Front Cover & Fiddlers Ferry images Courtesy of Gareth Bailey STFC Employee

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News from the
Science and Technology
Facilities Council

Exploring & Understanding Science

fascination

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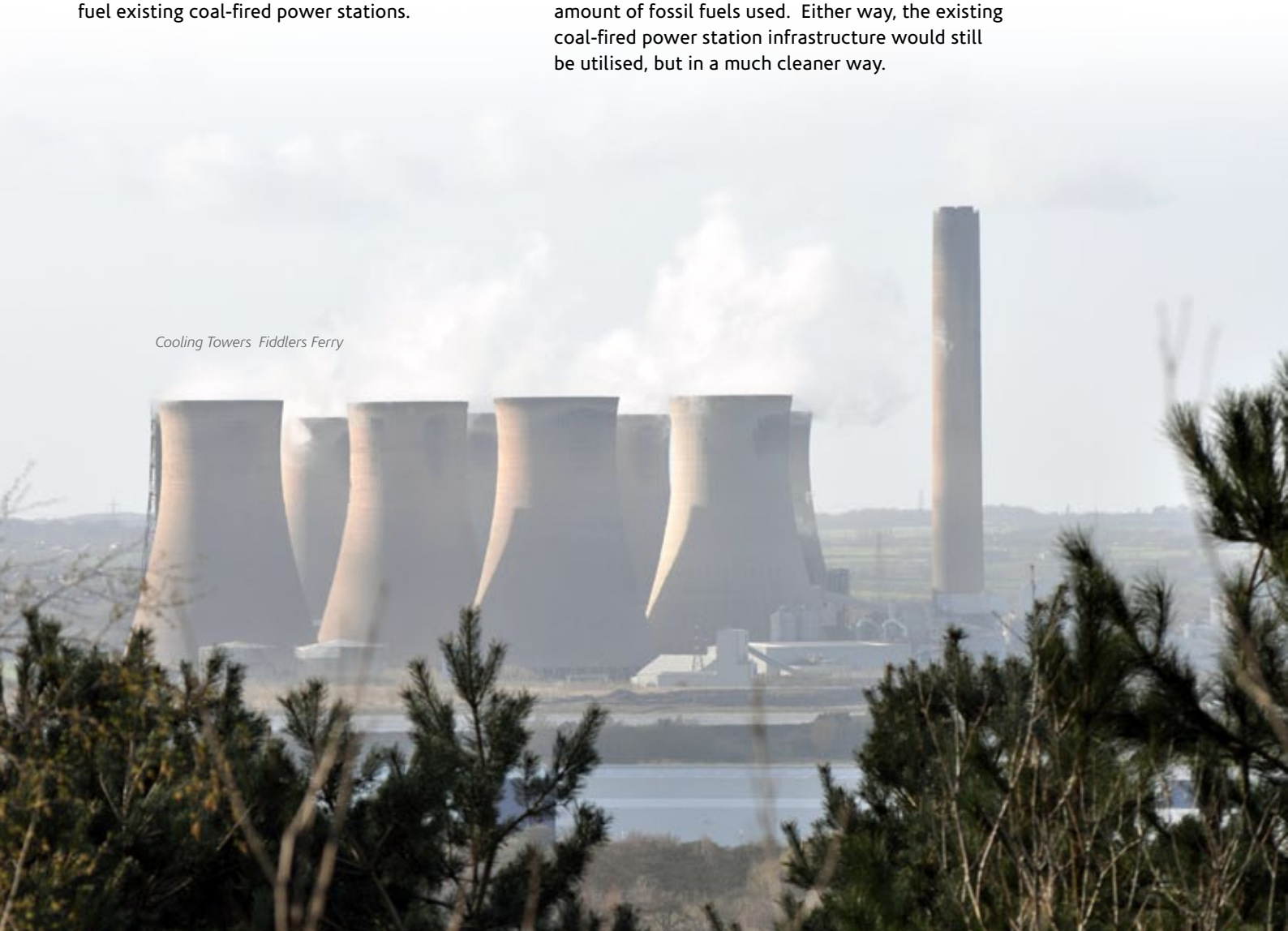
Science & Technology
Facilities Council

Sea 2 Sky

Managing climate change requires a breadth of actions, by governments, companies and individuals to protect our environment. Green technologies provide some of the solutions that are needed, for example, finding ways to meet our need for power to consume whilst reducing the pollution from power plants.

Coal-fired power stations and fossil fuels in general contribute significantly to global warming and a range of options are being examined as alternative power sources. Another crucial step is to develop a 'green' alternative to coal to reduce the world's dependence on fossil fuels. Liverpool-based green energy company, Sea2Sky Energy UK Ltd has brought its R&D operations to STFC's Innovations Technology Access Centre (I-TAC) at Daresbury Laboratory. Sea2Sky are looking to develop the technology in a co-operative effort with STFC to produce a low-carbon alternative to coal that could fuel existing coal-fired power stations.

Using the £3M high tech equipment available at I-TAC, that would normally only be available to academics and large budget companies, start up company Sea2Sky Energy UK is refining an existing technology known as torrefaction. This technology can be used to convert organic waste, such as roots, branches, leaves, in fact any biomass that would decompose and release greenhouse gases in the process after a tree has been cut down, to produce a biocoal that could either completely replace the coal used in existing power stations or at least be used alongside coal to reduce the amount of fossil fuels used. Either way, the existing coal-fired power station infrastructure would still be utilised, but in a much cleaner way.



Cooling Towers Fiddlers Ferry

What are the benefits of **'blue-sky'** science?

At a time where every penny counts, the STFC is making the case that fundamental or blue-sky research yields long term benefits to society as well as the more obviously applied work.

STFC's science is both application led and curiosity driven. Each of our areas of research has had an impact on people's lives -nomore so than astronomy, surely the definition of 'blue sky' research. Modern astronomy changes the way we see our world, the solar system in which it exists and our understanding of how the Universe was formed. UK scientists are second only to the US in this discipline, but beyond the astounding discoveries they make, their work has much wider impact.

The Royal Astronomical Society has produced a booklet, supported by STFC, which sets out some of the ways in which astronomy has had an impact on wider society, including its very wide public appeal and consequent vital role in inspiring young people to study science, as well as a breadth of technological advances that have transferred into everyday life – including wifi, GPS and the charge couple device (CCD) used in astronomical instruments, now in virtually every mobile phone and digital camera!

Royal Astronomical Society - http://www.ras.org.uk/publications/other-publications/1868-new-view-universe
The cutting-edge tools and techniques developed by astronomers to peer into the furthest reaches of the cosmos are now finding applications outside astronomy, ranging from devices for medical imaging through to sensors for security and defence. Astronomy technology is helping to address real-world problems here on Earth. Whilst the RAS study outlines the past contributions astronomy has made, an 'Applications of Astronomy' Conference, taking place at the STFC'S UK Astronomy Technology Centre - http://www.stfc.ac.uk/news+and_events/19687.aspx, and the Royal Observatory Edinburgh, (13-15 October) will focus the thoughts of current researchers on the wider applications of astronomy.

The conference will give an overview of technologies and techniques developed in astronomy, highlight the solutions they offer for solving commercially relevant issues, and provide information and guidance on how academics and industry can collaborate to develop future applications.

Blackford secures investment

Blackford Analysis is Scotland's newest university spin out company. A software company founded by astronomy experts, it is embarking on an ambitious programme of business development at home and in the USA after securing a six figure investment sum.

The original research was conducted at the university of Edinburgh and was partly sponsored by STFC through a Follow on Fund Award. The patented software was first developed to determine the age of stars in the Universe.

However the technology can be applied to many sectors where processing large amounts of data is routine, including seismic interpretation for oil and gas surveying, and fast image analysis for defence. Blackford's initial focus has been in medical imaging, where its technology can improve the diagnosis process for MRI and CT (computerised tomography) scans by automatically preparing images for radiologists.

http://blackfordanalysis.com/

Royal Patron for Science and Innovation Campuses

His Royal Highness The Duke of York has agreed to be Royal Patron of the two national Science and Innovation Campuses.

In his capacity as the UK's Special Representative for International Trade and Investment, His Royal Highness will help raise the international profile of the two Campuses, at Daresbury in Cheshire and Harwell in Oxfordshire, as world-leading centres for business, investment in multidisciplinary science, research and development.

The **mighty microbe** behind coastal erosion?

Diamond Light Source is a third generation synchrotron light source facility based at the Harwell Science and Innovation Campus. Diamond Light Source Ltd is funded by the Science and Technology Facilities Council (STFC) and the Wellcome Trust, owning 86% and 14% of the shares respectively.

Diamond produces X-ray, infrared and ultra-violet beams. These highly focused beams of light enable scientists and engineers to probe deep into the basic structure of matter and materials.

Using Diamond Light Source a team of scientists led by Professor Charles Cockell at the Open University, have been studying the weathering of shale cliffs in North Yorkshire to understand physical and chemical interactions on the molecular scale that could cause weakening of the cliffs , including the intriguing possibility that a novel microbial community might be responsible.

At least 17% of the UK coast suffers from erosion and the shale cliffs on the North East coast of England are particularly at risk.

The shale contains pyrite and there are micro-organisms known to catalyse pyrite oxidation. If the microbial community inhabiting the shale is oxidising pyrite along fracture planes in the shale, this could lead to rock weakening and detaching from the cliff. The team collected samples from cliff faces close to the village of Staithes in Yorkshire.

The samples were studied with a range of techniques to determine the physical characteristics of the surface and to examine the oxidation states within the surface weathering layer of the shale. They also examined the DNA within the bacteria and found there to be a novel microbial community with low diversity. While they were unable to determine a precise cause and effect mechanism between the microbes and weathering of the pyrite in the shale, some of the microbes were very similar to organisms found in iron oxidation environments. There are also methods of biological weathering to which the micro-organisms could contribute.

"We have shown that the microbial community in the shale could be changing the chemical conditions on the surface of the shale, and therefore contributing to rock weathering. But the potential impact is not limited to coastal erosion. The oxidised pyrite can produce sulphuric acid which can damage the local environment. Shale is also involved in the long-term carbonate-silicate cycle, during which CO_2 is consumed, reducing atmospheric CO_2 concentrations, which is then compensated for by volcanic eruptions. Further study of the microbes and how they interact with the rock surface will allow us to understand the extent to which they are responsible for rock weathering and other effects on the macroscopic scale", said Professor Charles Cockell.

http://www.diamond.ac.uk

STFC seeking input to Spending Review plans

The Government announced on 22 June plans for major reductions in government spending over the next four years to contribute to rebalancing public finances and in October will outline its plans to do so in the Comprehensive Spending Review. The budget for publically funded research may be made known at this time, or later in the year, STFC and the other research councils are putting forward clear plans for the future to ensure the UK retains its leading role in as many areas of science as possible. It also continues to be important to provide evidence to Ministers, HM Treasury and the Government of the tangible value of publicly funded science and research to the taxpayer.

STFC has been consulting key groups from our communities, university and business partners. STFC Council is overseeing the activity and leading on the planning. Although it will be some time before we know the outcome STFC is keeping its staff fully informed of all developments.

World-unique laser '**Octopus**'

- helps study tumours at the new Research Complex at Harwell

An 'Octopus' that comprises a complex set-up of multiple lasers and unique microscopes, that will be used to study the interaction of molecules within tumours, is among the first experiments at the newly-opened Research Complex at Harwell (RCaH).

Project OCTOPUS (Optics Combined To OutPut Unique Solutions) allows researchers to 'tag' multiple different species of proteins simultaneously with different coloured lights so that they can identify behavioural patterns.

Over the past six weeks scientists from the Lasers for Science Facility in STFC's Central Laser Facility and collaborators King's College London have been recording these interactions and developing a sophisticated software platform capable of revealing the meaning of the results.

Once the models have been added into the developed software, repeated tests will be carried out to demonstrate the consistency of these interactions in the laboratory and then the way the behaviour of the protein network changes when drugs designed to treat cancer are introduced.

Eventually, these same experiments will be conducted on primary cells from patients and tumour biopsies so that interactions can be further monitored and predictions on treatments can be tested. The ultimate aim is to build up enough of a picture of the way molecules interact in the presence of therapeutic drugs to enable concrete predictions to be made about which would be suitable for which patients according to the behaviour of their specific protein network interactions.

OCTOPUS is a unique set up because of its size and the number of lasers and microscopes it brings together, but also due to its ability to illuminate up to five species of protein simultaneously to reveal an unprecedented level of detail about the way molecules interact. The project is made possible thanks to sustained funding from STFC for several years and a grant from the Biotechnology and Biological Sciences Research Council (BBSRC).

OCTOPUS is one of numerous projects taking place within RCaH that benefit from bringing together scientists from all disciplines under one roof. RCaH which formally launched on 9 July is a joint initiative between BBSRC, the Engineering and Physical Sciences Research Council, Natural Environment Research Council, Science and Technology Facilities Council, Medical Research Council and Diamond Light Source.

Talking Science Trying **Science**

The Science in Society programme engages the public with STFC's science and technology. It aims to stimulate interest in science, to link STFC science and technology with schools and young people, to encourage the uptake of scientific training and skills, to support researchers' public engagement work, and to develop the STFC Laboratories and Campuses as excellent technical sites for outreach and training programmes.

Talking Science is a series of popular science lectures that take place at, or close to, STFC sites across the country. They offer a chance to hear about and discuss some of the hottest areas of science with some of the leading experts. You don't need to be an expert or even a scientist to come as they're aimed at everyone.

Every year STFC tackles a wide new range of topics. This year the Rutherford Appleton Laboratory series starts off with 50 years of the Laser and the impact of lasers on surgery and medical research. At Daresbury Laboratory the series commences with the engineering challenges involved in building a particle accelerator. As if to prove the diversity Swindon's Talking Science Lectures 'kick off' with a look at the physics underpinning the movements of a spinning ball.

http://www.stfc.ac.uk/Public+and+Schools/1284.aspx

Summer work experience placement projects at STFC

Students across Oxfordshire have spent the summer holiday programming robot prototypes designed to explore other planets and researching solutions to combat climate change.

Seventy GCSE and A-Level students have been taking part in work experience placements which were run by the Science in Society team who organise educational and public outreach events at STFC's Rutherford Appleton Laboratory (RAL). The placements ranged from space science, particle physics, laser science and communications and gave the students the opportunity to contribute to high tech science research to help prepare them for the competitive work place environment.

One of the projects, based in RAL Space, involved producing a series of interactive, hands-on classroom activities using a prototype robot or 'rover' to help primary and secondary schools learn more about science, computer programming and technology. The students also worked on the design of the robot adding equipment to measure temperature and an infrared finder to tell the robot how close it was to an object.

Work experience students at the Rutherford Appleton Laboratory.

Another group of students worked intensively over a two-week period on the GeoEngineering for Climate Change (GE4CC) project. The students investigated carbon capture and other technological ways of combating the build-up of carbon dioxide in the atmosphere. The students' report will feed into the STFC's Futures Programme which looks at where research can be best applied in areas which make a difference to people's lives.

The work experience projects not only equip the students with new skills and confidence, but can be invaluable for scientific research. http://www.stfc.ac.uk/Public+and+Schools/1286.aspx

STFC helps teachers make a Big Bang in the classroom

STFC has been helping physics teachers across the UK to stay at the forefront of the latest developments in physics research and bring these new ideas back to their classrooms and tomorrow's young scientists.

This year, almost 300 secondary school physics teachers have visited CERN, the European Particle Physics Laboratory in Geneva, to view the Large Hadron Collider - the world's largest science experiment.

CERN offers residential courses, lectures and tours for physics teachers from across the world, in their mother tongue, as part of its education programme. These give a valuable opportunity for teachers to re-connect with their subject and further their professional development.

STFC's Science in Society programme has funded UK teachers to help cover the cost of courses. STFC also contributes to the joint research councils Continued Professional Development Programme (CPD) for teachers, set up in collaboration with the National Science Learning Centre, to help secondary school teachers deliver some of the more challenging aspects of the curriculum in a way that captures and inspires their pupils. Teachers are also put in touch with local particle physics research groups.

David Alston, Physics teacher at North Walsham High School, Norfolk, a delegate at the CERN learning and evaluation tools conference said: "I cannot think of any course that I have ever done that has inspired me to do so much reading after I have been on it or any other course that I would ever step close to attaching the label of 'life changing' but with this one that label is tightly tied."

The UK subscription to CERN is provided by STFC. Since 1998, more than 560 physics teachers in total from the UK have visited CERN. This is the highest amongst all the other 20 member states, reflecting STFC's commitment to support modern physics teaching and inspire the UK's young physicists of tomorrow.

http://www.cern.ch/

CERN UPDATE

CERN has agreed a new medium term plan for the next five years, with reduced cost to member states in response to global economic circumstances.The plan protects the LHC programme, achieving cost savings by slowing down the pace of other programmes. There will be no running of CERN's accelerators in 2012. The decision to not run the LHC in 2012 had already been made for technical reasons. The whole CERN accelerator complex will now join the LHC in a year long shut down.

First results from the LHC at CERN have been revealed at ICHEP, the world's largest international conference on particle physics, which has attracted more than 1000 participants to its venue in Paris. The spokespersons of the four major experiments at the LHC – ALICE, ATLAS, CMS and LHCb presented measurements from the first three months of successful LHC operation at 3.5 TeV per beam, an energy three and a half times higher than previously achieved at a particle accelerator. UK scientists were particularly well represented at the conference, presenting the results as part of their work on data analysis and interpretation.

With these first measurements the experiments are rediscovering the particles that lie at the heart of the Standard Model – the package that contains current understanding of the particles of matter and the forces that act between them. This is an essential step before moving on to make discoveries and show that the LHC is on track to deliver great scientific breakthroughs in the coming years.

Climate data to be opened up

Joint Information Systems Committee (JISC)
JISC is funded by the UK higher education and further education funding bodies to provide world-class leadership in the innovative use of ICT to support education and research.

Climate scientists have been under scrutiny by the media for their apparent lack of openness with data. In order to combat this, climate scientists at the University of East Anglia (UEA) will soon be demonstrating new methods of providing open access to research data thanks to a major new investment from JISC to improve the way UK university researchers manage their data. Three independent reviews focused on hacked emails from climate scientists at UEA. The reviews found that the CRU researchers' scientific rigour and honesty was not in doubt, but the House of Commons Science and Technology Select Committee said that climate scientists should take even more steps to make available all their supporting data – right down to the computer codes they use – in order that research findings should be properly verifiable.

The Climatic Research Unit at UEA, in partnership with the STFC's e-Science is now embarking on a JISC-funded project that will address this recommendation. The centre provides computing, data storage and networking infrastructure for today's advanced science facilities. Building on previous work between the two organisations, the project will examine how best to expose climate data for re-use, make it easier for researchers to cite the data and also to understand its validity.

The results will be exploited by the British Atmospheric Data Centre who already provide access to a significant proportion of the climate data output of the UK research community.

The Climatic Research Unit at UEA, Credit: UEA

Cluster celebrates 10 years

July marked the 10th anniversary of the first launch of ESA's Cluster mission and the Joint Science Operations Centre (JSOC) marked the event by successfully completing the 500th week of science operations.

During the past decade, Cluster's four satellites have provided extraordinary insights into the largely invisible interaction between the Sun and Earth.

STFC's RAL Space is responsible for co-ordinating the vital science operations for ESA's Cluster mission, planning the complex operation of scientific instruments and generating the consolidated payload command set every week. This critical task is carried out by the JSOC.

Cluster's four satellites, Rumba, Samba, Salsa, and Tango, fly in formation around the Earth to provide a 3D picture of how the continuous 'solar wind' of plasma (charged particles) from the Sun affects our near-Earth space environment and its protective 'magnetic bubble', known as the magnetosphere. Cluster has revolutionised our understanding of the plasma sphere, the 20,000 km deep bubble of plasma that co-rotates with the Earth and that can have important effects on satellite navigation systems.

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