



DRIVING FORWARD
CLEAN **ENERGY** & LOW
CARBON SOLUTIONS
THROUGH INNOVATION
& COLLABORATION.

INTERNATIONAL IN OUTLOOK, GLOBAL IN OFFER.

OUR ENERGY OFFER



Sheffield
City Region

Sheffield City Region (SCR) is establishing itself as a leader in low carbon, resilient energy and is well positioned to deliver the Government's Industrial Strategy ambitions for 'affordable energy and clean growth' and to be recognised as the 'Green Heart of Great Britain'.

The region's soon-to-be-launched Energy Strategy will provide a clear plan of how our economy can decarbonise and decouple the link between economic growth and the increase in energy demand, whilst maintaining levels of productivity and competitiveness. The aim is to facilitate industrial clusters to become "world-leading low-carbon manufacturing hubs and safeguard existing jobs and companies on which the prosperity of key regions depends."

We are a City Region leading by example, which has already established a number of collaborative partnerships between academic institutions and businesses, including major research programmes that have led to innovative low carbon technologies.

Our position within the Northern Powerhouse, which generates 27 per cent of UK electricity, is backed by unique assets and a committed approach to renewables. This means Sheffield City Region is working towards being at the cutting edge of developing energy sector innovations.

Supply chain

Innovative companies across the Sheffield City Region manufacture products for the energy sector across the UK and beyond. Our region has place-based expertise in materials, light weighting, forging and casting, cutting tools and sealing technology for valves and pumps. This specialism extends to manufacturing components in high performance alloys and in developing sophisticated tooling and material processing.

Talent

Sheffield City Region has a highly skilled workforce (33% of local people have degree-equivalent qualifications) and two million people within a one-hour commute of the city. Our region has a strong talent pool, with a workforce that is renowned for hard work, resilience and its technical skill-sets. We are building a UK leading vocational, technical and lifelong education system, which equips people to seize the opportunities of today and tomorrow, particularly businesses and entrepreneurs. In addition, a strong professional services network exists here, as well as a large catchment area from which to recruit quality staff.

Our region is home to two world class universities; The University of Sheffield and Sheffield Hallam University, which together have 60,405 students and around 5,000-10,000 students graduate each year.

The number of students enrolled on Engineering and Manufacturing Technologies courses in our region continues to grow. There are currently around 20,325 students studying STEM subjects at university in the Sheffield City Region and the proportion of apprentices studying Engineering and Manufacturing Technologies in our region is higher than the national average.

National College for Advanced Transport and Infrastructure

The National College for Advanced Transport & Infrastructure (NCATI) was established to provide the higher-level skills needed to transform the UK rail and transport infrastructure network.

The College will deliver training required to create HS2, Northern Powerhouse Rail and other rail projects, as well as supporting demand from employers who are facing skills challenges arising from digitalisation of the railway and an ageing workforce.

Through a combination of classroom teaching and real-life work experience, apprenticeships and short courses, the College provides technical and professional courses, using the very latest industry technology. These courses are delivered to a diverse range of learners who are either starting out in the industry, are looking to switch careers, or are part of the existing workforce.

The college will support the region's innovation and research, and provide the skilled workforce required to support the move from diesel to electric trains.

INNOVATION

Sheffield City Region has long been known for its innovation. Harry Brearley the metallurgist invented Stainless Steel here in 1913. In the last 20 years, Sheffield innovations include the GEM Rolls-Royce engine used on Boeing aircraft, developed at the University of Sheffield Advanced Manufacturing Research Centre (AMRC); the world's first ceramic-coated hip joint replacements by JRI Orthopaedics Ltd, implantable synthetic bone grafts by Ceramisy, and 3D printed medical prosthetics for noses, ears and other body parts, by Fripp Design and Research with the University of Sheffield. Within the UK itself, Sheffield City Region has been identified by UK central government as a priority region to receive further large-scale investment in infrastructure to maximise our economic potential, for example to continue upgrading our already excellent rail networks.

Our Assets

Sheffield City Region has extensive assets where businesses are invited to collaborate with our academic institutions to solve industrial and sustainability issues.

AMRC

The University of Sheffield's Advanced Manufacturing Research Centre (AMRC) specialises in carrying out world-leading research into advanced machining, manufacturing and materials, for the benefit of UK and global businesses. The centre aims to transform industrial and economic performance by making step changes in productivity, increasing competitiveness, developing new products and processes and training new talent and skills. The AMRC's 110-plus industrial partners range from global giants like Boeing, Rolls-Royce, BAE Systems and Airbus to small companies, who work on everything from one-off projects or as part of long-term collaboration. Established in 2001, the AMRC now employs over 500 highly qualified researchers and engineers from around the globe.

The AMRC's core capabilities:

- Machining
- Integrated manufacturing
- Composite Manufacturing
- Castings
- Design & prototyping
- Structural testing
- Medical
- Additive Manufacturing
- Microscopy
- Metrology
- Manufacturing Intelligence

AMRC Research projects fall into three categories:

- Generic research carried out on behalf of the AMRC partnership, with results distributed to all members. Generic projects are agreed by the board of members, and results are shared between all members.
- Specific research for individual companies. The company invests directly in the research and has exclusive access to any resulting intellectual property.
- Collaborative projects into technologies and processes at an earlier stage of development. These projects are usually funded by EPSRC, Innovate UK, European Commission or other external bodies, and may involve collaboration with external research and industrial partners.

AMRC Training Centre

The AMRC Training Centre is regarded as the 'Centre of Excellence' for apprenticeships and CPD (Continuous Professional Development) delivery within the Yorkshire & Humber region. The state-of-the-art facility offers the very best in practical and academic training. Working with employers, the AMRC identifies and provides the skills that manufacturing companies need to compete globally, from apprenticeship through to doctorate and MBA level.

AMRC Group

The Advanced Manufacturing Research Centre is part of the AMRC Group, a cluster of world-class centres for industry-focused research and development of technologies used in the high-value manufacturing sectors. The group has specialist expertise in machining, casting, welding, powder metallurgy, composites, designing for manufacturing, testing and training. It has a global reputation for helping companies to overcome manufacturing problems and has become a model for collaborative research involving universities, academics and industry, worldwide. Sub-centres of the AMRC include **Rolls-Royce Factory of the Future, the Nuclear AMRC, AMRC Training Centre, Knowledge Transfer Centre (KTC), AMRC Castings, the Medical AMRC, The National Metals Technology Centre, Factory 2050, Composite Centre, Design and Prototyping Centre, Advanced Structural Testing Centre and Industrial Doctorate Centre.**

The AMRC is part of the High Value Manufacturing (HVM) Catapult. This is a thriving alliance of seven technology and innovation centres working with companies of all sizes to accelerate the activity between technology concept and commercialisation. It also allows companies to tap into a national network of manufacturing research excellence.

ENERGY DEVELOPMENT ASSETS

The University of Sheffield Energy Institute

The newly launched University of Sheffield Energy Institute is doing research differently. It has brought together 300 researchers to create a truly interdisciplinary institute that can be more responsive to the demands of industry and the needs of society.

The Energy Institute is conducting research in the following areas:

Circular economy

Looking beyond the current take-make-dispose industrial model, their research creates supply chains that are resource and energy efficient.

Conventional power

Finding ways to reduce and even eliminate carbon dioxide emissions from fossil fuel power plants and heavy industry.

Electrical energy storage

Energy storage facilitates grid balancing, enabling greater use of energy from renewable sources, lowering costs and reducing our carbon footprint.

Nuclear

Nuclear power generates electricity without producing greenhouse gases. Their research ensures this can be done safely, securely and sustainably.

Wind

Their wind power research centre is aligned with Siemens-Gamesa and is the only industrially-led design facility for wind generators in the UK.

Infrastructure and built environments

Finding ways to create built environments that allow humanity to thrive within the carrying capacity of the planet.

Sustainable liquid fuels

Developing ways to decarbonise fuels for aviation, heavy goods and marine transport.

Energy system simulation and modelling

Creating computational models that will help design, simulate and optimise various energy systems.

Renewable energy monitoring

Working with the National Grid to predict how much solar energy is being generated at any one time. This reduces emissions by ensuring alternatives are only used when necessary.



National Scale Facilities

The University of Sheffield Energy Institute focuses on high technology readiness level (TRL) research at the following national facilities:

Advanced Resource Efficiency Centre (AREC)

This supports the development of resource sustainable supply chains by proposing new ways of reducing risk for partners in overcoming the challenges of resource availability.

Centre for Research into Electrical Energy Storage and Applications (CREESA)

The Centre hosts the UK's only research-led, large-scale, energy storage test facility. It includes battery digitisation with reference to Internet of Things (IoT) and cloud computing.

Nuclear Advanced Manufacturing Research Centre (NAMRC)

The NAMRC provides a range of supply chain development support to help manufacturers enter the nuclear market and compete worldwide.

Pilot-scale Advanced CO2 Capture Technology (PACT)

This is a national scale specialist R&D facility for combustion and carbon capture technology research for power generation and industrial applications.

Sheffield Siemens Renewable Energy Research Centre

The first of its kind in the UK, the centre focuses on developing the most reliable and efficient wind turbine generators.

INTRODUCING THE TRANSLATIONAL ENERGY RESEARCH CENTRE

Operational from Autumn 2020, the Translational Energy Research Centre, a new national scale facility for low carbon energy research is the latest addition to The University of Sheffield Energy Institute. The centre will give start-ups, regional and global companies access to advanced testing facilities and opportunities to collaborate with leading academics.

The Translational Energy Research Centre will house state-of-the-art equipment for conventional energy, carbon capture, utilisation and storage, biomass, hydrogen, renewable energy, energy storage and smart grids.

This high-profile, innovation-focused facility will help develop next generation low carbon energy technologies that are sustainable, secure and affordable. The centre provides a platform for users to prove, test, develop, optimise and up-scale their ideas and developments on a cost-effective basis, before investing in commercial-scale testing or production.

Thereby, addressing demand for additional capacity, greater flexibility of operation, and enhanced capabilities of a wide range of energy applications.

Commercially focused

The Translational Energy Research Centre will shape early-stage research into commercially viable technologies. It will be automated to enable 24/7 long-run testing to rapidly increase the speed that new products can be brought to market. It will also enable businesses to simulate, test and optimise their technologies at scale before investing in deployment. This facility removes the financial risk of large-scale industrial pilot trials.

Prime Location

The Translational Energy Research Centre is located at the heart of The University of Sheffield's prestigious Innovation District. The district is the UK's first research-led manufacturing cluster and sits alongside the University's Advanced Manufacturing Research Centre, Factory 2050 and Royce Institute, as well as global industry leaders such as McLaren's Composites Technology Centre, and Boeing Sheffield. This wealth of expertise will ensure our focus remains on aligning research with future commercial goals.

Partner with us

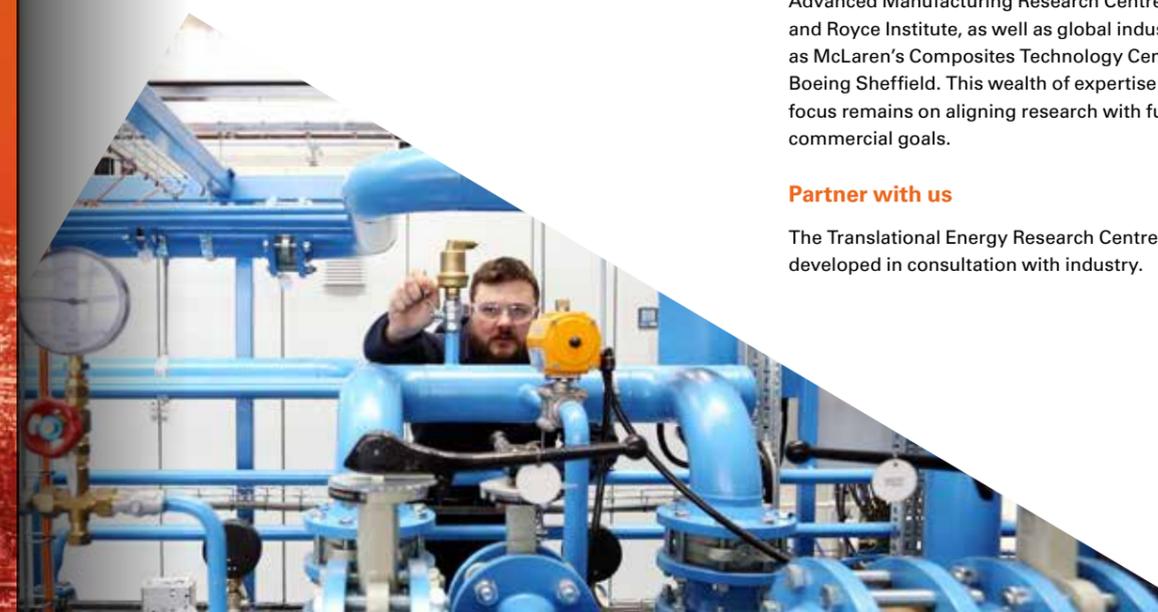
The Translational Energy Research Centre is being developed in consultation with industry.

Partnering with the University of Sheffield Energy Institute

The Energy Institute is proud to work in collaboration with businesses ranging from small- and medium-sized enterprises to the world's biggest energy companies to further enhance translational research and develop practical solutions for the energy industry.

There are many ways that organisations can work with the Energy Institute, including:

- partnership agreements for long term projects that give an organisation access to all of the University's energy related capabilities.
- consultancy for when a business has a specific, short-term problem to be resolved.
- PhD or post-doctoral projects for when a longer-term opportunity is identified, but the organisation does not have the in-house resource.
- access to specialised testing facilities.
- design and prototyping that can shorten development times for energy technologies.
- support for the development of resource sustainable supply chain and overcoming challenges of resource availability.



NEW FUSION ENERGY RESEARCH FACILITY IN SHEFFIELD

A new £22 million fusion energy research facility will be established in Rotherham in 2020, as part of the University of Sheffield. The facility will work with research and industry partners to put the UK in a strong position to commercialise nuclear fusion as a major source of low-carbon electricity in the years ahead.

Energy Research Projects:

In Sheffield City Region there are currently a number of innovative projects underway where businesses are collaborating with our universities, with a view to securing a low carbon future.

Offshore wind turbine technology

The University of Sheffield is the academic partner of the Offshore Renewable Energy (ORE) Catapult's new research hub. Because of its world-renowned expertise in electronic and electrical engineering, research carried out by the University at the hub will aim to improve the operation, reliability and performance of wind turbines – which in turn will lead to greener, lower cost electricity generation. The research hub will focus on offshore wind turbine powertrains – the gearbox and generator that enable turbines to generate electricity.

The hub's key objectives are:

- Reliability improvement and advanced test methodologies
- Advanced health condition monitoring and prognostic technologies
- Development of next generation powertrain components for larger sized wind turbines
- Research conducted as part of the hub will also focus on minimising human interventions throughout the life of the wind turbine – repair work that can be hazardous for engineers to carry out.

Professor David Stone from the University of Sheffield's Department of Electronic and Electrical Engineering, who is also the Scientific Director of the Hub, said: "The University of Sheffield sees working with ORE Catapult as a fantastic opportunity to apply its cutting-edge research ideas to support the rapidly expanding field of green energy generation solutions. *"The synergies brought about by the Powertrain Research Hub will not only bring benefits for the University and the offshore wind sector, but consumers as a whole through higher reliability, lower cost electricity generation."*

Battery Technology

Part of Sheffield City Region's upcoming Energy Strategy focuses on developments in battery technology and how this will enable wind and solar to meet increased demand in the future and deliver cheaper, longer-running electric vehicles. The University of Sheffield has recently been awarded £11m from the Faraday Institution to develop the next generation of lithium-ion battery cathodes with longer lifespans and increased energy density. The FutureCat project will see the team use a co-ordinated approach to cathode chemistry design, development and discovery to deliver cathodes that hold more charge, are better suited to withstand prolonged cycling

and promote ion mobility – all of which could be used to increase the range and acceleration of electric vehicles. Improved cathode design could also help reduce the dependency of cell manufacturers on cobalt – an element defined by the European Union and United States as a critical raw material, which is expensive and dangerous to source, with miners often working in deadly conditions.

Professor Serena Corr said:

"Lithium-ion batteries are crucial to the performance and range of electric vehicles and developing existing and new cathodes can ultimately enhance battery performance. Our research is setting ambitious targets to make fundamental breakthroughs that will put us on the path to commercialising a battery with significant improvements to energy and power densities.

"We are also keen to improve the sustainability of lithium-ion batteries and make them more cost-effective. With the ethical, sustainability and cost concerns surrounding cobalt, our project will investigate alternatives to the traditional cobalt containing cathodes. We are investigating a range of new cathode architectures, as well as chemistries, driven by a highly collaborative and interdisciplinary approach."

Other areas where our region is involved with battery technology include:

- Cumulus Energy Storage based at the Advanced Manufacturing Park in our region offers grid-scale Copper-Zinc battery systems and has received Energy Entrepreneurs Fund investment from BEIS (the government's Business, Energy & Industrial Strategy).
- Magtec designs and manufactures electric drive systems and components for a wide range of vehicle types including off-road multi-wheeled and tracked military vehicles. The company is also one of the UK's leading manufacturers of electric drivetrains for single- and double-decker buses, which are fitted with its state-of-the-art clean technology that is in use worldwide.
- Electric Vehicle end of life disposal and battery recycling are nascent areas that could offer significant industrial opportunities. RS Bruce based in Rotherham has established the first lithium-ion battery recycling facility in the UK in 2019.

Hydrogen

More than a simple molecule, hydrogen offers high density storage of energy which will maximise the generation capacity of renewable energy. Sheffield City Region is well placed to develop hydrogen for transport as the region not only has the northern-most hydrogen refuelling station in England, capable of producing 100kg of hydrogen per day, it is also home to ITM Power whose new electrolyser manufacturing facility is the largest in the world.

From 2020, the facility will manufacture integrated hydrogen energy solutions for grid balancing, energy storage and the production of green hydrogen for transport, renewable heat and chemicals. In addition, Sheffield City Region has another electrolyser manufacturer, CPH2, based in Doncaster, which has ambitious plans for growth over the next five years. The ability to build on this and expand access to hydrogen as a fuel source is an important opportunity for our region, both in terms of reducing emissions from road transport, but also in developing our capability in the research and development of hydrogen refuelling technology. **This is equipping us with skills and technology we can export elsewhere.**

Sheffield City Region and the multidisciplinary company Arup established the South Yorkshire Hydrogen Network. This brings together experts from all sectors to share knowledge about hydrogen opportunity areas in South Yorkshire and bring forward ambitious plans for Sheffield City Region to become a hydrogen economy.

Minewater Energy

Around 30% of Sheffield's built environment sits on a former coalfield – and there are estimated to be over 400 former mines in South Yorkshire. With little or no seasonal variation in temperature (water is usually retained at 11-21oC), minewater is an ideal source energy to provide low carbon heating or cooling for 4th and 5th generation heat networks. Sheffield has expertise in this area as a heat network was established in the city in 1988, which delivers heat to over 140 buildings across the city via 45km of distribution pipework.

Sheffield City Region is working with strategic partners including the Coal Authority, BEIS, the Environment Agency, and the North East, Yorkshire and Humber Local Energy Hub to further explore the opportunities to harness energy from minewater.

RECENT ENERGY SUCCESS STORIES IN THE SHEFFIELD CITY REGION

Blackburn Meadows is a typical example of the changing energy landscape in the Sheffield City Region. It started life as a coal fired power station back in 1921, but was closed and alternative power sources were sought. It was rebuilt and reopened in 2014 as a cutting-edge biomass recycling station, taking waste wood from the surrounding area to power 40,000 homes and thus paving the way for a renewable energy future.

Sheffield's district energy network has been providing an economical, low carbon and environmentally-friendly heat source to buildings in Sheffield since 1988. The Energy Recovery Facility (ERF) in Sheffield, generates electricity for the National Grid and heat for the local heat network from the city's rubbish.

Heat provided by the district energy network prevents around 21,000 tonnes of carbon emissions from being released every year.

The Templeborough Biomass Power Plant in Rotherham generates around 41 megawatts of green energy, which powers 78,000 homes and saves 150,000 tons of CO₂ per year.

DID YOU KNOW?

In Sheffield City Region, 1,500 people work in nuclear technologies across 230 nuclear companies, including the Nuclear Advanced Manufacturing Research Centre, UK Atomic Energy Authority, Chesterfield Special Cylinders and Sheffield Forgemasters.

27% of UK electricity is generated within Northern Powerhouse, with over 30% of UK renewable electricity being generated here.

At £350 billion, if it were a country, the Northern Powerhouse has a GDP which would make it the 21st largest economy in the world (Department for International Trade, 2017)

**We are developing our energy story – and are looking for partners to collaborate.
Be part of our journey into a low carbon future.**



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