Research Councils UK

Transforming our energy future

RESEARCH COUNCILS UK

Research funded by the Research Councils makes a vital contribution to the UK's economic growth, prosperity and well-being.

We take a variety of approaches to support innovation and deliver impact from research, including the development of collaborative research programmes, investment in major research capabilities, such as national research facilities, and the support of impact-related capabilities.

Often the impact of research is realised through the combination of several investments over time. The Research Councils seek to ensure that the outputs and outcomes of their funded research have significant long-term benefits for the economy and society. This timeline, one of a series, highlights how investments made in research over the long term combine to create a significant impact in particular areas. In addition, research in one area can combine with that from another to drive innovation and make a key contribution to UK growth. For example, the RCUK SUPERGEN programme was initiated in 2002 to create a viable renewable energy research community to foster industrial engagement with the research base, generate immediately useful research and build research capacity in specific areas.

A key part of the Government's Industrial Strategy is supporting technologies where the UK has the depth of research, expertise and the business capability to develop and exploit them commercially. Energy and its storage is one of 'Eight Great Technologies' identified by the Chancellor of the Exchequer in autumn 2012 when he announced an additional £600 million to help support their development. These eight are: Big data and energy-efficient computing; Satellites and commercial applications of space; Robotics and autonomous systems; Synthetic biology; Regenerative medicine; Agri-science; Advanced materials and nanotechnology; and Energy and its storage.

Transforming our energy future

To combat climate change, the world needs to reduce carbon dioxide emissions by at least 50 per cent by 2050 – an enormous task requiring systemic changes to every sector of energy generation and use.

Research is key to achieving an affordable low carbon energy system while preserving our natural resources, the environment and our quality of life. Cleaner energy technologies such as Oyster, a wave energy harvesting system which provided its first electrical power to the grid in 2012, and innovative energy storage solutions including a new type of air-fuelled battery developed by RCUK-supported scientists that can store up to 10 times more energy than current batteries, are just some examples of how research is helping to accelerate the use of green energy technologies.

RCUK has played a key role in helping to develop energy policy over recent decades and appointed Professor Nigel Brandon as Energy Senior Research Fellow in 2003 to champion energy research both in the UK and overseas.

In 2004, RCUK was instrumental in establishing the UK Energy Research Centre (UKERC) as the focal point for the UK whole system research on sustainable energy and agreed a strategic partnership with Carbon Trust to form Carbon Vision. More recently in 2010 the International Review of Energy Research was carried and Professor Jim Skea was appointed as Energy Strategy Fellow to develop a prospectus for future energy research and training needs.

The RCUK energy programme, established in 2004, is investing more than £860 million in research and skills to help combat climate change, accelerate the deployment of green energy technologies and create new industries and growth. Only fundamental research focused on the next generation of energy systems can transform our energy future beyond 2050.

Cleaner energy

1957: The Energy Research Unit is established at the RCUK-supported Rutherford Appleton Laboratory. Today it has an international reputation in wind energy research, providing collaborative energy research and development, strategic advice and information about energy R&D priorities and outdoor test facilities for renewable energy research.

1996: The Sleipner project, supported by the British Geological Survey, begins. It is the world's first demonstration of carbon dioxide capture and underground storage at the exhausted Sleipner oilfield.

2003-05: The RCUK Sustainable Technologies Programme feeds into DEFRA's sustainable consumption work.

2004: The Atlas of UK Marine Renewable Energy Resources is first produced by the National Oceanography Centre, funded by Department for Trade and Industry.

2005: UK researchers help pave the way for the world's largest fusion reactor, building on the research undertaken through the Joint European Torus (JET) and MAST.

2005: A process for removing mineral matter from coal using chemical leaching is developed by RCUK-supported scientists; it could offer a more efficient and cleaner option for burning coal.

2006: An RCUK-supported team at the Centre for Gas Hydrate Research at Heriot-Watt University identifies a natural physical process that could secure sub-seabed storage of carbon dioxide produced by fossil-fuelled power stations.

2008: The SeaGen turbine, supported by the Sea Mammal Research Unit, is installed at Strangford Lough, producing 6,500 MW-hr per year, a commercially viable amount of electricity. MCT aims to deploy 500-1,000 turbines in UK waters by 2020.

2008: A Knowledge Transfer Partnership between the National Oceanography Centre and Pelamis Ltd leads to global maps of ocean wave power based on satellite altimeter wave period data. Ocean wave power maps are used by renewable energy companies to characterise wave resources worldwide.

2008: Invented by RCUK-supported researchers in the UK, the 'Anaconda', an innovative wave energy concept, is unveiled. The system's ultra-simple design means it is cheap to manufacture and maintain enabling it to produce clean electricity at lower cost than other types of wave energy converter.

2009: Scientists draw up a roadmap to identify potential obstacles and challenges to the implementation of carbon capture and storage technology in Britain.

2009: RCUK funding establishes the Sustainable Bioenergy Centre which aims to bring together academics and industry to develop UK capability in bioenergy.

2011: Based on a 2009 DECC report, Prosperity without Growth is named as one of the most significant social science publications of recent years. The book introduces new conceptual understandings in the field of sustainable living.

2011: An RCUK-sponsored research team at the University of Warwick and spin-out company Molecular Solar Ltd create solar cells from an ultra-thin layer of gold deposited on to a flexible plastic film instead of the traditional method which uses glass, with the potential for cheaper solar power.

2011: Research Council spin-out Cella Energy is formed. In collaboration with UK researchers, the company develops a novel technology that allows hydrogen to be stored in a cheap and practical way.

2011: Research by UK scientists, using the RCUK-supported ISIS and Diamond facilities, demonstrates how efficient solar cells can be manufactured using flexible layers of material deposited over large areas like cling-film.

2012: The first electrical power is supplied to the grid from a fully operational second-generation Oyster 800 wave energy machine, installed by Aquamarine Power, a company set up to commercialise RCUK-sponsored research, at the European Marine Energy Centre in Orkney.

2012: UK scientists, using the RCUK-funded facility, ISIS, develop a new material, NOTT-300, with the potential to revolutionise the capture of greenhouse gases.

2012: Scientists at the University of Oxford and Diamond Light Source describe a new chemical catalyst for producing methanol, a promising future biofuel. By reducing the energy needed to convert biomass to methanol, the new catalyst offers a more sustainable way to make the useful chemical and fuel.

2013: After demonstrating how a wave farm of multiple Oysters will operate, Aquamarine Power receives full consent from the Scottish Government for a 40MW wave farm off the north-west coast of Lewis, Scotland – making it the world's largest fully permitted ocean energy site with 10 per cent of Europe's wave power potential and 25 per cent of its offshore wind and tidal power potential.

2013: Researchers at the University of East Anglia publish the first study to look at supply and demand for bioenergy over the whole of England.

Energy efficiency

2003: Research Council spin-out, Oxsensis Ltd, is formed. The company has produced a sensor that can withstand hostile environments and can help improve the energy efficiency of gas turbines used in aircraft engines and power stations, helping to reduce greenhouse gas emissions.

2005: The 40 per cent House project demonstrates how to cut the UK's residential energy use by 60 per cent of carbon emissions before 2050.

2005: The Carbon Reduction in Buildings (CaRB) project, part of the Carbon Vision programme, is initiated to better understand which energy efficiency measures and which renewable energy technologies are most appropriate to different buildings.

2009: University of Cambridge researchers develop a new technique that paves the way for the UK manufacture of affordable LED light bulbs.

2009: The HOTFIRE project, supported by RCUK, develops a new car engine that sprays fuel straight into the cylinders without needing to mix it with air, boosting fuel efficiency and delivering a 15 per cent cut in carbon emissions.

2009: The world's first fully sustainable racing car is developed with RCUK support, paving the way for green motorsport and showcasing cutting-edge materials technologies.

2010: Pioneering engineers at De Montfort University together with E.ON create an intelligent heating device – the Wattbox – which learns householders' energy habits and could lead to home energy savings of up to 20 per cent without compromising comfort.

2011: Pilio, a company spun out from the University of Oxford, creates the sMeasure and iMeasure software, which helps Small and Medium Enterprises (SMEs) to assess a building's energy performance and make informed decisions on prioritising energy-saving investment.

2013: Researchers use UK facilities to investigate a new zeolite material, ITQ-29, that could be used to improve the separation process or propylene from propane, reducing the amount of energy used by the petrochemical industry.

2013: A new £1 million growth facility for growing Gallium Nitride opens in Cambridge, enabling researchers to expand and accelerate their pioneering work in the field of low-cost, highly efficient LEDs.

2013: A revolutionary pilot manufacturing facility that can turn buildings into power stations by helping them generate, store and release their own energy, is launched in Baglan, Wales. Production begins on eco-friendly functional industrial coatings for integration into the fabric of roofs, walls and ceilings of new and existing buildings.

2013: Eight19 Limited, a solar energy company formed to commercialise RCUK-sponsored research, develops a pay-as-you-go personal solar electricity system for the developing world. The IndiGo system uses high-performance, low-cost plastic solar cells capable of generating solar electricity for off-grid applications.

2013: Research at the RCUK-funded Loughborough University Innovative Manufacturing Research Centre leads to a technique, adopted by Mercedes, Vauxhall and BMW, that helps replace copper wiring used in cars with printed flexible circuits, reducing the weight of a car by 40-70 kilogrammes and lowering fuel consumption.

Nuclear

1950s: The Geological Survey of Great Britain starts providing advice on nuclear waste disposal.

1997: The British Geological Survey (BGS) complete investigations for Nirex into proposals for an underground storage facility at Sellafield.

2003: Stewardship of the UK Fusion programme moves from the DTI to RCUK to improve links with the academic research base and for fusion research to be considered in the context of broader national research programmes.

2003: The Keeping the Nuclear Option Open (KNOO) consortium is initiated to address some of the key areas in nuclear fission power.

2005: A letter of arrangement is signed with the major nuclear energy stakeholders, AWE, BNFL and the Secretary of State to allow closer collaboration.

2006: UK research into the structural integrity of two UK nuclear power stations helps extend their lifespan for five more years.

2008: New expansion of the nuclear industry is initiated by the 2008 Nuclear White Paper, which was itself informed by computer models developed by the RCUK-funded UK Energy Research Centre.

2010: The UK Fusion for Energy Strategy is published.

2010: The RCUK Nuclear FIRST (Fission Research, Science & Technology) Centre for Doctoral Training is initiated to find a new generation of experts with the skills to turn 21st century visions of nuclear energy into a reality.

2012: UK scientists use the RCUK-funded ISIS facility to trial a new method of nuclear waste clean-up. Hydroxyapatite, a bio-mineral similar to bones and teeth, is produced by Serratia bacteria and can be used to absorb radioactive materials from the soil. UK scientists are now working with the Japanese Atomic Energy Agency and will be testing the method on Fukushima contaminated soils.

Energy storage

1980s: Pioneering work by RCUK-supported researchers in Oxford on $LiCoO_2$ leads to the first commercial lithium-ion battery and subsequent portable electronics revolution.

1990s: The discovery of $LiMn_2O_4$ spinal positive electrodes, lower in cost and safer than $LiCoO_2$, results them being the material of choice for the first generation of electric vehicle batteries.

2007: UK scientists develop a compound of the element lithium which may make it practical to store enough hydrogen on board fuel-cell-powered cars to enable them to be driven over 300 miles before refuelling.

2009: RCUK-funded researchers develop a new type of air-fuelled battery that could give up to 10 times the energy storage of current batteries, paving the way for a new generation of electric cars, mobile phones and laptops.

2010: Energy storage research co-developed by RCUK-supported researchers at the University of Leeds, Chinese scientists, and commercial partners leads to the creation of a joint international research institute with over 45 researchers working on over 20 projects. A pilot project has been providing electricity to the National Grid since April 2010 with the capacity to meet the power needs of several hundred houses for up to eight hours.

2011: RCUK-sponsored researchers develop a revolutionary type of personal power pack that is up to 50 per cent lighter than conventional chemical battery packs used by British infantry, the solar and thermoelectric-powered system could make an important contribution to future military operations.

2012: UK researchers use the RCUK-funded ISIS facility to define the mechanisms for how lithium-ion batteries work at the atomic scale. This understanding will allow better battery materials to be used in the future, and could lead to nanoparticles being used as the cathode component of batteries. Using nanoparticles changes the properties of the material, with potential increases in efficiency possible.

Transforming our energy future

RESEARCH COUNCILS UK

The seven Research Councils are:

- Arts & Humanities Research Council (AHRC)
- Biotechnology & Biological Sciences Research Council (BBSRC)
- Economic & Social Research Council (ESRC)
- Engineering & Physical Sciences Research Council (EPSRC)
- Medical Research Council (MRC)
- Natural Environment Research Council (NERC)
- Science & Technology Facilities Council (STFC)

Research Councils UK
Polaris House, North Star Avenue
Swindon, Wiltshire SN2 1ET
United Kingdom
Tel: +44 (0) 1793 444420
Fax: +44 (0) 1793 444009
Email: info@rcuk.ac.uk
Web: www.rcuk.ac.uk

www.rcuk.ac.uk

Research Councils UK is the strategic partnership of the UK's Research Councils.

We invest annually around £3 billion in research. Our focus is on excellence with impact. We nurture the highest quality research, as judged by international peer review providing the UK with a competitive advantage. Global research requires we sustain a diversity of funding approaches, fostering international collaborations, and providing access to the best facilities and infrastructure, and locating skilled researchers in stimulating environments.

Our research achieves impact – the demonstrable contribution to society and the economy made by knowledge and skilled people. To deliver impact, researchers and funders need to engage and collaborate with the public, business, government and charitable organisations.

RESEARCH COUNCILS UK