develop a UK supply chain that can support the transition of BMW to SiC-based power electronics in their future generations of BEV (Battery Electric Vehicle). This will ensure competitive powertrains in function and costs and enable UK technology transformation to zero emission mobility.



LOCATE Facility at the Michelin Scotland Innovation Parc (MSIP)

As part of DER-IC Scotland, the Hydrogen Accelerator has attracted £4m of investment from Transport Scotland to fund the new LOCATE facility (Low Carbon Transport Applications Centre) which will be located at the Michelin Scotland Innovation Parc (MSIP) site in Dundee - the home of sustainable mobility in Scotland. The project is being led by the University of St Andrews, Hydrogen Accelerator and the Power Networks Demonstration Centre (PNDC) at the University of Strathclyde.

This is part of a pipeline of support preceded by the DER funded equipment at PNDC which provides sub-systems and powertrain testing and de-risking prior to platform level testing at LOCATE. DER-IC has helped to facilitate this partnership through its connections with partners the University of St Andrews, which specialises in batteries, fuel cells and hydrogen; and the University of Strathclyde, which has expertise in energy systems, power electronics, machines and drives.

LOCATE provides a first of a kind, platform level, route-to-market Power Train Test Bed (PTTB) for hydrogen fuel cell/battery electric drive trains. LOCATE will form part of a Low Carbon Transport Programme being jointly developed between Scottish Enterprise and Transport Scotland. The LOCATE test facility will provide an 'emulated' representation of real world duty cycles for a variety of heavy-duty road/niche vehicles. This replaces and brings forward what would traditionally have been on-road testing. It is aimed at platform level testing at TRL levels 5-7 and will reduce cost and time to market for the users.



CASE STUDIES

UK-Alumotor

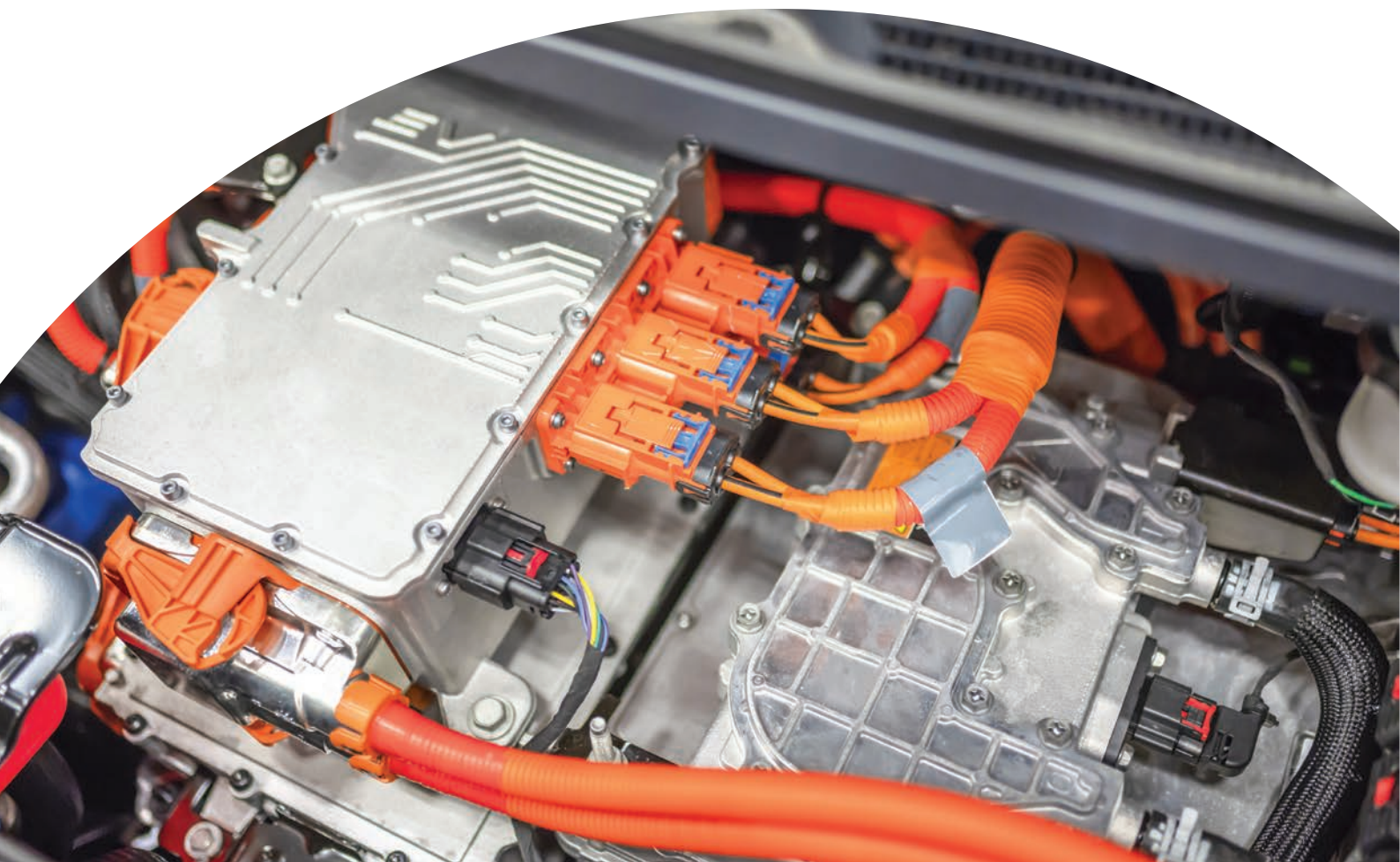
UK-Alumotor received £2.85m funding from the UKRI Driving Electric Revolution Challenge fund. A consortium of key industry partners was formed to develop the UK's electric motor supply chain by leveraging its manufacturing expertise to deliver the next generation of sustainable electric motors.

DER-IC network partner Warwick Manufacturing Group (WMG) was part of the consortium along with Ricardo, Aspire Engineering, Brandauer, Phoenix Scientific Industries and Global Technologies Racing.

Over the duration of the project, the partners identified and developed preferred manufacturing processes which are suitable for volume production of the patented motor design from a UK supply chain, whilst refining the design to meet the future requirements of their UK and international stakeholders.

The project supported the UK's net zero ambitions by developing a more affordable, environmentally sustainable design which displaces the need for scarce material resources, resulting in a greener and more affordable solution to support the mass adoption of electrification.

Training the next generation was also a focus and UK-Alumotor was committed to growing the UK's PEMD manufacturing capability and training the next generation of skilled engineers and technicians, positioning the country at the forefront of the global electric revolution.



H2GEAR

The H2GEAR programme, involving leading academics at Newcastle University's School of Engineering and led by GKN Aerospace, will be at the heart of the technological developments needed for the future of more sustainable aviation. The programme will have access to equipment at the DER-IC North East Centre in Sunderland, including a power electronics assembly line and a flexible electric machines assembly line.

The Newcastle University team will use their understanding of electronic materials, power electronics and electrical power networks to develop an ultra-high efficiency power and propulsion system that will provide the backbone of this advanced technology. The programme will develop a liquid hydrogen propulsion system for short-distance aircraft that could be scaled up to larger aircraft. Liquid hydrogen is being converted to electricity within a fuel cell system. This electricity efficiently powers the aircraft, eliminating CO2 emissions. This would create a new generation of clean air travel, eliminating harmful CO2 emissions.

H2GEAR will reinforce the UK's position at the forefront of aerospace technology research and development. Newcastle University's collaboration with GKN Aerospace, Intelligent Energy, Aeristech, University of Manchester and University of Birmingham will create more than 3,000 jobs in the next decade.

The programme is supported by £27m of Aerospace Technology Institute funding, matched by GKN Aerospace and its industrial partners to make a total investment of £54m.

The DER-IC Centre Leads



Rachel Chambers
Chief Operating Officer, DER-IC North East

Rachel has extensive experience of working at board level within a range of sectors/markets, including automotive, manufacturing and technology/distribution etc. as well as having developed and delivered many large strategic innovation projects. In her role, Rachel brings together industrial partners, Government bodies, academia and research and technology organisations across the UK.

Rachel led the work to set-up the Centre of Excellence for Sustainable Advanced Manufacturing (CESAM) in the North East where she was seconded from CPI, one of the High Value Manufacturing Catapults where she managed large funded projects and the Business Development team.

Her career in HR developed a wealth of experience operating as a Global HR Director responsible for driving innovation, commercial value, cultural change with a big focus on Equality Diversity and Inclusion and workforce planning, which she now uses to accelerate the UK supply chain in Power Electronics, Machines and Drives (PEMD) through facilitating cross-sector collaboration and supporting industry with prototyping, scale up and development of manufacturing processes, with the vision to make the UK globally recognised as the centre of excellence in PEMD.



Prof. Jon King
Centre Lead, DER-IC Midlands

Following a BSc in Mechanical/Vehicle Engineering at the University of Hertfordshire, Jon has worked in a variety of roles in the automotive industry. He soon moved into automotive engineering consultancy and joined the WMG Centre High Value Manufacturing Catapult in 2017 with a focus on the electrification of transport and supply chain development, especially at SME level.

Jon is a Royal Academy of Engineering Visiting Professor in the Principles of Engineering Design and was awarded an Honorary Doctorate at UoHerts in 2002 and is a long-standing member of the UK Automotive Council Supply Chain Group. He is a past chair of the Society of Motor Manufacturers and Traders Automotive Components Section and is an enthusiastic proponent of automotive sector supply chain improvement programmes.



Daniel Cutting
Centre Lead, DER-IC Scotland

Dan comes from an aerospace background, with a Masters in Aero-Mechanical Engineering from the University of Strathclyde. He is experienced in electrification and the challenges across transport and energy. With his experience at Rolls-Royce as a design engineer and further working in System Design, he developed skills and knowledge of working with operators, OEMs and suppliers to facilitate the technology and supply chain development of Power Electronics, Machines and Drives for current and future electrical systems. He now works across a multitude of sectors from industry, energy and transport and supports organisations in their need to accelerate their PEMD supply chain capabilities and processes in electrification.



Paul Jarvie
Centre Lead, DER-IC South West and Wales

Paul Jarvie received his BSc degree in Electrical and Electronic Engineering from the University of the West of Scotland in 1985. He gained 16 years' experience with NEC Semiconductors in product engineering for DRAM Memory Devices followed by three years with NXP Semiconductors' TV Systems Innovation Centre in Southampton. He joined Techworks in 2005 and led the Electronic Product Design/Test and Power Electronics Networks for over seven years.

Paul became Director of AESIN (Automotive Electronic Systems Innovation Network) in 2015, engaging the full automotive electronics supply chain while co-chairing SEMI GAAC (Global Automotive Advisory Council) with Volkswagen. Paul is now Centre Lead of the Driving the Electric Revolution (DER) Industrialisation Centre - South West and Wales, based at Compound Semiconductor Applications (CSA) Catapult, focusing on Power Electronics and Magnetic materials technology scale up for electrification.



Testimonials

"@FutureBEV with Warwick University is demonstrating the ability of industry and academic partners coming together to deliver accelerated technologies to market. The access to a strong academic base with matched development and test hardware enables rapid implementation of ideas from drawing board to real hardware. The investment from DER-IC is one of the enablers for this ensuring the facility is tooled with the latest test equipment, meaning the university is ready and able to support business. The @FutureBEV team directly benefit from quick access to the BEV specific test equipment enabling risk reduction as well as improving the change of emerging technologies to be implemented in new designs. The net benefit is through this collaboration we can bring these CO2 reducing technologies to the road quicker whilst keeping the business case and enabling a next generation of engineers."

David Bock, Project and Technical Lead for @FutureBEV, BMW Group

"It is essential that the UK reacts quickly to the growing market demand for Electric Motors and Power Electronics systems, scaling up capacity at every level within the supply chain. AEM is already working closely with the DER Industrialisation Centres to deliver a truly sustainable end-to-end supply chain for our unique, rare earth free, high performance motor technologies."

Mike Woodcock, Chief Commercial Officer, Advanced Electric Machines

"Rolls-Royce believes the DER Industrialisation Centres play an important role helping the supply chain to access both manufacturing process development and scale up and test capabilities and that they will ultimately support us as we develop our electrification capability and solutions."

Eddie Orr, Head of Research Partnerships, Rolls-Royce Electrical

"McLaren Applied is working alongside the DER-IC North East Centre in its grant funded programme SCIENZE (Supply Chain Innovation for Net Zero). The expertise of DER-IC NE, particularly around automation of power electronics based products, is key to ensuring McLaren Applied stays innovative and competitive in not only power electronics product design but also in manufacturing process technology."

Steve Lambert, Head of Electrification, McLaren Applied

Join the Revolution!

Connect with partners in the PEMD supply chain and create new opportunities

Reduce risk by sharing manufacturing process expertise, technical advice and facilities

Access national, regional and devolved funding

Promote training and skills activities, from vocational to postgraduate

We can help you grow your PEMD capability, capacity and competitiveness.

Please get in touch with any of us - we are looking forward to supporting you in your electrification journey.



Driving the
Electric Revolution
Industrialisation Centres

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