

# INSIGHT AND INNOVATION

Learn more about our expertise across the entire energy journey from generation to consumption. From advanced new materials and smart technologies to fresh perspectives on policy and behaviour, we tackle the energy challenge from all angles.

Energy

GLOBAL CHALLENGES MANCHESTER SOLUTIONS

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# 600 researchers. A £75 million research portfolio. World-class facilities. Strategic industry partnerships.

Our network of Manchester Energy researchers work across diverse fields including power networks, advanced materials, climate change and clean energy generation such as nuclear, solar, wind, tidal and bioenergy. We also explore how societies can develop low-carbon futures.

With such scale and scope, we look forward to a brighter, more sustainable world tomorrow.





#### **Energy transitions**

What technologies, policies, markets and controls do we need to expedite a low-carbon future?

**Policy modelling** 

**Socioeconomics** 

**Behavioural insights Carbon accounting** 

We explore the whole spectrum of geographical, socio-political and economic systems to develop effective policy mechanisms and incentives to reduce emissions of greenhouse gases and mitigate the impacts of climate change.

Tyndall Manchester has an international reputation for delivering cutting-edge and impartial analyses based on its unique interdisciplinary expertise. Our reports and evidence have informed climate and energy policy and legislation at all levels.

The Sustainable Consumption Institute uses systems thinking to help us understand how we can transform approaches and attitudes on a global scale to align energy and material production and consumption with global carbon reduction targets.

The Manchester Urban Institute explores our options for more economically, environmentally and socially sustainable cities. It focuses on vulnerabilities in urban neighbourhoods, the impact of smart technology, inequalities and governance.

#### **Energy networks**

How do we manage grid instabilities today and design better grids for tomorrow?

> Smart technologies Systems science **Distributed grids Big data**

With the rise in commercial and micro-generation from renewable sources, we are helping to efficiently integrate these intermittent energy sources into the electricity grid. Our research is producing new ways to harmonise different systems and networks - electricity, heating, cooling and transport - to improve overall energy efficiency both within the UK and across international borders. Our research also shows how smart data analytics makes networks more reliable with greater capacity despite the dramatic change in the fuel mix. We are also leading the development of new forms of equipment for use on the electricity network, such as new transformer designs that use greener and safer insulating oils and overhead lines that can operate at reduced height and with guieter conductors.

#### Materials

Can we design new materials that improve system efficiencies but lower environmental impacts?

Advanced chemistry Graphene 2D materials

Materials testing

We are making more robust and effective battery materials to make it easier to balance power supply and demand and improve electric transportation. Resilient and smart materials are also essential so components in the next generation of nuclear power reactors can withstand extreme environments for the long-term

The £61 million National Graphene Institute in Manchester draws in specialists from across the globe. It houses state-ofthe-art cleanrooms, plus laser, optical, metrology and chemical labs and equipment – the ideal environment for world-class research in graphene and other 2D materials.

#### Nuclear

How do we enhance nuclear energy's contribution to low-carbon generation?

Next generation design	Life extension
Waste	Decommissioning
Advanced materials	

We have strengths across the full nuclear fuel cycle from plant and component design to decommissioning and waste management. In the UK and elsewhere, nuclear generation has a key role to play in helping countries meet ambitious targets for carbon emissions reduction. Our research is helping operators to extend the life of existing plants while developing the next generation of reactor designs to offer greater efficiency and enhanced safety.

The **Dalton Nuclear Institute** is the UK's largest and best-equipped university centre for nuclear research and professional training. We collaborate with all major stakeholders in the industry including commercial operators, regulators and specialist service providers









#### Bioenergy

What contribution can crops and novel bioenergy sources make to low carbon generation?

#### Synthetic biology

Industrial biotechnology

#### Life cycle assessment

Sustainable development

More than 60 core researchers and additional support staff are involved with research related to bioenergy. Our multidisciplinary projects involve researchers from engineering, physical and life sciences, humanities and social sciences. Projects range from engineering algae to analyses of biomass supply chains and controlling airborne emissions.

The University of Manchester coordinates the UK's flagship interdisciplinary Supergen Bioenergy Hub. This national programme is developing new approaches for dealing with the significant engineering challenges associated with bioenergy implementation and technology deployment. Interdisciplinary studies are also investigating the impacts of bioenergy on ecosystems, social responses to technology deployment and the economic context of policy development.

#### Oil and gas

How can we help companies make more efficient use of existing resources?

#### **Exploration**

Modelling and simulation

**Advanced materials** 

Extraction

We work with the major oil and gas corporations on fuel supply and security as global society moves towards a low-carbon economy. Our expertise is solving the engineering challenges associated with the exploitation of reserves located in deeper water and other difficult environments.

The collaborative \$100 million BP International Centre for Advanced Materials (BP-ICAM), headquartered at The University of Manchester, is conducting research to improve the safety, reliability and performance of materials used in the oil and gas industry. BP-ICAM is helping to extend the lifetime of pipelines, prevent and mitigate corrosion and improve the efficiency of membranes used in separation processes.

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### We deliver solutions... ...for a low-carbon future

The global growth in population and energy demand means that people are still emitting too much carbon and depleting limited natural resources. Only breakthrough solutions – a mix of novel technologies and purposeful policy-making – can secure our future. Without research and urgent action, what kind of a world will the next generation inherit?

Sometimes solving immediate industry or policy issues, sometimes investigating fundamental science, we always focus on how to make the world a better place. We don't just want answers to questions; we want solutions that will work.

#### Policy

- Insights and advice to governments on tackling fuel poverty through The University of Manchester-led European Energy Poverty Observatory (EPOV)
- Key evidence supports UK as first in world to write carbon budgets into legislation
- First socioeconomic evaluation of novel energy storage technologies as a key element of a low-carbon economy

#### Industry

- Quantum dots improve performance of solar cells
- Corrosion studies allow nuclear plant operators to extend plant generation life
- Development and testing of novel, advanced nuclear fuels and cladding materials
- Bioengineered enzymes and metabolic processes for first synthetic propane production
- Submersible mini robots inspect and help maintain inaccessible areas of nuclear plants
- Novel GPS system helps prevent power blackouts
- Novel Arago cross arms for electricity pylons double transmission power and permit lower towers

#### Science

- Comprehensive analysis demonstrates dramatic reduction in build time and costs of nuclear plants using carbon dioxide instead of steam to drive turbines in pressurised water reactors
- Feasibility study shows rice straw's potential as a fuel source in the Philippines
- First in the world to use pulsed electron paramagnetic resonance technology to measure covalency in actinide bonding, paving the way for multiple avenues of research in actinide chemistry and helping in a range of technologies including in nuclear fuels and the separation and recycling of nuclear waste
- We are improving the imaging and modelling of fluids (oil, gas, CO<sub>2</sub>) in reservoir rocks at multiple scales
- Analysis of the pattern of reflected acoustic waves Acoustic Pulse Reflectometry - applied to develop a non-destructive, non-invasive pipeline surveying tool to detect blockages in high-pressure natural gas pipelines and quickly identify damage such as corrosion

## **Unique facilities**

Our collaborators and partners have unprecedented access to our comprehensive range of state-of-the-art and bespoke experimental equipment and powerful computing infrastructure, all supported by specialist technical experts.

#### These facilities include:

- The UK's largest university high voltage facility including a 2MV impulse generator
- Manchester X-ray Imaging Facility (MXIF)
- Diamond Light Source (DLS) synchrotron facility
- Six-rack RTDS real-time power system simulator with advanced capability for hardware-in-the-loop simulation
- Fully-programmable AC grid-connected energy storage system with islanding capability
- 1MW energy storage test bed
- Unique wide wave flume, wind tunnel facilities, advanced laser laboratory, materials characterisation and analysis labs, and more

#### **Dalton Cumbrian Facility**

The £20 million Dalton Cumbrian Facility (DCF) provides state-of-the-art research facilities as part of the UK's National Nuclear User Facility (NNUF). Visiting scientists from academia and industry can carry out high-end research in radiation science and nuclear engineering decommissioning, with access to the world's highest energy dual ion beam accelerator (2.5MW and 5MW) and a Cobalt-60 irradiator.

Through our partnership with the Nuclear Decommissioning Authority and the National Nuclear Laboratory we have an agreement covering academic access to the National Nuclear Laboratory's Central Laboratory, on the Sellafield site.

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