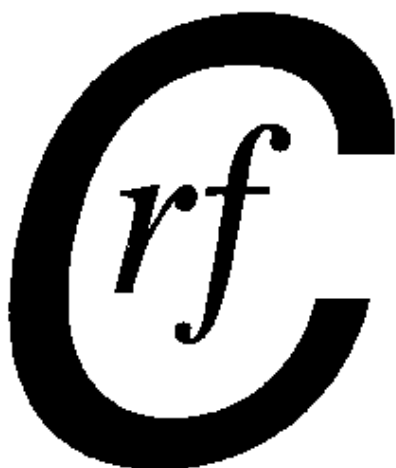


# NEWSLETTER



## *of the Coal Research Forum*

### **EDITOR'S COMMENTS:**

Welcome to the Autumn edition of the newsletter. Well, it's not really Autumn just yet - it's just that it seems like it! Anyway, I won't get started on climate change again - it's not good for my dicky ticker! What it has been so far this year is a rather quiet one as far as CRF meetings have been concerned. The last meeting was held in April and was reported in the June newsletter and the next is planned for September 15<sup>th</sup> at University of Nottingham. It is probably the lull before the (comparative) storm in that the next ECCRIA conference, the 8<sup>th</sup>, at the University of Leeds looms rather distantly on the horizon (see preliminary announcement in the Newsletter).

It seems the Government are at last fairly gingerly opening up on the likely actual costs to the consumer of addressing climate change. It is not good news as I guess most of us reading this would have expected but two interesting comments have recently been reported. "The Sunday Mirror reported that plans to cut carbon dioxide emissions in the government's Renewable Energy Strategy - due to be unveiled shortly would mean an average annual increase of £230 on household fuel bills. Mr Miliband said he did not believe the figure was accurate, but acknowledged that "whatever route we go down", prices were likely to rise. (Are you kidding?, Ed)

More recently this comment appeared in the press "Taxpayers may be forced to subsidise Britain's nuclear renaissance through a levy tacked on to household fuel bills under plans being developed by the energy industry. Utility executives have told ministers that their pledge not to use public aid to fund the £40 billion rollout of new nuclear power stations is no longer realistic".

But all is not lost as the following story reveals," Households which contribute electricity to the National Grid are to receive payments under a new government scheme. Communities will be encouraged to generate wind, water and solar power, and be paid for how much they produce. Energy and Climate Change Secretary Ed Miliband said the project would "help create the clean energy of the future". So get your old water wheel or wind turbine cranking away and you'll be quids in!!

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## **8th European Conference on Coal Research and its Applications: ECCRIA 8 University of Leeds, 5-8 September 2010**

As regular CRF members will recall our premier event is the biennial conference now recognised as ECCRIA. We are up to number eight and, as you will see, it is to be held at the University of Leeds. We are intending to make a few changes to the organisation of the conference but the format, which most agree, works well, will remain the same. One new departure for us is to have a webpage and a preliminary version is to be found at [www.eccria.org](http://www.eccria.org) I have been assured that this will be developed as time goes on.

As background to any that are new to the CRF or the conference the first UK National Meeting on Coal Research and its Applications, as it was then known, was first held in 1996 and attracted about 40 people at Loughborough University. The seventh meeting held in 2008 at the University of Cardiff attracted almost 100 abstracts, the majority being given as oral presentations, with around 25 poster presentations. A special publication of FUEL was subsequently prepared which included a number of the presentations as full papers.

For those unfamiliar with the city of Leeds it is situated in the North of England on the edge of the Yorkshire Dales. Leeds grew to become one of the largest cities in the UK following the boom of the Industrial Revolution and today, whilst retaining a rich industrial heritage, Leeds can also be regarded as a cultural centre and the financial capital of the North.

It is the only English city outside London with its own opera house, repertory theatre, and ballet companies and Leeds Art Gallery has one of the UK's best collections of contemporary British art. The city is also home to the national collection of arms and armour at the Royal Armouries.

Leeds is also known as a favoured location for shoppers and with five miles of shopping streets and one of the country's largest pedestrianised zones it's easy to see why. The city also has an excellent nightlife scene, with many restaurants and independent bars, and is widely regarded as one of the UK's best cities for dining out.

This bustling and vibrant city provides an excellent base for the conference and a showcase for the North of England, it is hoped that delegates from outside the UK continue to support the event and thoroughly enjoy their stay in Leeds.

So, watch this space and we hope to see many of you in Leeds in September 2010 if not before!

### **Vatten-fails to convince locals about burying CO<sub>2</sub>**

29 July 2009

It was meant to be the world's first demonstration of a technology that could help save the planet from global warming – a project intended to capture emissions from a coal-fired power station and bury them safely underground. But the German carbon capture plan has ended with CO<sub>2</sub> being pumped directly into the atmosphere, following local opposition at it being stored underground.

The scheme appears a victim of "numbyism" – not under my backyard. Opposition to the carbon capture plan has contributed to a growing public backlash against renewable energy projects, raising fears that Europe will

struggle to meet its low-carbon commitments. Last week, the Danish firm Vestas blamed British "nimbies" opposing wind farms for its decision to close its turbine factory on the Isle of Wight.

Many countries continue to use coal for generating power as it is the cheapest and most readily available fuel in the world. It will probably power the development of China and India. But coal is also seen as the dirtiest fuel. So, Vattenfall's Schwarze Pumpe project in Spremberg, northern Germany, launched in a blaze of publicity last September, was a beacon of hope, the first scheme to link the three key stages of trapping, transporting and burying the greenhouse gases.

The Swedish company, however, surprised a recent conference when it admitted that the €70m (£60.3m) project was venting the CO<sub>2</sub> straight into the atmosphere. "It was supposed to begin injecting by March or April of this year but we don't have a permit. This is a result of the local public having questions about the safety of the project," said Staffan Gortz, head of carbon capture and storage communication at Vattenfall. He said he did not expect to get a permit before next spring: "People are very, very sceptical."

The spread of localised resistance is a force that some fear could sink Europe's attempts to build 10 to 12 demonstration projects for carbon capture and storage (CCS) by 2015. The plan had been to transport up to 100,000 tonnes of carbon dioxide from the power plant each year and inject it into depleted gas reservoirs at a giant gas field near the Polish border.

Scientists maintain that public safety fears are groundless: the consequences of escaping CO<sub>2</sub> would be to the climate, not to public health. Many big environmental groups support CCS, both off and onshore, as a necessary evil in the battle against climate change. But Jim Footner, a Greenpeace climate campaigner, said the German protests were "a stark warning to those that think CCS is an easy solution to the huge climate problems of coal-fired power stations".

The first wake-up call came in March, when a Dutch council objected to Shell's plans to store CO<sub>2</sub> in depleted gas fields under the town of Barendrecht, near Rotterdam. This was despite a successful environmental impact assessment and the enthusiastic backing of the Dutch government, which, in September, must decide whether to give Shell the green light, despite the council's opposition.

Wim van de Wiel, a Shell spokesman, said: "For Shell the only suitable location for the tender was, and still is, Barendrecht, because of the safety and the depleted status of the [gas] field." Jeff Chapman, chief executive of the Carbon Capture & Storage Association, said Vattenfall should study the example of Total, which made great efforts to engage the local community when it launched its CCS pilot project in Lacq, southern France.

Stuart Haszeldine, a CCS expert at the University of Edinburgh, warned of the danger of opposition towards CCS snowballing into a "bandwagon of negativity" if too many early projects were rejected. "Once you've screwed up one or two of them, people are going to think 'if they rejected this in Barendrecht, there must be a reason'," he said.

In the UK, CCS is one of the four "pillars" of the government's decarbonisation strategy. A spokeswoman for the Department of Energy and Climate Change said: "We plan to store the CO<sub>2</sub> from CCS plants offshore, for example in depleted oil

and gas fields in the North Sea. We are one of the first countries to have legislation ... to regulate environmental and safety risks."

<http://www.guardian.co.uk/environment/2009/jul/29/germany-carbon-capture>

## **Future for coal hangs on carbon capture**

11 August 2009

At a bend in the Ohio River, a bulky new device is being attached to a 30-year-old coal plant near the small town of New Haven, West Virginia, USA. The device is being housed in a building four stories tall and bigger than a football field. A 150-foot-tall exhaust stack -- so wide that it would take six adults with their arms fully stretched to reach around it -- will reach into the sky. And pipelines will run out of the building and into saline aquifers two miles underground. The entire contraption will start up as early as September.

The purpose: capturing carbon dioxide emissions and stashing them in underground rock formations -- a critical part of the global effort to slow climate change. This is the technique that promoters say will make coal "clean" and critics say is an expensive pipe dream.

The stimulus bill devoted \$2.4 billion to pilot projects. On Monday the Obama administration awarded \$20 million of that to a program that uses supersonic shockwaves to compress carbon for storage, on top of \$408 million in stimulus money awarded to two other carbon pilot projects. It has pledged \$1 billion more to a model plant called FutureGen. If the Waxman-Markey climate bill becomes law, a new Carbon Storage Research Corp. would pump another \$1.1 billion a year into researching this nascent technology, and first movers would get billions of dollars more in bonus emission allowances that could be sold.

Coal companies and environmentalists alike are counting on a breakthrough in carbon capture and storage technology to siphon off harmful emissions from the world's coal plants. Coal plants in the United States account for a third of U.S. greenhouse emissions. In the past five years China has brought online coal-fired electricity equal in size to total U.S. installed capacity, and new plants are coming online in the developing world all the time. Without a breakthrough on coal plants, it may be impossible to meet emission limits climatologists say are needed.

Yet carbon capture and storage remains the elusive holy grail of the coal industry, an idea that could contain the damage inflicted by coal-burning power plants but a technology that remains expensive, energy intensive and largely untested. Even optimists say it will not be commercially available for another six to 10 years. Pessimists say it might take much longer, and may never be ready for widespread use without attaching a punishingly high price to carbon.

"There is no credible pathway towards prudent greenhouse gas stabilization targets without CO<sub>2</sub> emissions reduction from existing coal power plants," Ernest Moniz, a professor at the Massachusetts Institute of Technology and a member of President Obama's Council of Advisers on Science and Technology, said in a report earlier this year. "We urgently need technology options for these plants and policies that incentivise implementation."

Coal "is still the elephant in the room," said John Ashton, special representative for climate change at Britain's Foreign and Commonwealth Office, at a meeting in Washington last month. "We can't deal with it, we can't tame it without . . . carbon capture and storage." He said that to meet the newly agreed upon target of limiting global warming to two degrees, nations must make carbon capture "standard technology by 2020."

The West Virginia plant belongs to American Electric Power, an electric utility that is the largest consumer of coal in the United States. "Clearly carbon capture and storage is essential for a company like AEP, and I would argue equally essential for the United States, because you can't go through the process of prematurely shutting down half the supply base of the American utility industry," said Michael Morris, chief executive of AEP.

But the AEP project illustrates the tremendous obstacles ahead. As big as it is, the equipment there will only capture the emissions from 20 megawatts of power generation, a meagre 15% of the plant's output. Morris's predecessors were smart enough to buy lots of extra land at the West Virginia plant, but other coal plants would have trouble finding room.

The big capture device, built by France's Alstom, would take the exhaust of the plant after the coal is burned and "bubble" it through a solution of chilled ammonia. The CO<sub>2</sub> will bond with the ammonia and be separated from other gases. Then the carbon dioxide will be separated from the ammonia and compressed for storage.

The huge carbon capture and storage devices are hugely expensive, too. AEP executives estimate that the cost of carbon capture for a modest-size coal plant of about 235 megawatts would start at \$700 million. That works out to about \$100 for a ton of carbon dioxide, far above the projections made by the Environmental Protection Agency about prices under a cap-and-trade scheme similar to one passed by the House in June. MIT put the cost of carbon capture and storage at \$50 to \$70 a ton. (The Waxman-Markey bill would give the first six gigawatts of plants -- equal to around seven average-sized plants -- a \$90 per ton subsidy in the form of free allowances.)

Capture and storage devices also require large amounts of energy. The Alstom approach sucks up about 15% of the power plant's energy output; other processes use as much as 30%. That means the utility must purchase other energy sources to cover the shortfall. (The energy lost is part of the \$700 million cost, AEP executives said.)

As a result, many experts say countries would be better off retrofitting old coal plants or replacing them with new, more efficient ones. Retrofits could result in emission reductions of 4% to 5%, MIT said in its study. More costly replacements of older plants could cut more than a quarter of their emissions.

Storage carries its own challenges. This involves pumping the carbon dioxide into the ground; a way of sweeping coal's harmful by product under the Earth's rug -- forever. That can't be done just anywhere. Most of the Earth's rug has holes; it is too porous to keep carbon dioxide bottled up.

At the AEP plant in West Virginia, the gas will go into a saline aquifer; in other parts of the country storage can be established below geologic caps. The Obama administration has decided to provide \$1 billion to fund FutureGen, a small, new coal plant in Illinois that would store 60% of its emissions in sandstone formations thousands of feet underground. Coal plants could also sell carbon dioxide to oil companies that use it to boost oil recovery in aging wells.

Many coal plants will have to be hooked up to new pipeline networks to carry the carbon dioxide to areas more suitable for storage. If linked to enhanced oil recovery projects, that could help cover costs. Otherwise, those lines will be an added expense.

"If carbon sequestration is to have an impact on the CO<sub>2</sub> concentrations in the atmosphere, we will need to inject billions of tons of CO<sub>2</sub> underground over the next 40 to 50 years and store them for very much longer," John Tombari, an executive at Schlumberger Carbon Services, said in congressional testimony. "The sheer scale of the challenge is daunting, and the industry that will need to develop to achieve this will be massive."

Varun Rai, a research fellow at Stanford University's Center for Environmental Science and Policy, says that there is a "disconnect" between "what is happening and what is needed by 2030." He said that the world will need to capture and store 1.5 billion to 2 billion tons of carbon dioxide by 2025.

How big is that? According to the International Carbon Bank and Exchange, a private service provider for carbon trading, a new VW Beetle driven about 12,000 miles a year will generate enough carbon dioxide to fill up the Washington Monument three times. The United States produces enough carbon dioxide to cover the nation's entire land mass with a layer one foot deep every year. Greenpeace, a foe of coal-fired power, says that to sequester all the emissions from coal-fired plants, the volume of CO<sub>2</sub> would be equal to 28 million train cars a day, or a Grand Canyon every 15 days.

Legal quagmires also lurk. Someone will need to take responsibility for monitoring and maintaining storage sites that will have to last hundreds of years, said Tombari, far "beyond the likely lifespan of any corporation." And who will pay for that? If consumers pay a fee for storage, that fee will grow over time, and tomorrow's consumers might end up paying big legacy costs to make sure they contain the emissions of today's consumers. Many companies want the government to relieve them of any liability for unexpected consequences. (A naturally occurring "burp" of carbon dioxide from a Cameroon lake in 1986 killed hundreds of people.)

One of the prevailing theories about carbon capture and storage and about other climate-friendly technologies is that they will get better and cheaper over time. It is central to selling climate policies to consumers, because it permits policymakers to assert that costs will be tamed and energy prices will get only modestly higher.

"I'm prepared to bet on American ingenuity," said Sen. John F. Kerry (D-Mass.), when asked about the still dim prospects for carbon capture and storage. He said he believed that there are some "game-changing possibilities" being worked on. Indeed, one company claims to have a technique that would bubble a power plant's emissions through sea water and then trap the carbon dioxide in cement. Other firms say they have pre-combustion strategies for extracting carbon dioxide, though they face the same challenges when it comes to storage. A Stanford University study of carbon capture technologies warned that "the conventional wisdom that experience with technologies inevitably reduces costs does not necessarily hold." It said that it found "the opposite of the conventional wisdom to be true" for U.S. nuclear power from 1960 to 1980 and global liquefied natural gas from 1960 to 1995 -- both areas with substantial government support. Indeed, it found costs increased.

[http://www.washingtonpost.com/wp-dyn/content/article/2009/08/10/AR2009081002709\\_2.html?hpid=topnews&sid=ST2009081100203](http://www.washingtonpost.com/wp-dyn/content/article/2009/08/10/AR2009081002709_2.html?hpid=topnews&sid=ST2009081100203)

## **British UCG project to produce clean electricity**

14 August 2009

A project in the UK aims to combine the underground gasification of coal with fuel cell technology to produce extremely low carbon emission electricity from coal.

This is the aim of a memorandum of understanding (MoU) signed last month between two British companies, Thornton New Energy and Waste2Tricity, which is intended as the first step in the creation of a joint venture programme which will combine the two technologies to cleanly exploit deeper lying coalfields in Britain.

In January, Thornton New Energy was awarded the UK's first underground coal gasification licence by the country's coal authority, covering coalfields under the Firth of Forth, in Fife, Scotland. These reportedly cover more than 200 square miles (over 500 km<sup>2</sup>) and were previously unmineable, lying 500 m or more below the surface, which is deep by coal-mining standards.

Thornton New Energy is a subsidiary of another UK company, BCG Energy, while Waste2Tricity has the exclusive rights for the application of alkali fuel cells, developed by another British enterprise, AFC Energy, with any gasification technology (including gas from waste) within Britain. The aim is to use hydrogen gas produced by the underground gasification of the coal to feed AFC Energy's fuel cells, and so generate electricity with water as the waste product. The extraction of hydrogen from the gas generated from the coal will allow the free capture of at least 99% of the carbon dioxide also produced by the gasification process, which can then be stored or sequestered.

Underground coal gasification is very simple in principle: you gasify the coal in its seams underground, extracting just the gas – you are simultaneously extracting and processing the resource. This is done by drilling boreholes into the coal, and injecting mixtures of water and air or water and oxygen. The mixture plus the coal is ignited (through an ignition well) and the result is the burning of the coal, creating hydrogen-rich synthetic gas (syngas), which is extracted through a production well.

Thornton New Energy plans to use a process, called Controlled Retractable Ignition Point (Crips), to exploit the Fife coalfields. This will involve using the most recent long-reach and horizontal drilling and completion methods developed by the oil and natural-gas industry. A number of injection boreholes will be drilled and these will usually be long-reach wells with horizontal sections up to 500 m in length. A mixture of oxygen and steam will be injected down them. The ignition well will have an ignition source running down it, while the production well will be the simplest type of borehole, and will collect the syngas produced by the burning of the coal. When the coal around the ignition well is depleted, the ignition source will be retracted from the well and inserted into a new ignition well – hence, the term 'Crips' for this technique.

In terms of the MoU with Waste2Tricity, the resulting syngas will, after reaching the surface, be separated into two streams by a process known as pressure swing absorption; one stream will be pure hydrogen, which will then feed the fuel cells, and the other stream will be pure carbon dioxide. (In other applications, the syngas could also be used to directly fuel modified gas turbines, although it has only one-third of the calorific value of natural gas, or it could be turned into liquid fuels using Fischer-Tropsch processes – perfected, it should be noted, by South African petrochemicals group Sasol).

The underground gasification of coal is not a new idea. The concept dates back to the nineteenth century, and is believed to have originated in 1868 with two German-born engineers, the brothers Werner and Wilhelm Siemens (although Wilhelm Siemens had emigrated to the UK in 1844 and became British in 1859, being knighted in 1883 and ending up as Sir William Siemens; Werner Siemens remained in Germany, founding what is now the global Siemens group, and was ennobled in 1888, becoming Werner von Siemens – the two brothers remained closely associated throughout their lives). The concept was further developed, including detailed design work, in the 1880s and 1890s by Russian scientist Dmitry I Mendeleev.

In 1928, the then Soviet Union became the first country to develop underground coal gasification in practice and opened its first commercial-scale plant in 1938. Technically successful trials were held in various countries after the Second World War, but very cheap oil and natural gas rendered the technology uncompetitive. But oil and gas are no longer very cheap, which is why underground gasification of coal is back in favour, with various projects under development, including those by Sasol in South Africa.

<http://www.miningweekly.com/article/british-project-aims-to-use-energy-from-coal-to-produce-clean-electricity-2009-08-14>

## **Green energy plan: costs seriously outweigh benefits-report claims**

10 August 2009

The figures are buried deep in the UK Government's Renewable Energy Strategy paper produced last month. The Government's plans to increase the proportion of Britain's energy generated by "green" sources is set to cost between 11 and 17 times what the change brings in economic benefits.

The figures are buried deep in the Government's Renewable Energy Strategy paper produced last month. According to the document, while the expected cost will total around £4bn a year over the next 20 years, amounting to £57bn to £70bn, the eventual benefit in terms of the reduced carbon dioxide emissions will be only £4bn to £5bn over that entire period.

The figures make up part of the Government's impact assessment of the policies, which include plans to raise the proportion of British electricity produced by renewable sources from 5.5pc today to 30pc.

It is the Government's assessment that the non-monetary benefits of the policies will compensate for the possible £65bn shortfall, but economists are sceptical as to how much of this sum such factors can make up.

The White Paper has also calculated that household gas and electricity bills will have to rise by up to £249 a year, although Energy and Climate Change Secretary Ed Miliband has insisted that new measures to improve consumers' energy efficiency would reduce the extra cost to an average of £92 a year per home.

<http://www.telegraph.co.uk/finance/newsbysector/energy/6001259/Governments-green-energy-plan-may-cost-17-times-more-than-its-benefits.html>



## **US utility looks for alternative uses for coal-ash**

8 July 2009

The Tennessee Valley Authority (TVA) announced in July 2009 that it will pay \$1 million a year for at least the next three years to fund research on alternative ways to contain and process coal ash, the material that spilled from one of TVA's coal plants last December.

The Oak Ridge Associated Universities (ORAU) will manage the TVA-funded research to explore the effects of coal ash and ways to reuse the combustion material left from the burning of coal. ORAU is soliciting proposals for both basic and applied research on coal ash and plans to award grants for winning proposals from \$50,000 to \$300,000. The grants will cover from one to three years.

"The proposals with the highest technical merit will win the opportunity to explore ways to facilitate the scientifically sound development of new beneficial uses for coal combustion products and the creation of new environmental information," said Robb Turner, peer review manager at the Oak Ridge Associated Universities. "The knowledge will be useful not only to TVA, but also to the utility industry, regulators and the public."

TVA agreed to fund the research as part of up to \$1 billion the federal utility expects to spend on environmental studies, land purchases and cleanup costs for more than 1 billion gallons of muck and ash that spread over 300 acres on Dec. 22 when a holding pond ruptured at the Kingston Fossil Plant in Kingston, Tenn.

In 2007, coal power plants generated almost 72 million tons of ash and an additional 55 million tons of other coal combustion products, according to the American Coal Ash Association. Nationwide, about 40 percent of coal ash is beneficially used in concrete and cement products, wallboard, highway construction and other applications.

<http://www.timesfreepress.com/news/2009/jul/08/tennessee-tva-funds-study-coal-ash-alternatives/?breakingnews>

## **Marine energy research in the UK gets cash**

9 July 2009

South West England's ambition to be a global centre for harnessing energy from the sea received a major boost last week with the announcement of a £10.3 million investment in marine energy research.

The Peninsula Research Institute for Marine Renewable Energy (PRIMaRE), set up two years ago by the Universities of Exeter and Plymouth with funding from the South West RDA (Regional Development Agency), will use the cash to support its team of academics and researchers, buy new equipment and collaborate with business. The bulk of the investment, £5.3 million, has come from the ERDF (European Regional Development Fund) Convergence Programme in Cornwall (£4.2m) and the ERDF Competitiveness Programme (£1.1m) in the rest of the South West.

The South West RDA is contributing £4.3 million with a further £200,000 from the University of Plymouth and £466,000 from the University of Exeter. The funding will support PRIMaRE's 15 academic staff, 60 researchers and a dedicated technology transfer team that works with businesses to support high quality job

creation across the South West. There will be substantial investment in new equipment including wave and tidal measuring devices, wave making facilities, subsea electrical equipment, collision avoidance and monitoring equipment and research into the environmental impact and benefits of marine renewable energy.

PRIMaRE will support and complement the South West RDA's pioneering Wave Hub project, which will create the world's largest wave energy farm 10 miles of the Cornish coast and is on course to be built next year. Stephen Peacock, Enterprise and Innovation Director at the South West RDA, which plans to invest around £70 million in low carbon activities by 2012 said, 'PRIMaRE and Wave Hub are central planks in the RDA's drive towards a low carbon economy in South West England. We want our region to be one of the best places in the world to build a low carbon business and a global leader in the development of environmental and renewable energy technologies.'

Nigel Howells, Head of Competiveness in the South West, said 'Climate change presents many challenges but there are also great opportunities for new low carbon goods, services and energy production. It is only through investment in top quality scientific research and knowledge transfer to businesses that we will successfully tap these new markets. This ERDF Competiveness and Convergence investment will stimulate the creation of a whole new industry and related business opportunities.' Professor Wendy Purcell, University of Plymouth Chief Executive and Vice-Chancellor added, 'This new funding recognises the very substantial expertise in marine energy, research, development and innovation now present in the South West and provides additional support for engaging business with world-class research for the benefit of our region and the wider environment. 'In partnership with the University of Exeter, we will generate important new marine knowledge to inform the emerging renewable energy sector, positioning the region at the forefront of marine science and technology expertise.'

Accompanying the announcement, local businesses viewed the South West Mooring Test Facility (SWMTF) buoy at an event at Falmouth's Maritime Museum. Developed by the University of Exeter's PRIMaRE team, the buoy has been designed with unique features so it can obtain very detailed data to show how moored structures respond to changes in wind, wave, current and tide. Using this information, developers will be able to model and test mooring designs and components for their marine energy devices as they convert wave movement into energy.

[http://www.maritimejournal.com/archive101/2009/july/online\\_news/10m\\_boost\\_for\\_marine\\_energy\\_research](http://www.maritimejournal.com/archive101/2009/july/online_news/10m_boost_for_marine_energy_research)

## **Jet stream could generate wind power**

18 June 2009

The Carnegie Institution and California State University have published new research that shows that high altitude winds could power the world 100 times and the greatest sources of wind energy are found above some of the world's largest population centers in East Asia, the eastern U.S., southern Australia and north-eastern Africa.

The study looked at measurements compiled over 28 years by the National Center for Environmental Prediction and the DOE. What resulted are the first high-altitude wind energy maps that plot wind energy density (kW/m<sup>2</sup>) around the globe. The high population areas have an average high-altitude wind energy density of 10kW/m<sup>2</sup> compared to the average ground level wind energy density of

less than 1kW/m<sup>2</sup>. New York City has the highest wind energy density of a major city at 16kW/m<sup>2</sup>.

Researchers say the best place to capture this great source of energy is up near the jet streams at around 30,000 feet. The wind is 10 times faster than on the ground there and also blows much more steadily, making it ideal for wind power generation. As exciting as that is, it presents the large challenge of figuring out how to capture wind energy that high above the ground. One idea that has been proposed is high-flying kite turbines that are tethered to the ground. The current designs could potentially generate 40 MW of electricity and transmit it back down the tether.

Beyond just building the technology to harness those high winds, even the most steady winds stop blowing occasionally - about five percent of the time - so energy storage would also be a major factor in this type of renewable energy.

<http://www.ecogeek.org/wind-power/2815-high-altitude-wind-could-power-big-cities-and-beyo>

## **Key role in energy research for Welsh university**

17 June 2009

Cardiff University is to play a key role in mapping out our low-energy future with developments in everything from storing household electricity in car batteries to turning off fridges and freezers to save power. The university's newly-launched Institute of Energy has been chosen to lead a UK-wide research programme into energy supply.

Cardiff is the only university outside Oxford or London to have been picked for such a role. John Loughhead, executive director of the UK Energy Research Centre, came to Cardiff last week to inaugurate the new programme. He said the challenge of developing a new energy system for the future is "much bigger and more dramatic than the challenge of putting somebody on the moon". Mr Loughhead added: "It's an enormous task and it's going to have huge implications. "Our job is to try to make sure those implications are generally benign and to develop the solutions that are going to be used. "What's really pleasing is that Cardiff has shown a real commitment to this area, has invested money, brought people in and is setting itself up to play a major role."

Prof Nick Jenkins, director of the institute, is in charge of around half-a-million pounds worth of research projects at Imperial College, London, and Exeter University, besides the £498,000 he has received via the UKERC for work at Cardiff. In addition, the Higher Education Funding Council for Wales has given Cardiff University another half-a-million for research in the energy field.

Asked why Cardiff had been chosen for the task, Mr Loughhead said: "We were looking round for research teams that have international reputations, have the capability to tackle what we want to do and the ability to play a key role in shaping how UKERC works. "Professor Jenkins was the best person." One of the biggest problems Prof Jenkins' team will be trying to find an answer to is how to accommodate our expectation for electricity whenever we need it to the uncertainty and variability of renewable energy sources, such as wind farms and tidal energy.

<http://www.walesonline.co.uk/news/wales-news/2009/06/17/cardiff-university-s-vital-role-in-energy-research-91466-23894653/>

## **Oxygen-blown IGCC trials planned in Japan**

4 August 2009

Japanese utility companies Electric Power Development and Chugoku Electric Power have announced they are to join forces to test a new "low emissions" clean coal technology as part of a new \$1.1bn (£650m) project.

The two power firms last week announced that they have formed a 50:50 joint venture, CoolGen Corp, with the aim of starting trials of oxygen-blown integrated gasification combined cycle (IGCC) technology by 2017. The utilities claim that it produces 10% lower carbon dioxide emissions than conventional coal-burning methods.

The second phase of the project, expected to start in 2021, will test CO<sub>2</sub> separation and recovery methods, which are intended to combine with the IGCC process to reduce greenhouse gas emissions from the facility to zero. Supporters of the technology argue that it is highly efficient and can deliver significant cuts in emissions compared with conventional coal-burning plants.

A CoolGen test facility is to be built on the site of Chugoku's power plant in Hiroshima prefecture, which integrates coal-fired gas turbine generating equipment and steam generating apparatus. Chugoku has agreed to purchase electricity generated from the CoolGen facility. CoolGen's technology was researched and developed by Electric Power Development, with the government providing financial backing. It differs from air-blown IGCC methods being tested by other Japanese utilities – developed in conjunction with Mitsubishi Heavy Industries – which are believed to have higher investment and cleanup costs than the oxygen-blown process.

However, developers of air-blown IGCC technologies claim that oxygen-blown gasifiers require large amounts of power to produce oxygen, therefore resulting in a less-efficient process than the air-blown technologies.

<http://www.businessgreen.com/business-green/news/2247211/japanese-utilities-test-low>

## **Greenpeace reports Chinese power plants large emitters of GHG**

28 July 2009

China's three biggest power firms produced more greenhouse gas emissions last year than the whole of Britain, according to a Greenpeace report published today/yesterday. The group warned that inefficient plants and the country's heavy reliance on coal are hindering efforts to tackle climate change. While China's emissions per capita remain far below those of developed countries, the country as a whole has surpassed the United States to become the world's largest emitter.

Greenpeace said the top 10 companies, which provided almost 60% of China's total electricity last year, burned 20% of China's coal — 590 million tonnes — and emitted the equivalent of 1.44 billion tonnes of carbon dioxide.

The efficiency of Chinese power generation compares unfavorably with other countries. In Japan, 418 grams of carbon dioxide are emitted per kilowatt hour and in the US, the equivalent figure is 625 grammes. But most of the top 10 firms in China produce 752 grammes of CO<sub>2</sub>.

"China is suffering the pains of extreme weather events such as droughts, heat waves, typhoons and floods, worsened by climate change. These power companies can and must help China to prevent climate disaster by rapidly increasing efficiency and the share of renewable energy such as wind and solar," said Yang Ailun, Greenpeace's climate campaign manager, at the launch in Beijing of the Greenpeace report, *Polluting Power: Ranking China's Biggest Power Companies*.

The report says that in 2008, Huaneng, Datang and Guodian — the top three firms — emitted more greenhouse gases than the whole of the United Kingdom. But Yang added: "China is ideally placed to become the world's superpower in terms of smart energy and renewable energy." The group said China closed down 54.07GW of the least efficient coal-fired plants over the last three and a half years — more than the total electricity installed capacity of Australia. It urged power firms to phase out all inefficient coal-fired plants under 100 megawatt by 2012, saving 90 million tonnes of coal consumption and 220 million tonnes of carbon dioxide annually.

Firms are already turning to renewable energy and by the end of last year Guodian had installed 2.88GW of wind power; almost 24% of China's total and enough to make it the biggest wind energy firm in Asia.

But Greenpeace said only three of the top 10 produced 10% or more of their energy from renewable sources. The vast majority relied heavily on hydropower — with eight of the firms not even halfway to their legal obligation to produce 3% of energy from other renewable sources by 2010.

Greenpeace urged the Chinese government to impose energy and environment taxes on coal, encouraging increased efficiency and a move to renewable sources. It also called for a doubling of the national renewable energy target to 30% by 2020 and for stricter efficiency standards for coal-fired power stations.

The State Council, China's cabinet, is currently drawing up plans for a massive "new energy" programme to cut emissions and ensure energy security. Reports in the domestic media and from foreign diplomats suggest the next decade could see between 1.4 trillion (US\$200 billion) and 4.5 trillion yuan (US\$600 billion) investment in projects ranging from nuclear power, low carbon transport and clean coal technology to super-efficient electric grids.

This huge expansion is already causing problems. Manufacturing capacity is outstripping supply and the country's under-invested power grid networks were not ready for large-scale wind power input. Some wind farms have been unable to start operating because of a lack of grid connection or were operating at levels lower than planned. But experts warn that de-carbonising the energy supply must happen fast, given the massive toll on China's environment. State news agency Xinhua reported yesterday that the country's largest desert lake could vanish in decades due to climate change and human activities.

"Just 10 years ago, one couldn't see the other bank of the Hongjiannao even through a telescope. Today, it's visible with the naked eye," said He Fenqi, a researcher with the Chinese Academy of Sciences.

The Hongjiannao, sandwiched between the Muus Desert in Shaanxi Province and the Erdos Plateau in Inner Mongolia, has shrunk by at least 30% in the past two decades, Xinhua reported. It now covers 4,600 hectares and its water level is declining by 20 centimetres annually.

<http://www.guardian.co.uk/environment/2009/jul/28/china-greenhouse-gas-emissions-greenpeace>

## **UK Government likely to miss its own emissions targets'**

5 August 2009

The Government is still producing 2.7 million tonnes of carbon dioxide a year and is not doing enough to meet its own targets on emissions, MPs will warn today. The House of Commons Environmental Audit Committee (EAC) said the Government had cut emissions from its offices – by far the biggest source – by 6.3% on 1999 levels – just half of its target of a 12.5% cut by 2010-11.

The report welcomed improvements in some areas, such as government road vehicles, where emissions have been cut by 10.3%. However, road travel accounts for a relatively small percentage of overall emissions. The report also claimed that under the new Carbon Reduction Commitment (CRC) scheme, which begins in April 2010, the Government could have to pay money to private sector firms if it does not improve its performance. The scheme will require about 5,000 organisations to buy "allowances" costing £12 a tonne for all the CO<sub>2</sub> they emit each year, and be judged on how much they are doing to cut their emissions.

The money for purchasing allowances will go into a central pot and those cutting their emissions the most will get their original payment back plus a bonus, while those doing worst will be penalised by getting less back than they paid in. "The consistent thread is that the Government has talked a good game but when it comes to the actual achievements, the picture is rather more mixed," said the EAC chairman Tim Yeo. "In too many areas, like emissions of carbon dioxide from offices, it [the Government] has made little or no progress and in others it is backsliding. "What is clear is that, given there has only been a six per cent reduction over nine years, the chances of getting an 80% reduction by 2050 would require a dramatic improvement. "Our impression is that there is a very patchy approach across government. I have not seen any evidence that we have a change in the Government's thinking yet. We need a strong commitment at the top to drive through a process of change."

<http://www.independent.co.uk/environment/climate-change/government-set-to-miss-its-own-emissions-targets-1767361.html>

## **Geothermal energy from closed mines?**

31 July 2009

Mine shafts on the point of being closed down could be used to provide geothermal energy to local towns. This is the conclusion of two engineers from the University of Oviedo, whose research is being published in the journal *Renewable Energy*. The method they have developed makes it possible to estimate the amount of heat that a tunnel could potentially provide.

"One way of making use of low-intensity geothermal energy is to convert mine shafts into geothermal boilers, which could provide heating and hot water for people living nearby", Rafael Rodríguez, from the Oviedo Higher Technical School of Mining Engineering, tells SINC. This type of energy, which is hardly used in Spain, is obtained from the internal heat of the Earth. The engineer and his colleague María Belarmina Díaz have developed a "semi-empirical" method (part mathematical and part experimental) to calculate the amount of heat that could be produced by a mine tunnel that is due to be abandoned, based on studies carried out while it is still in use.

"When the mine is still active one can access the tunnels easily in order to gather data about ventilation and the properties of the rocks, as well as to take samples and design better circuits, and even programme the closure of some sections in order to use them for geothermal energy production", says the engineer, who stresses that, although geothermal energy can be made use of once the mine is closed, "it is no longer possible by that stage to make any modifications, or to gather any useful data to evaluate and improve the system".

The study looks into geothermal exploitation of a two-kilometre-long mine shaft, in which the temperature of the rocks 500m below the surface is around 30° C. This is typical of many of the mining areas in Asturias, although it could also be applied to other parts of the world. Water could be forced in through tubes at 7° C and return at 12°C, a big enough heat gain to be of benefit to towns located above the mines.

Rodríguez and Díaz highlight the benefits of building geothermal boilers in mine shafts in that, aside from their predictable energy production levels, they also function practically as an open tube system "but without any risk of heat contamination of aquifers".

Using geothermal energy also helps to reduce CO<sub>2</sub> emissions, and is not dependent upon climatic conditions (unlike other renewable energies such as solar or wind power). Other advantages are that these facilities make use of a country's own resources, do not require new developments on large sites, do not pollute the immediate environment, and are believed to be profitable over the long term. Geothermal energy can be used directly in family homes, housing developments, swimming pools, fish farms, industrial units and other buildings.

<http://www.sciencedaily.com/releases/2009/07/090727081108.htm>

## **Do wind farms pose a health risk?**

2 August 2009

Living too close to wind turbines can cause heart disease, tinnitus, vertigo, panic attacks, migraines and sleep deprivation, according to groundbreaking research to be published later this year by an American doctor.

Dr Nina Pierpont, a leading New York paediatrician, has been studying the symptoms displayed by people living near wind turbines in the US, the UK, Italy, Ireland and Canada for more than five years. Her findings have led her to confirm what she has identified as a new health risk, wind turbine syndrome (WTS). This is the disruption or abnormal stimulation of the inner ear's vestibular system by turbine infrasound and low-frequency noise, the most distinctive feature of which is a group of symptoms which she calls visceral vibratory vestibular disturbance, or VVVD. They cause problems ranging from internal pulsation, quivering, nervousness, fear, a compulsion to flee, chest tightness and tachycardia – increased heart rate. Turbine noise can also trigger nightmares and other disorders in children as well as harm cognitive development in the young, she claims. However, Dr Pierpont also makes it clear that not all people living close to turbines are susceptible.

Until now, the Government and the wind companies have denied any health risks associated with the powerful noises and vibrations emitted by wind turbines. Acoustic engineers working for the wind energy companies and the Government say that aerodynamic noise produced by turbines pose no risk to health, a view

endorsed recently by acousticians at Salford University. They have argued that earlier claims by Dr Pierpont are "imaginary" and are likely to argue that her latest findings are based on a sample too small to be authoritative.

At the heart of Dr Pierpont's findings is that humans are affected by low-frequency noise and vibrations from wind turbines through their ear bones, rather like fish and other amphibians. That humans have the same sensitivity as fish is based on new discoveries made by scientists at Manchester University and New South Wales last year. This, she claims, overturns the medical orthodoxy of the past 70 years on which acousticians working for wind farms are using to base their noise measurements. "It has been gospel among acousticians for years that if a person can't hear a sound, it's too weak for it to be detected or registered by any other part of the body," she said. "But this is no longer true. Humans can hear through the bones. This is amazing. It would be heretical if it hadn't been shown in a well-conducted experiment."

In the UK, Dr Christopher Hanning, founder of the British Sleep Society, who has also backed her research, said: "Dr Pierpont's detailed recording of the harm caused by wind turbine noise will lay firm foundations for future research. It should be required reading for all planners considering wind farms. Like so many earlier medical pioneers exposing the weaknesses of current orthodoxy, Dr Pierpont has been subject to much denigration and criticism and ... it is tribute to her strength of character and conviction that this important book is going to reach publication."

Dr Pierpont's thesis, which is to be published in October by K-Selected Books, has been peer reviewed and includes an endorsement from Professor Lord May, former chief scientific adviser to the UK government. Lord May describes her research as "impressive, interesting and important".

Her new material about the impact of turbine noise on health will be of concern to the Government given its plans for about 4,000 new wind turbines across the country. Ed Miliband, the Secretary of State for Energy and Climate Change, has made wind power a central part of his new green policy to encourage renewable energy sources. Another 3,000 are planned off-shore.

Drawing on the early work of Dr Amanda Harry, a British GP in Portsmouth who had been alerted by her patients to the potential health risk, Dr Pierpont gathered together 10 further families from around the world who were living near large wind turbines, giving her a cluster of 38 people, from infants to age 75, to explore the pathophysiology of WTS for the case series. Eight of the 10 families she analysed for the study have now moved away from their homes.

In a rare interview, Dr Pierpont, a fellow of the American Academy of Pediatrics, told The Independent on Sunday: "There is no doubt that my clinical research shows that the infrasonic to ultrasonic noise and vibrations emitted by wind turbines cause the symptoms which I am calling wind turbine syndrome. There are about 12 different health problems associated with WTS and these range from tachycardia, sleep disturbance, headaches, tinnitus, nausea, visual blurring, panic attacks with sensations of internal quivering to more general irritability.

"The wind industry will try to discredit me and disparage me, but I can cope with that. This is not unlike the tobacco industry dismissing health issues from smoking. The wind industry, however, is not composed of clinicians, nor is it made up of people suffering from wind turbines." The IoS has a copy of the confidential manuscript which is exhaustive in its research protocol and detailed



case series, drawing on the work of leading otolaryngologists and neurotologists – ear, nose and throat clinical specialists.

Some of the earliest research into the impact of low-frequency noise and vibrations was undertaken by Portuguese doctors studying the effects on military and civil personnel flying at high altitudes and at supersonic speed. They found that this exposure may also cause the rare illness, vibroacoustic disorder or VAD, which causes changes to the structure of certain organs such as the heart and lungs and may well be caused by vibrations from turbines. Another powerful side effect of turbines is the impact which the light thrown off the blades – known as flicker – has on people who suffer from migraines and epilepsy.

Campaigners have consistently argued that much research hitherto has been based on written complaints to environmental health officers and manufacturers, not on science-based research. But in Denmark, Germany and France, governments are moving towards building new wind farms off-shore because of concern over the potential health and environmental risks. In the UK there are no such controls, and a growing number of lobbyists, noise experts and government officials are also beginning to query the statutory noise levels being given to councils when deciding on planning applications from wind farm manufacturers. Lobbyists claim a new method of measuring is needed.

Dr Pierpont, who has funded all the research herself and is independent of any organisation, recommends at least a 2km set-back distance between potential wind turbines and people's homes, said: "It is irresponsible of the wind turbine companies – and governments – to continue building wind turbines so close to where people live until there has been a proper epidemiological investigation of the full impact on human health.

"What I have shown in my research is that many people – not all – who have been living close to a wind turbine running near their homes display a range of health illnesses and that when they move away, many of these problems also go away."

A breakthrough into understanding more of the impact of vibrations came last year, she said, when scientists at Manchester University and Prince of Wales Clinical School and Medical Research Institute in Sydney showed that the normal human vestibular system has a fish or frog-like sensitivity to low-frequency vibration. This was a turning point in understanding the nature of the problem, Dr Pierpont added, because it overturns the orthodoxy of the current way of measuring noise. "It is clear from the new evidence that the methods being used by acousticians goes back to research first carried out in the 1930s and is now outdated."

Dr Pierpont added that the wind turbine companies constantly argue that the health problems are "imaginary, psychosomatic or malingering". But she said their claims are "rubbish" and that medical evidence supports that the reported symptoms are real.

The British Wind Energy Association, UK's biggest renewable energy trade association, said last night: "One of the first things first-time visitors to wind farms usually says is that they are surprised how quiet the turbines are. To put things in context: the London Borough of Westminster registered around 300,000 noise complaints from residents in 2008, none from wind turbines. The total number of noise complaints to local councils across the country runs into millions. In contrast, an independent study on wind farms and noise in 2007 found only four complaints from about 2,000 turbines in the country, three of which were

resolved by the time the report was published. Wind turbines are quiet, safe and sustainable. It is not surprising that, according to a DTI report, 94% of people who live near wind turbines are in favour of them. There is no scientific research to suggest that wind turbines are in any way harmful, and even many of the detractors of wind energy are honest enough to admit this. Noise from wind farms is a non-problem, and we need to move away from this unproductive and unscientific debate, and focus on our targets on reducing carbon emissions.

<http://www.independent.co.uk/environment/green-living/are-wind-farms-a-health-risk-us-scientist-identifies-wind-turbine-syndrome-1766254.html>

## **Severn tidal barrier on shortlist**

16 July 2009

The government yesterday published a shortlist of five proposals for harnessing the tidal power of the Severn estuary, which it hopes could eventually supply up to five per cent of the UK's electricity needs. There are two tidal lagoon options and three barrage options on the shortlist, and the government confirmed that it could choose a combination of different projects – or none at all.

The government response to the first consultation, published yesterday, says the scheme has huge potential, but also warns that planning approval for the controversial projects is far from a foregone conclusion. "Drawbacks include the cost of detailed feasibility work and the risk that a scheme might not be consented, impacts on the natural environment and on industries such as ports and fisheries that currently use the estuary, and the multibillion-pound construction cost with a long payback period," the report warns.

The schemes under consideration are a 0.625GW barrage at Beachley, costing £2.3bn; a 1.05GW Shoots barrage, costing £3.2bn; a larger 8.64GW Cardiff-Weston barrage, costing £20.9bn; or two 1.36GW lagoon proposals at Bridgewater Bay and Welsh grounds, costing £3.8bn and £4bn respectively. The lagoons and Shoots Barrage proposals were backed by a Friends of the Earth consultation, which said they would have less of an impact on the local environment than a barrage.

Among the schemes omitted from the shortlist were a number of smaller innovative tidal technologies, which were considered to be too far from commercial viability. However, the government said it will continue to provide funding to support their development. Also rejected were larger outer-barrage schemes considered too expensive.

Variants of the short listed options are constantly under consideration, the government said, a process called design optimisation. In addition to the shortlist, the government set out a number of options for funding, including a market-priced revenue support mechanism, similar to the Renewables Obligation (RO) or a separate "Severn Obligation", as well as fixed-price support mechanisms, such as a feed-in tariff.

The government's initial analysis suggests that a large Cardiff-Weston barrage could not be supported under the existing RO in view of the volatility this would create for ROC prices and the resulting impact on other renewable investments. Smaller barrages or tidal lagoons do, however, have the potential to be accommodated within the current RO. Next year, a second public consultation will take place on whether or not the government should support a Severn tidal project. Construction on any chosen scheme is envisaged to begin after 2015, with operation commencing after 2018.

Neil Crumpton, energy spokesperson for Friends of the Earth, said the government had rejected less-intrusive and financially risky ways of harnessing power from the Severn Estuary such as offshore lagoons and tidal reefs. "Though we welcome the establishment of a feedback loop where these ongoing technologies could be introduced as they develop," he said. Friends of the Earth say offshore lagoons could be constructed for about a third of the price outlined in the original consultation. Offshore lagoons would still be relatively more expensive than the land-connected lagoons and barrage options short listed, but they would have less effect on the local environment, according to Crumpton.

<http://www.businessgreen.com/business-green/news/2246191/svern-tidal-renewables-options>

## **Teesport biomass plant gets the go-ahead**

15 July 2009

Plans to build a £500m biomass power station at Teesport have been given the go ahead. The scheme proposed by MGT Power has been granted consent by the government under the Electricity Act. It will be one of the largest-ever biomass plants to be built in the world. With a capacity of 295MW, the Tees Renewable Energy Plant will generate enough electricity for approximately 600,000 homes across the north east and will use around 2.4m tonnes of woodchips per year. The plant will create 600 jobs during the three year construction period.

Chris Moore, director of MGT Power said: "The Government's consent is welcome news as we are at an advanced stage with forestry establishment for fuel sourcing, and power plant procurement." We can now mandate our banks, conclude the financing and reach agreement with our preferred technology bidders. We are moving towards an early construction start with a high degree of confidence. "Other similarly sized biomass plants are proposed in other parts of the country but our Teesport project is currently two years ahead of the pack and likely to be one of the first to be operational. It comes at a time when replacement UK energy generation capacity is urgently needed. We will continue to work closely with Redcar & Cleveland Council as well as PD Ports, the owners of Teesport, Renew Tees Valley and the local Trade Unions to complete the project." The plant will be built on a site next to Tees Dock at South Bank and is expected to be operational by late 2012.

<http://www.builderandengineer.co.uk/news/environment/green-light-for-500m-teesport-biomass-plant-4116.html>

## **The Exxon future's green – it's algae**

15 July 2009

The oil giant that environmentalists love to hate, ExxonMobil, which for years denied the existence of man-made climate change, is sensationally "going green" in a very literal sense – investing \$600m (£369m) in algae. The company says it believes it can make a new kind of fuel for cars and aircraft, one that can be produced in its existing refineries and will not require modification of vehicles' engines. At the heart of the project is Craig Venter, the scientist best known for his private-sector effort to sequence the human genome, and his latest company, Synthetic Genomics.

Exxon is putting \$300m into its own research and at least as much again into Synthetic Genomic's efforts to build a lab and, ultimately, large-scale production facilities. Both sides were enthusiastic but cautious announcing the partnership

yesterday. "We need to be realistic," said Emil Jacobs, vice-president of research at Exxon. "This is not going to be easy, and there are no guarantees of success." Spending on the algae fuels project will require only a fraction of Exxon's annual capital budgets of \$25bn to \$30bn, but it will be the world's largest biofuels development project of its kind, Mr Venter said.

Environmentalists are keen on algae as a fuel source because, unlike many ethanol products, it is not taking up land, water and crops that might otherwise be given over to the production of food. Exxon Mobil has come under pressure from shareholders – including descendants of its founder, John D Rockefeller – to diversify from fossil fuels, though management insists oil and gas will continue to be the dominant sources of fuel for decades to come.

BP already has a partnership with Synthetic Genomics. Royal Dutch Shell, which is second to Exxon Mobil in global refining capacity, announced plans in December for an algae project in Hawaii.

<http://www.independent.co.uk/news/business/news/oil-giant-exxon-sees-the-future-ndash-and-it-is-green-algae-1746491.html>

## **Household energy bills to rise by £200 a year**

11 July 2009

Household energy bills will rise by more than £200 a year under the Government's low-carbon strategy being announced next week. Meeting Britain's targets for cutting emissions could push another 1.7 million households into fuel poverty, meaning that seven million homes would be spending more than 10% of their income on fuel. The Renewable Energy Strategy, to be published on Wednesday, will state that more than £100 billion will have to be invested in renewable energy infrastructure, including 7,000 wind turbines, by 2020.

The Government has bound itself legally to cutting CO<sub>2</sub> emissions by 34% by 2020 and 80% by 2050. To achieve this, it must increase the amount of energy generated from renewable sources from 2% at present to 15% by 2020. The strategy estimates that energy bills will have to rise by about 20 per cent to pay for the investment. The average household currently pays about £1,150 a year for electricity and gas, a small decline on last year but still double the amount paid in 2003.

The cost of converting to renewable energy and modernising Britain's power supply would add about £230 to annual bills. Costs are likely to ratchet up quickly as the investment is made, with the increase reaching 20% within three years. Industry estimates due to be published next week will take an even gloomier view and claim that bills could rise by 30%.

Ed Miliband, the Energy and Climate Change Secretary, admitted to *The Times* that energy bills would rise, but said that the carbon-reduction targets were not the only factor. "There is upward pressure on energy prices whether you go for a high-carbon or a low-carbon alternative," he said. "The costs of not acting on climate change far outweigh than the costs of acting."

Derek Lickorish, chairman of the government-appointed Fuel Poverty Advisory Group, urged ministers to introduce measures to protect poorer families from rising energy prices. "We need decisive action on energy efficiency and social tariffs or many hundreds of thousands more pensioners, families and disabled people will struggle to afford their energy bills," he said.

Ministers are expected to announce a "pay-while-you-save" scheme under which families can spread the cost of home insulation, paying by installments based on the amounts they save by consuming less energy. John Sauven, director of Greenpeace, said that higher energy bills would be accompanied by massive investment in renewable energy, with 250,000 new jobs and the opportunity to turn Britain into a world leader in low-carbon technology.

A White Paper detailing how Britain will make the transition to being a low-carbon economy will also be published on Wednesday. It will contain measures designed to accelerate plans to slash Britain's dependency on fossil fuels such as coal, gas and oil for electricity generation from the current level of 78%.

The White Paper will include predictions that Britain will have to cut its gas consumption by nearly 30% by 2025 and coal by 34%. Consumption of petrol and diesel will also have to fall by 10% by 2020.

<http://www.timesonline.co.uk/tol/news/politics/article6684912.ece>

## **Energy industry attacked by scientists**

28 June 2009

Britain's energy systems are no longer fit for purpose, according to leading members of the UK's best-known scientific academy, the Royal Society. A meeting of experts at the society said the government must invest hugely to create a new low-carbon economy. And it must take on the big generating companies who dominate energy policy, participants said. The government says the key issues on energy will be addressed in its forthcoming energy White Paper.

The experts say ministers must make up lost time by investing massively in research and deployment of renewables; creating a more wide-ranging electricity 'supergrid'; and ensuring that coal-fired power stations capture 90% of their carbon emissions by 2020. One leading member of the society said privately that the government's performance on carbon capture so far had been pathetic - although would agree that criticism should not be confined to the UK. The meeting agreed that failure to develop renewables in time meant that the UK must continue to rely on nuclear power - even though questions over waste and security were unresolved. First priority on the society's action list is a big push on energy efficiency in existing homes, taking advantage of the latest technologies. The call is echoed by the all-party parliamentary climate change group, which is set to insist that landlords should be prevented from letting homes which waste energy.

The group's vice-chairman, Lord Redesdale, said the UK would never reach its climate change targets unless it radically improved policies on existing homes. He said: "A billion tonnes will have failed to be saved from domestic carbon emissions and this is equivalent to the CO<sub>2</sub> pollution from Britain's aviation sector over the next 25 years. "We can either heat our homes and have hot baths, or fly but not both. There really does need to be much tougher policies on reducing carbon emissions from the homes." The government says many of the issues will be addressed in its energy White Paper - although to the frustration of ministers in the energy and environment departments, the Treasury has blocked whole scale investment in home refurbishment until after 2012.

Ministers argue that their policy on carbon capture and storage is ahead of any other major nation - calling for four demonstration projects and insisting that new coal-fired power stations should capture a percentage of their emissions until the technology is fully proven.

A Department of Energy and Climate Change spokesman said the UK had made major strides recently on energy and climate change. He listed The Climate Change Act, carbon budgets, and leadership for the Copenhagen climate summit - including the Prime Minister's suggestion last week that rich nations should transfer \$100bn-a-year to poor nations to help with climate change.

<http://news.bbc.co.uk/1/hi/uk/8122864.stm>

## **Proposed funding for four CCS trials**

29 June 2009

A new Energy Bill was today proposed for the forthcoming session of Parliament as part of the Government's plans to position the UK as world leaders in breakthrough clean coal technology. The Bill would enable the Secretary of State for Energy and Climate Change to introduce a financial mechanism to fund up to four commercial-scale Carbon Capture and Storage (CCS) demonstration plants. The first of these could be feeding cleaner energy into the grid by the middle of the next decade. This follows the publication on 17 June of the Government's consultation document 'A framework for the development of clean coal' which sets out how the Government proposes to reconcile the need to curb emissions of carbon from future coal fired power stations with the need to maintain a secure diverse energy mix. The consultation also contains proposals for the detailed design of the financial support mechanism that will be introduced through the Energy Bill.

Energy and Climate Change Secretary Ed Miliband said: "We're moving fast on CCS. It's a critical technology in the fight against climate change and I want the UK to lead the world with it. This Bill is about providing the finance needed for the construction of commercial-scale demonstration plants. "Through CCS we can develop a new high tech industrial sector, we can maintain a diverse energy mix and, once deployed around the world, make a major contribution to the fight against climate change." The proposed Energy Bill was announced today in 'Building Britain's Future', published by the Prime Minister, which outlines the Government's priorities and its draft legislative programme.

This is now open for consultation before being finalised in the Queen's Speech in the autumn. The shift to low carbon at home and abroad, and capitalising on the opportunities presented by new green industries, is seen by the current government as an important part of building Britain's future. On Friday last week, Ed Miliband set out the Government's case for an ambitious global climate deal in Copenhagen, what it should look like and why it's of vital importance for every UK citizen.

In July he and Cabinet colleagues will set out a comprehensive strategy on energy and climate change to meet the UK's carbon budgets, aimed at cutting emissions by more than a third by 2020 and at least 80% by 2050. Central to this will be shifting our electricity mix to low carbon - based around new nuclear power stations, a massive expansion of renewables and clean coal technology such as CCS.

<http://www.clickgreen.org.uk/news/national-news/12287-proposed-clean-coal-bill-to-fund-four-carbon-capture-trials.html>

## Novel approach to prolong coal use

28 June 2009

Craig Venter, the controversial American scientist who helped decode the human genome, has announced the discovery of ancient bacteria that can turn coal into methane, suggesting they may help to solve the world's energy crisis. The bugs, discovered a mile underground by one of Venter's microbial prospecting teams, are said to have unique enzymes that can break down coal. Venter said he was already working with BP on how to exploit the find.

Venter even suggested the discovery could open up the world's coalfields to an entirely new form of mining, where coal is infected with the bacteria, allowing methane to be harvested "without even digging up the coal". Venter, speaking at the recent La Jolla research and innovation summit, in La Jolla, California, told an audience of researchers and technology investors how he had harvested 20m new genes by analysing the DNA of micro-organisms collected underwater or deep underground.

He said: "We have found a huge number of microbes a mile or so deep in the earth. In fact, there is more diversity under the surface of the earth than in the ocean. It is absolutely stunning. "Some of these underground water sources have been isolated for 50m to 135m years and we have found totally unique organisms." Venter flashed up a black-and-white image of a piece of coal that appeared to be carpeted with a mossy substance. He said: "We have a large number that eat coal and break it down into organic acids, hydrogen, CO<sub>2</sub> and so on. Then we have other organisms with enzymes that can take those organic acids, hydrogen and CO<sub>2</sub> and make methane."

Venter added: "We have a deal with BP to look at the biological conversion of coal into natural gas, where microbes colonise coal particles and produce methane." He also showed a second image with coal submerged in a liquid from which bubbles, said to be methane, were rising. He added: "We and BP think we can scale this up substantially to provide a huge increase in the amount of natural gas available without even digging up the coal."

Such ideas need to be treated with caution. The biotech industry is renowned for making claims that later turn out to have been excessive. This is often driven by the need to attract investors. Venter does have a good track record, as shown by his lead role in the race to decode the human genome, but his discovery would need far more research and investment before it could be deployed on an industrial scale.

If it worked, however, the potential would be huge. Coal is the world's most important fossil fuel with about 6.5 billion tons used each year. This is expected to rise by more than 60% by 2030. This has serious environmental implications because coal is highly polluting, generating more CO<sub>2</sub> per ton than any other major fossil fuel. There is, however, no ready alternative to coal, especially in power generation, which means greenhouse gas emissions are likely to keep rising for decades if more is burned.

Methane, by contrast, is significantly less polluting. Venter also described separate research that, he said, could one day lead to CO<sub>2</sub> being seen as a resource in the manufacture of biofuels. He described how researchers at Synthetic Genomics, the firm he founded, had genetically engineered an algal species to produce large amounts of lipids — liquid fats that can be used to make biofuels.

All the cells needed was sunlight, a growing medium and CO<sub>2</sub>. They would then pump out lipids that would float to the top of the container, where they could be skimmed off. He said: "We see CO<sub>2</sub> as raw material. We have been engineering cells to use CO<sub>2</sub> driven by sunlight to make biopolymers, methane and sugars. "One of the most exciting breakthroughs is that we have engineered algal cells to pump out lipids in a pure form into the growing medium. You can literally skim the cream off the top and isolate it like a biocrude and we are not too far away from scaling this up on a very substantial scale.

Venter said: "Why do this? If we look around the world, we are going from 6.5 to 9 billion people in the next 40 years. We have never had the challenge of trying to feed and provide medicine, clean water, shelter and energy for that change in population. We are not doing such a great job right now."

<http://www.timesonline.co.uk/tol/news/environment/article6590538.ece>

## **UK 'must plan' for warmer future**

18 June 2009

The UK needs to plan now for a future that will be hotter and bring greater extremes of flood and drought, says Environment Secretary Hilary Benn. Launching the UK Climate Projections 2009 report (UKCP09), Mr Benn told MPs that the UK climate will change even with a global deal on emissions. By 2080, London will be between 2C and 6C hotter than it is now, he said. Every part of the UK is likely to be wetter in winter and drier in summer, according to the projections.

Summer rainfall could decrease by about 20% in the south of England and in Yorkshire and Humberside by the middle of the century. Scotland and the north-west of England could see winter rainfall increase by a similar amount. The government hopes UKCP09 will allow citizens, local authorities and businesses to plan for future decades. It uses computer models of the world's climate to make projections of parameters such as temperature, rainfall and wind. "Climate change is going to transform the way we live," said Mr Benn. "These projections show us the future we need to avoid, and the future we need to plan for."

<http://news.bbc.co.uk/1/hi/sci/tech/8107014.stm>

## **Scottish Power begins CCS tests**

30 May 2009

Scottish Power took a big step forward in the attempt to produce carbon-free energy from coal yesterday when it switched on newly installed machinery at Longannet power station in Fife.

The company is bidding to win a £1 billion government competition to develop the technology needed to fit carbon capture and storage technology to a coal-fired power station — described as the holy grail of alternative energy.

However, it emerged that Norwegian rather than Scottish companies stand to be the big winners if the bid succeeds. At the heart of the process is a technology that is Norwegian-owned and which Scottish Power and other companies will have to pay for if carbon capture becomes big business.

The eventual aim is to capture about 90 per cent of the carbon dioxide that goes up power station chimneys, Scotland's biggest single emitter of climate-changing



gases. This would go a long way towards the target of cutting the country's harmful emissions by 50% from 1990 levels by 2030.

The Scottish and British governments have claimed that there is potentially a big economic gain if Britain can become a leader in finding a cheap technology to fit to the estimated 50,000 fossil-fuelled power stations around the world.

Scottish Power has formed a consortium with Aker Clean Carbon of Norway, which is developing the capturing technology, and Marathon Oil, which is working on the pipelines and undersea installations needed to transport and store carbon dioxide under the North Sea.

The machinery switched on yesterday, which belongs to Aker, will process less than 0.5% of Longannet's exhaust gases, equivalent to 1MW of electricity output. The tests will take 6-7 months to find the most efficient and cheapest way of extracting the carbon dioxide. Critical to the success of the tests is reducing the amount of energy needed to capture carbon. Current technologies would require between 25-30 per cent of Longannet's electricity output to be diverted into carbon capture if all of the station's emissions were to be cleaned up.

Tony Corless, Scottish Power's technical manager of the capturing equipment, explained that the process involved using nitrogen-hydrogen compounds called amines which stick to carbon dioxide, enabling it to be extracted from other exhaust gases. "The holy grail is to get a low-energy amine," Mr Corless said, adding that it was hoped to reduce the amount of energy used in carbon capture to about 12% of Longannet's power output.

This technology, however, will not belong to Scottish Power. It will only license it for use from SOLVit, a Norwegian consortium in which Aker Clean Carbon is the main partner with Sintef, a Norwegian research company, and the Norwegian University of Science and Technology.

Steven Marshall, a Scottish Power executive overseeing the carbon project, said that the company hoped to profit by selling the expertise accumulated in making a carbon capture project technically and economically viable.

Duncan McLaren, chief executive of Friends of the Earth Scotland, said that it favoured fitting carbon capture and storage technology to existing coal-fired power stations, but raised concern that it could lead to more fossil-fuelled power stations being built at the expense of developing renewable power.

<http://www.timesonline.co.uk/tol/news/uk/scotland/article6391118.ece>

## **North Sea carbon storage capacity to be investigated**

28 May 2009

A study of the carbon storage potential under the North Sea has been jointly commissioned by Britain and Norway, it was announced today. Meeting in the Norwegian city of Bergen for the Climate Change and Technology conference, UK energy minister Lord Hunt and Norwegian minister Terje Riis-Johansen sought to agree a vision for the role of the North Sea in the future deployment of CCS in Europe.

The study will look at how quickly the base of the North Sea could be needed for European carbon dioxide storage and what the UK, Norway and other countries have to do to get it ready in time. Lord Hunt, Minister of State for Energy and

Climate Change, in the UK, said: "Today's agreement reaffirms the UK's leadership in tackling the emissions from fossil fuel power generation. The strength of the UK's offshore industries means we are well-placed to store that carbon dioxide under the North Sea." He added: "The benefits of CCS are not only environmental. There are clear business and job opportunities to be found in green energy technology. This study will help assist the governments in Europe to work together to store carbon dioxide safely under the North Sea and to plan the implementation of CCS." The two ministers also agreed to speak to the Transmission System Operators to explore the possibility of a new transmission line between the UK and Norway, specifically for the future export of renewable electricity.

The British-Norwegian study will build a profile for the whole of the North Sea, assessing each country's storage potential and likely volumes and locations of carbon dioxide flows, against a rising price of carbon. This will involve identifying network issues and proposing methods for managing carbon dioxide flows across borders. The study will also consider how the offshore storage business might develop. Britain and Norway have agreed to exchange information on national CCS demonstration plants, as well as campaigning for international recognition of the technology. The two countries want to encourage other nations to explore the potential role of CCS within their own energy generation programmes. Norway and the UK will also be seeking to include Germany and the Netherlands in the new study as to build on previous studies that focused solely on Norwegian and UK data. "The strength of the UK's offshore industries means we are well-placed to store that carbon dioxide under the North Sea" Lord Hunt, UK government

Earlier this month a study funded by Scottish Power claimed that the North Sea could hold potentially all of Europe's carbon emissions. Initial British-Norwegian studies in 2007 and 2008 found that there was great potential to provide carbon dioxide storage under the North Sea. The Department of Energy and Climate Change today described the study as "the next step" that will provide further evidence as to how important the sub-seabed of the North Sea is in the deployment of CCS in Europe. Last month Secretary of State for Energy and Climate Change Ed Miliband issued a ban on new coal-fired power stations without CCS, declaring that the "era of unabated coal is over".

To encourage the take-up of the technology, the government is currently running a competition to support CCS technology in the UK. Topped up by the Chancellor's Budget in April, a funding mechanism is to be set up to support between two and four projects to test both post-combustion and pre-combustion technology. It is understood that the four possible projects will include the scheme on the existing CCS competition, for which the government has been assessing bids from Scottish Power, E.ON and Peel Energy/npower. It is expected that the government will agree to support the other projects at the level of 300-400MW of coal-fired capacity.

[http://www.newenergyfocus.com/do/ecco.py/view\\_item?listid=1&listcatid=32&listitemid=2678&section=Carbon](http://www.newenergyfocus.com/do/ecco.py/view_item?listid=1&listcatid=32&listitemid=2678&section=Carbon)

## **Energy firms wriggle over 2025 carbon capture deadline**

11 May 2009

Energy companies will lobby the government for a get-out clause from the deadline to fully fit carbon capture and storage (CCS) technology to new coal plants by 2025 because they are worried it might not work in time. Companies, including German-owned groups E.ON and RWE npower, want guarantees that

they will not be forced to close their coal-fired plants in 2025 if the technology has not been proven by then.

They will call on energy and climate change secretary, Ed Miliband, to draw up provisions which would allow them to keep the plants open until 2030, or for an additional number of operating hours. The utilities are warning that without firm guarantees, they will not invest in a new generation of cleaner coal plants which are crucial to keeping the lights on in Britain over the next decade. Environmental groups warned Miliband against watering down his radical policy on coal power, which proposed far tougher measures to curb carbon emissions than many expected.

John Sauven, the executive director of Greenpeace, said: "CCS technology is still fraught with uncertainties. If Miliband doesn't show the necessary leadership to completely rule out unabated coal, then all the evidence suggests that's what we'll get. "Ed Miliband must stand firm against the big power companies lobbying for loopholes and get-out clauses." Last month, Miliband announced that any new coal plant would have to have CCS technology fitted to about a quarter of the plant from the outset. All new coal plants would be required to have the technology fully fitted within five years of it being proven. Miliband said in a statement to the Commons: "We will plan on the basis that CCS will be technically and economically proven by 2020."

In public, energy companies welcomed Miliband's proposals. While they are confident the technology can be made to work, in private some harbour doubts about how feasible it is to fully fit by 2025 and are concerned that they will have to foot the bill if they cannot. One executive said: "If you are going to spend billions of pounds building a new power station which could be online in 2015 – if you are only going to get 10 years out of it, it's not going to be worth it." Companies are also warning that switching off up to 6GW of coal plants in 2025 – enough to power 6m homes – if CCS is unworkable by then, would threaten the UK's security of supply.

There is also disquiet within the energy industry about the role of the Environment Agency, headed by Lord Smith (the former Labour minister Chris Smith). Miliband said the agency would judge whether CCS technology was technically and commercially feasible. Some companies believe the EA does not have the relevant expertise or business know-how to make that decision and would prefer a body, like energy regulator Ofgem, to act as an independent judge. One executive said: "Imagine a company saying to investors, "let's spend billions building a coal plant, but don't worry, the EA will tell us whether we can get a return on our investment or not". When Miliband announced the proposals, he said he would "seek views on whether we need a safety net in the eventuality that it [CCS] does not become proven as quickly as we expect". The consultation – where both environmental groups and energy companies will rigorously press their cases – will be launched in the next few weeks. The requirement to fit carbon-capture technology does not cover existing coal plants which will remain open into the 2020s and beyond. This includes Drax, the Yorkshire coal plant which provides about 7% of Britain's electricity and is the single biggest source of carbon emissions in Britain.

<http://www.guardian.co.uk/business/2009/may/11/energy-carbon-capture-ccs-miliband>

## FutureGen - Is it really back on?

25 June 2009

Two weeks after the Obama administration brought the "clean coal" Futuregen project back from the dead, two major power companies are walking away. American Electric Power Co. and Southern Co. – two enormous coal consumers and power generators – are pulling out of Futuregen. "We've moved onto other projects," Southern Chief Executive David Ratcliffe told the Dow Jones Newswires. He said he told Energy Sec. Steven Chu that "I've had to devote my resources to other, more tangible projects that are moving faster."

AEP CEO Mike Morris also played the moving-too-slowly-for-us card. He said his company would focus on carbon-sequestration projects such as one at the Mountaineer plant in West Virginia. "It's going to happen a whole lot sooner than Futuregen," he said. What does this mean for the future of Futuregen? The demonstration coal plant was meant to figure out the best way to capture and store carbon emissions. The Obama administration has earmarked \$1 billion of stimulus money to help pay for the at least \$1.5 billion price tag.

But if big backers keep bailing, even that kind of bump might not be enough the Futuregen to ever be built. The project still faces an uncertain future, what with members moving on and lots and lots of technical hurdles to be overcome.

<http://blogs.wsj.com/environmentalcapital/2009/06/25/taking-lumps-futuregen-backers-back-out/>

## Student Bursaries for 2009-2010

Up to 6 travel and subsistence bursaries for up to £300 are on offer to bona-fide full-time students wishing to attend appropriate National and International coal-related conferences, such as the "8<sup>th</sup> European Conference on Coal Research and its Applications" to be held at University of Leeds in September 2010, (please see the Calendar of Coal Research Events for details of both this and other events at the end of this Newsletter). To apply, please send the abstract submitted to the conference with a brief supporting letter from your supervisor to:

Prof. J.W. Patrick  
School of Chemical & Environmental Engineering  
The University of Nottingham  
University Park  
Nottingham NG7 2RD

The bursaries come with no obligations to the recipient other than to supply a short essay about his or her impressions of the conference to the Newsletter for inclusion in the next edition.

## Update on new BCURA Projects

A warm welcome from the CRF to BCURA's new Technical Officer: Mr. Peter W. Sage,

### **LIST OF CURRENT AND RECENTLY COMPLETED BCURA PROJECTS AT JUNE 2009**

B80 IMPERIAL COLLEGE LONDON, (DEPT. OF MECHANICAL ENGINEERING), "Characterising Biomass Particle Behaviour under Co-combustion Conditions", Dr.J.R.Gibbins, (01/10/06 to 30/09/09).

B81 IMPERIAL COLLEGE LONDON, (DEPT. OF MATERIALS), "Coal Mineral Transformations under Oxy-fuel Combustion Conditions", Mr.F.Wigley, (01/01/07 to 31/12/08).

B82 IMPERIAL COLLEGE LONDON, (DEPT. OF CHEMICAL ENGINEERING), "Improvements in Amine Flue Gas Scrubbing Systems for Coal Fired Power Plants", Dr.C.S.Adjiman, Dr.A.Galindo, Prof.G.Jackson and Dr.J.R.Gibbins, (01/10/06 to 30/09/09).

B83 UNIVERSITY OF NOTTINGHAM, "Mercury Oxidation by Fly Ash Constituents and Flue Gases and its Optimisation for the Development of Mercury Control Technologies", Dr.M.Maroto-Valer and Prof.C.E.Snape, (01/10/06 to 30/09/09).

B84 UNIVERSITY OF GLAMORGAN, "Optimisation of Fluidised Bed Combustion of Mixtures of Coal and High Moisture Content Biomass", Dr.D.R.Garwood, Prof.J.Ward, Dr.S.J.Wilcox and Mr.M.Fisher, (01/10/06 to 30/09/09).

B85A UNIVERSITY OF BIRMINGHAM, "On-line Condition and Safety Monitoring of Pulverised Coal Mills Using a Model Based Pattern Recognition Technique", Dr.J.Wang, (01/10/06 to 30/09/08).

B86 TES BRETBY, "The Maintenance of the BCURA Coal Bank", Mr.G.Bradley, (01/04/07 to 31/03/10).

B87 UNIVERSITY OF SOUTHAMPTON, "Enhancing Mercury Capture by Wet FGD Systems", Dr.S.M.Ullrich and Prof.T.W.Tanton, (01/01/08 to 31/12/10).

B88 UNIVERSITY OF CARDIFF, "Environmental Impact of Carbon Capture from Coal Fired Power Plant by Amine Absorption", Prof.K.Williams, Prof.A.Griffith and Dr.M.Spratt, (01/10/07 to 30/09/10).

B89 UNIVERSITY OF GREENWICH, "Improved Performance of Discharge Equipment for Coals with Poor Handling Characteristics", Prof.M.S.A.Bradley and Mr.R.J.Farnish, (01/10/07 to 30/09/10).

B90 UNIVERSITY OF KENT, "Dynamics and Movement Behaviours of Biomass/Coal Flow", Prof.Y.Yan, (01/10/07 to 30/09/10).

B91 IMPERIAL COLLEGE LONDON, "The Interactions of Coal-Biomass Ash with Supercritical Boiler Materials", Mr.F.Wigley, (01/01/08 to 31/12/09).

B92 UNIVERSITY OF LEEDS, "Applying Coal Milling Technologies to Thermally Pre-treated Biomass – Proof of Concept", Prof.J.M.Jones and Prof.A.Williams, (01/10/08 to 31/03/09).

B93 CRANFIELD UNIVERSITY, "The Effects of Impurities for Capture Technologies on CO<sub>2</sub> Compression and Transport", Dr.A.Bosoaga and Mr.J.E.Oakey, (01/10/08 to 30/09/10).

## CALENDAR OF COAL RESEARCH MEETINGS AND EVENTS

Date	Title	Location	Contact
<b>Tuesday 15th September 2009</b>	<b>Joint Meeting of the Coal Research Forum Environmental Division and the Royal Society of Chemistry Energy Sector with the RSC Energy Sector AGM</b>	<b>University of Nottingham</b>	<b>Dr D.J.A.McCaffrey, Secretary of the CRF, e-mail address mail@coalresearchforum.org Telephone 01242 236973</b>
21-24 September 2009	2009 International Pittsburgh Coal Conference	Pittsburgh, PA, USA	Conference Secretary, International Pittsburgh Coal Conference, University of Pittsburgh, 1249 Benedum Hall, Pittsburgh, PA 15261 USA Tel: +1 412 624 7440 Fax: +1 412 624 1480 email: ipcc@pitt.edu <a href="http://www.engr.pitt.edu/pcc/index.htm">www.engr.pitt.edu/pcc/index.htm</a>
26-29 October 2009	15th International Conference on Coal Science & Technology (ICCS&T)	Cape Town, South Africa	Mrs Angelique Freyer, Syngas and Coal Technologies, Sasol Technology Research and Development, 1 Klasie Havenga Avenue, PO Box 1, Sasolburg 1947, South Africa Tel: +27 16 960 4505 Fax: +27 11 219 1095 email: angelique.freyer@sasol.com <a href="http://www.iccst.info">www.iccst.info</a>
29 September to 1 October 2009	IEA Greenhouse Gas R&D's 12th international post combustion network meeting	Regina, SK, Canada	Dr. John Topper, IEA Greenhouse Gas R&D Programme, The Orchard Business Centre, Stoke Orchard, Cheltenham, Gloucestershire GL52 7RZ, UK Tel: +44 1242 680753 Fax: +44 1242 680758 Email: john.topper@iea-coal.org <a href="http://www.co2captureandstorage.info/networks/Capturemtg12.htm">www.co2captureandstorage.info/networks/Capturemtg12.htm</a>
<b>Wednesday 25<sup>th</sup> November 2009</b>	<b>Coal Research Forum (Coal Preparation Division) joint seminar with the Minerals Engineering Society Southern Group and the South Midlands Institute of Materials, Minerals and Mining</b>	<b>The Coal Authority, 200, Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG</b>	<b>Mr Andrew Howells E-mail: <a href="mailto:hon.sec.mes@lineone.net">hon.sec.mes@lineone.net</a></b>
23-24 November 2009	Conference on coal mine methane	London, UK	Abigail Worsfold, Conference Producer - Energy, The SMi Group, Unit 122/4 Great Guildford Business Square, 30 Great Guildford Street, London, SE1 OHS, UK Tel: +44 20 7827 6130 Fax: +44 20 7827 6131 Email: aworsfold@smi-online.co.uk <a href="http://www.smiproduction@smi-online.co.uk">www.smiproduction@smi-online.co.uk</a>
25-30 April 2010	XVI international coal preparation congress	Lexington, KY, USA	Coal Preparation Society of America, PO Box 309, Blacksburg, VA 24063, USA <a href="http://www.icpc2010.com">www.icpc2010.com</a>
1-6 August 2010	33rd international symposium on combustion	Beijing, China	The Combustion Institute, 5001 Baum Boulevard, Suite 635, Pittsburgh, PA 15213-1851, USA Tel: 1 412 687 1366 Fax: 1 412 687 0340 Internet: <a href="http://www.combustioninstitute.org/conferences.htm">www.combustioninstitute.org/conferences.htm</a>

August 30 to 2 September 2010	8th MEGA symposium	Baltimore, MD, USA	Carrie Hartz, Air & Waste Management Association, One Gateway Center, 3rd Floor, 420 Fort Duquesne Blvd. Pittsburgh, PA 15222-1435, USA Tel: +1 412 904 6008 Fax: +1 412 232 3450 Email: <a href="mailto:chartz@awma.org">chartz@awma.org</a> Internet: <a href="http://www.megasymposium.org">www.megasymposium.org</a>
<b>September 5-8 2010</b>	<b>8th European Conference on Coal Research &amp; Its Applications</b>	<b>University of Leeds</b>	<b>To be advised</b>