

# NEWSLETTER



*of the  
Coal Research  
Forum*

## **EDITOR'S COMMENTS:**

Welcome to the second edition of the CRF Newsletter for 2011. This edition contains details of the recent Annual Meeting held at the University of Nottingham, information on BF2RA, the successor programme to BCURA, and a further plea for any of our readers who think they may qualify for a travel bursary to make an early application. There is no absolute guarantee of success but the chances are much better than the National Lottery!

Well, we are now well into the year and, unfortunately, it seems impossible to keep the news about climate change and energy supply out of the headlines it seems. Everyone must have vivid memories, shown for the first time in such graphic detail, of the Japanese earthquake as it happened and the even more deadly tsunami and its aftermath. All our hearts go out to the Japanese people after such a cataclysmic event. The magnitude of this earthquake, following so soon after the Christchurch earthquake in New Zealand once again heightened concerns in some people's minds over global warming and its apparent effect on weather systems. As if this was not enough the consequences of the tsunami on the future of nuclear power took a severe blow just when its image was starting to improve. As with many such disasters some good will has come out of it if new lessons can be learned to avoid their repetition. This seems to have happened with the review of worldwide existing nuclear plant, which has to be a reassuring move.

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## **Student Bursaries for 2011-2012**

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. 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.

### **22nd Annual Meeting and Meeting of the Coal Conversion and Coal Characterisation Divisions**

The Coates Building, University of Nottingham  
13th April 2011

On a rather overcast Spring morning the attendees began gathering in good time in the Coates Building of the Department of Engineering at the University of Nottingham. This venue has become something of a regular host for these meetings and this showed as all of the preparations were in place well ahead of time. Coffee and biscuits, name badges and a co-operative and fully functional AV system gave confidence to the organisers that all should be well! In the event it was, but behind the scenes last minute re-arrangements had had to be made as a number of late cancellations from speakers happened. Happily, all of the gaps were filled and with papers which were well aligned to the theme of the meeting. Well done to all of those involved!

Professor John Patrick welcomed the attendees and followed this up with a short talk entitled "Policy, Needs and What Needs to be Done". He explained that the CRF had been formed 22 years ago in 1989 and that its intention was to bring together those with an interest in coal research for the exchange of information on research topics related to the utilisation of coal. Its policy was, and still is, to provide a forum for the exchange of information; to support the utilisation of coal and to promote UK coal research and expertise. [Despite John's admission at the time of some initial scepticism of the viability of such a venture, I have to say, speaking personally and as an industry-based fuel technologist in 1989, I thought this was just what I was looking for and I still hold this view today, Ed].

John then went on to describe the structure of the CRF with the Executive Committee and the various divisions. As chairman on the Coal Conversion division John explained what the topic means and how the research needs have changed over time. Coal conversion spans the fields of carbonisation, gasification, liquifaction and chemicals from coal. Coal carbonisation has, in the past, focused on understanding the overall process, how coal blends would behave and identifying key process parameters and their effects. More recently, carbonisation research has examined coke oven life and the potential use of lower quality fuels and wastes in coke making. Future aims are expected to address the carbon footprint of carbonisation and how to reduce it and whether, given the cost of new ovens, their lives can be extended even further.

Research into gas production from coal, which had been significant in the past, ceased with the discovery of large reserves of relatively cheap natural gas. It was not until the development of the Integrated Gasification Combined Cycle (IGCC) concept that coal gasification enjoyed a rebirth. However, the research was not so much into the fundamentals, which were well understood, but rather into the engineering and reliability issues of combining the various parts of the process into a reliable electricity generating plant. Whilst some plants continue to operate in a developmental mode there seems some way to go before fully commercial plants will be operating. One other concept, not new in itself but again enjoying something of a comeback, is Underground Coal Gasification (UCG). Whilst its proponents claim several virtues for this idea it still has some way to go to convince everyone of its viability, especially from an environmental standpoint. The future research needs for gasification are aimed at improving combined cycle reliability and hot gas clean up together with addressing the need for fuel flexibility in the overall process.

Coal liquefaction research had in the past been confined to the indirect Fischer Tropsch process but in recent years much more has been done with the direct liquefaction process using novel catalysts and waste materials (see Andrew Minchener's presentation later). The chemical industry was largely reliant in the past on the use of coal for extracting valuable substances. This changed with the availability of large supplies of cheap crude oil but the focus is now returning to coal as oil is getting more expensive and scarcer whilst coal is still readily available and reasonably cheap.

John rounded off his talk by spelling out three themes which are key for cleaner coal technology, namely, the reduction or removal of emissions, the capture and storage of carbon dioxide and the use of advanced systems to maximise efficiency gains. To achieve this, John feels that what is needed is a clear energy policy, funding and guidance as spelled out in the CRF's "Coal and Engineering Research Needs in the UK" report. The clear energy policy must contain direction, time scales and must be realistic and the funding will need to be provided by the UK Government, the EU and industry.

John, as chairman of the Coal Conversion division, then opened Session 1: Meeting of the Coal Conversion Division, "A Review of Recent Developments in Coal Conversion". The first presentation in this session, which aimed to answer some of the key issues mentioned by John Patrick, was from Matthew Billsom of the Department of Energy and Climate Change (DECC) who gave us an "Update on Carbon Capture and Storage Policy from a UK Government Perspective".

Matthew, who is Head of Technology Development in the Office of Carbon Capture & Storage (OCCS), began his talk by quoting from a recent (April 2011) IEA report which stated that 'in the past decade coal had been the fastest growing global energy source, meeting 47% of new electricity demand. Extensive deployment of CCS is critical to achieve climate change goals'. Matthew went on to explain the recent changes that had been introduced by the UK Government in the energy market. These included the Carbon Floor Price (CFP), introduced in the 2011 budget, and the Electricity Market Reform (EMR). The CFP is a fuel duty levied on all fossil fuels used in the UK to generate electricity which is intended to provide more certainty and support to the carbon price. It is expected that this will help provide better returns and lower costs of capital for low carbon investors. To be introduced from 1 April 2013 the combined carbon price will start at £16/tonne and rise steadily by £2 every year with a target price of £30/t by 2020. The Government intends to introduce relief for CCS.

EMR will attempt a fundamental overhaul of electricity market arrangements to help to promote investment in energy infrastructure, especially low-carbon generation. For example, it will consider the implementation of a carbon floor price to reduce risks associated with investment in low-carbon technologies and to advance the UK's climate change mitigation agenda. The consultation process for the EMR closed on 10<sup>th</sup> March 2011. The introduction of an Emissions Performance Standard (EPS) – to limit emissions from power stations – is felt to be

necessary to meet the UK's carbon budgets and develop new technology, but is likely to increase energy prices. The consultation focused on two limits, 450g and 600g CO<sub>2</sub> per kWh. We were told by Matthew that EMR is a very complex topic but it is happening now and is viewed as being of great importance.

The UK Government remains committed to funding four CCS demonstration plants. Project 1 has a Government funding commitment of £1 billion and the contract negotiations are expected to be completed by the end of 2011. It will be a coal-based post-combustion capture project. The single consortium in contention comprises Scottish Power (Longannet power station), National Grid and Shell (pipeline and aquifer undersea storage). However, although only one consortium is still in contention this group is not necessarily going to be awarded the contract.

Projects 2 to 4 are to be funded through general taxation and will not be part of any CCS levy. The fuels for these projects have not been chosen and more information, including the call details, is to be provided later this year.

Also mentioned in this talk was the New Entrants Reserve or (NER300). The NER300 will be a fund worth between €4.5 billion and €9 billion to support carbon capture and storage (CCS) and innovative renewable projects across the European Union. Nine of a total of 22 CCS projects are from the UK. Further details on the projects were supplied by Stuart James in the next presentation.

Other related on-going R&D includes a project at Ferrybridge which is the UK's largest pilot plant demonstrating post combustion capture. Attracting £6.3m UK Government funding (DECC, TSB, Northern Way) the partners include SSE, Doosan Babcock and Vattenfall. The system will have a capability to capture 100 t/d CO<sub>2</sub>, equivalent to 5MWe. Test operations are due to start in Autumn 2011.

Doosan Babcock is involved in an Oxyfuel combustion demonstration aimed at providing a technology which would be suitable for new power plants and for retrofit applications. DECC continues to be involved with support for Technology Strategy Board (TSB) projects.

The OCCS intends to produce a CCS road map by the end of this year. The road map aims to; give strategic direction; ensure actions by key players are aligned; measure progress and guarantee alignment with UK Government energy policy.

The OCCS will achieve this by outlining scenarios and trajectories for CCS deployment needed to meet emissions targets in 2050 and by setting a framework for UK Government and private sector actions over the coming decade. It intends to describe what is a shared understanding between UK Government and key stakeholders of the issues that need to be addressed, by when and the organisations responsible for taking action.

Matthew ended his talk by describing the plans for the launch of the roadmap. The OCCS will engage stakeholders as work streams are taken forward. They intend to hold workshops in the first half of 2011 and to publish the roadmap at the 2011 CCS Stakeholder Conference in Autumn. The timeline for stakeholder engagement is: Spring 2011 - Identify barriers & actions, Summer 2011 - Development of action plan and strategy document, Autumn - 2011 - Publication.

The third presentation was from Stuart James of E.ON New Build & Technology Ltd. Stuart stood in at short notice to give his presentation entitled "IGCC – Current Projects and Technology Status". Stuart began by summarised the operating large-scale IGCC demonstration plants of which there are currently six. Their sizes range from 250MW to 398MW and their year of start-up from 1993 to 2007. They represent a combined output of just under 1,750MW. The relatively small numbers of operating plant are felt to be a reflection of the approximately 20% higher cost of IGCC compared with conventional PF plant and the continuing operational and reliability issues which remain to be resolved. Stuart emphasised the uncertainty regarding the

development of new IGCC projects by mentioning only three which he felt were showing real signs of progress. Of these two are in the USA and one is in China.

Stuart then showed a slide featuring plant that was part of the European Energy Programme for Recovery (EPR). The origin of the EPR is as part of a global €200 billion European Economic Recovery Plan presented by the European Commission on 26 November 2008. Investment in energy projects was considered an important tool to support the economic recovery.

On 9 December 2009, the European Commission announced details of the six CO<sub>2</sub> capture and storage (CCS) projects which will receive funding (€1 billion in total) under the EPR. The six projects are:

Belchatow (Poland) – Post-comb. PGE EBSA; Compostilla (Spain) – Post-comb. Endesa; Hatfield (UK) - IGCC Powerfuel; Jämschwalde (Germany) – Oxyfuel Vattenfall; Porto Tolle (Italy) – Post-comb. Enel and Maasvlakte (The Netherlands) – Post-comb. E.ON.

Funding has been set at €180M for each project (except Porto Tolle, which has €100M). The requirements are that there should be greater than 80% CO<sub>2</sub> capture followed by transport and storage underground. The plant should be 250 MWe or greater. The projects will be required to share and disseminate effectively some of the key results of their technological advances and project progress.

Stuart then described the NER300 programme which had been mentioned earlier by Matthew Billson. A breakdown of the projects was given as follows: 7 coal-fired power stations; 2 gas-fired plants; 2 retrofits to existing power stations; 7 are new power plants; 5 pre-combustion, 3 post-combustion and 1 Oxyfuel project. The UK proposals are Blyth (Pre) – Progressive Energy; Teesside (Pre) - Progressive Energy; Hatfield (Pre) - Powerfuel; Endex (Pre/gas) - Powerfuel; Killingholme (Pre) - C.Gen.; Peterhead (Post/gas) - SSE/Shell (retrofit); Longannet (Post) - Scottish Power (Retrofit); Hunterston (Post) - Ayrshire Power; Drax (Oxyfuel) - Drax Power/Alstom.

Stuart then summarised the status as he viewed it for European IGCC plant. None of the plants listed had final sanction and Stuart speculated that this may be due to storage issues yet to be resolved. The plants mentioned were Hatfield (IGCC) – Powerfuel – Phase 1 (CCGT); Magnum (Nuon/Vattenfall) – Phase 1 (CCGT); Rotterdam (Essent) – Postponed; Rotterdam (C.GEN) – Polygen (S/U 2015) – In feasibility; Hürth (RWE) – 450 MW IGCC – Postponed; Kedzierzyn (ZAK/PKE) – Polygen (S/U 2015?) - Unknown; Ketzin (EU Project) – CO<sub>2</sub> injection into aquifer; Sleipner (Statoil) – CO<sub>2</sub> injection into gas field and Snøhvit (Statoil) – CO<sub>2</sub> injection into gas field.

Regarding an update on IGCC technology Stuart reported that there are many types of gasifier available, i.e. Conoco Phillips, GE, MHI, KBR, Shell, Siemens, TPRI. These are either proven, or starting to enter service. Other novel designs are being developed, but are not yet commercially available.

Warm gas clean up is currently of particular interest as it offers significant efficiency and CAPEX benefits. In terms of gas turbine technology, so-called H-class turbines, which operate at a higher firing temperature than previous designs, are now available for natural gas and can offer 60% CCGT efficiency, compared with 55% for older F-class GTs.

To summarise the current status of IGCC Stuart indicated that costs are still very high and this option only makes sense if carbon is restricted. However, if that were to be the case then IGCC with CCS could be competitive. Technology is slowly moving forward to drive costs down. Many projects are moving forward slowly or not at all due to uncertainty over the future role for coal and CCS and the associated financial constraints.

Dr Andrew Minchener, wearing his IEA Clean Coal Centre hat, presented some of his recent work for this organisation entitled “Coal to Oil, Gas and Chemicals: Recent Challenges and

Opportunities". Andrew began by explaining the two approaches to coal conversion i.e the direct and indirect processes. The direct liquefaction process, as its name suggests, involves direct conversion of coal into useful products; the indirect process, i.e. the Fischer Tropsch process, relies on gasification of coal followed by further processing of the syngas to produce useful products.

Both have advantages and disadvantages as indicated. **Direct process:-** Advantages- Conceptually simple process which can produce high-octane gasoline. The process is more energy efficient and its products have a higher energy density than those from indirect conversion. Disadvantages - Products have a high aromatic content and produce low-cetane number diesel. There are potential water and air emissions issues and the fuels produced are not a good environmental fit for certain markets. The process may have higher operating expenses than indirect conversion. **Indirect process:-** Advantages - The products are ultra-clean and well suited for CO<sub>2</sub> capture and for electric power co-production. The process may have lower operating costs than direct conversion. Disadvantages - The process is conceptually more complex than direct conversion, offers less efficient fuel production than direct liquefaction and produces low-octane gasoline and lower energy density than direct conversion products.

Drivers for developing coal conversion technologies were discussed by Andrew with the following factors being of major importance. One of these is the ability to achieve security of supply for liquid fuels and chemicals in countries that have substantial coal reserves. Such countries can be characterised as being "oil poor, coal rich", with increasing vehicle numbers and demand for liquid fuels – as well as increasing imports of crude oil and petroleum products. Coal-to-liquid (CTL) projects and associated coal conversion developments have the potential to create higher paid employment in coalfield areas. Isolated and low rank/poor quality coal deposits can be utilised in the production of liquid fuels. Use of UCG may also be beneficial in creating added value. Unlike some fossil fuel technology development, CTL activity is very much dependent upon the relative prices of crude oil and coal.

Andrew then briefly reviewed the historical development of CTL from its origins in Germany at the start of the 20<sup>th</sup> century through the high R&D investment period of the 1970's in the USA when crude oil prices rocketed and the enforced development via Sasol of the Indirect process to provide South Africa with liquid fuels during the apartheid regime. China now has the dominant role in CTL due, no doubt, to its rapid new consumer market and its enormous coal reserves have been established in several Chinese provinces. Close to 100 major coal to chemicals plants have been established in several Chinese provinces using modern gasification technologies for ammonia or methanol production. The most prominent DCTL project, with 1Mt annual product capacity, is being operated by the integrated energy company Shenhua Group. Other large scale plants have also started operation with annual capacities of some 160kt. Various other very large demonstration units are being established for coal conversion to synthetic natural gas (each 4 billion m<sup>3</sup> annual output) and key chemicals such as olefins and dimethyl ether (up to 3Mt annual capacity).

In Australia several companies have been developing UCG projects which will provide opportunities to test this evolving technology with small volumes of product gas being used for power generation and/or CTL production.

Until recently, activity in the USA centred on the development of several direct coal-to-liquids pilot plant projects. However, over the last two years several larger scale coal liquefaction/polygeneration projects have been announced based on indirect coal conversion.

In central and Eastern Europe, large commercially proven lignite reserves exist but very limited oil and gas reserves. As such, many countries are possible candidates to establish coal liquefaction given the expectation of an economically-favourable crude oil price.

Andrew summarised the economic issues by saying CTL is expensive to build and expensive to run and that economies of scale are important (80,000 bbl/day). Capital costs are high US\$ 5-6 billion, as are annual operating costs of around US\$ 250 million. The process requires 28,000 t/day of bituminous coal or double that if lignite is used. Production cost per barrel will rise by US\$5/barrel if CCS is added. The process has a vulnerability to oil and coal price fluctuations. Coal-to-chemicals is vulnerable to imported products produced from low cost gas. Commercial considerations include decisions on scale and product mix (e.g. chemicals, power, CO<sub>2</sub>), coal cost and security, products off-take agreements, and financing mechanisms.

Environmental impacts of CTL can be both direct and indirect. For example, Andrew stated that it takes about 4 tonnes of coal to produce 1 tonne of synthetic oil so more coal will be needed and, if CCS is introduced, even more again. In addition there is a need for up to 10 tonnes of water to produce 1 tonne of synthetic oil, which may well introduce constraints in terms of where plants might be sited. There are also local emissions, effluents and residues from a CTL plant to be considered.

For those countries that wish to take forward coal conversion, the challenge is that more RD&D is required over the next decade to improve CTL plant design, efficiency and operational characteristics. Process intensification could ensure significant improvements in plant efficiency and also the economic utilisation of smaller, stranded coal deposits. Links with UCG may prove very attractive. Improvements are also needed in catalyst utilisation (particularly the use of nano-catalysts) which will help reduce the costs of producing CTL fuels. This is important as some catalysts are based on high cost materials such as cobalt and molybdenum. Finally, in many countries that have an interest in coal conversion, there is a serious shortage of engineers and specialists who would be needed to build and operate new facilities.

In his summary Andrew said he believes that coal based liquid and gaseous fuels will have to compete with other energy sources in the coming decades – not just traditional crude oil, but also biofuels, natural gas and non-traditional hydrocarbon fuels. The future development of coal conversion technologies will depend on the process plants being able to produce products that are competitive in the transportation fuel and chemicals markets - and also being able to meet increasingly strict environmental operating standards. Strong government support must be a key element in the future development of such projects.

The closing talk before lunch was given by Dr Anup Patel who is the Centre Manager for the RCUK Industrial Doctorate (EngD) Centre. His talk was entitled “Efficient Fossil Energy Technologies EngD Centre Activities”. The University of Nottingham is the lead partner in the Centre and the other partners are Loughborough University and the University of Birmingham. All three universities are partners in the Midland Energy Consortium.

Anup began by describing the objectives behind the setting up of the centre. It was he said to produce research leaders to tackle the major challenges over the next 15 years in implementing new power plant to generate electricity more efficiently using fossil energy with near zero emissions. These leaders will be part of the new breed of engineers thoroughly versed in cutting edge research and capable of operating in multi-disciplinary teams, covering knowledge transfer, deployment and policy roles. They will have the skills to analyse the overall economic context of their projects and to be aware of the social and ethical implications. The aim is to produce 60 EngDs based in industry over the next 8 years (50 funded by EPSRC). The demand is probably significantly higher, particularly due to proposed EU/UK demonstrations that are needed for deployment of clean coal CCS technologies by 2020.

The special features of an EngD degree were said to be that it is of 4 years duration with a general training programme; it has a higher stipend than for a traditional PhD (ca. £20k). There is an extensive period of time of close to three years spent conducting basic research in industry and there is still an emphasis on conducting original research, indeed, aiming for PhD collating peer reviewed publications.

Anup then identified the topics of interest in the University of Nottingham's Clean Coal Technology & Carbon Abatement Technologies area. These include CO<sub>2</sub> capture in combustion and gasification, novel adsorbents; Oxyfuel combustion; Flue gas clean-up – Hg adsorbents, carbons for NO<sub>x</sub> reduction; CO<sub>2</sub> storage/sequestration, coal seams and mineralisation and long-term CO<sub>2</sub> utilisation and photocatalytic reduction.

Other academics involved in the Centre are Professor Richard Green of Birmingham, who won a Philip Leverhulme Prize for his work on electricity markets, and is work stream leader for training in the Supergen Flexnet consortium and the Specialist Advisor to the House of Lords Economic Affairs Committee inquiry on renewable energy. Professor Robert Dingwall, formerly of the University of Nottingham and now founder of Dingwall Enterprises, is the founding Director of the Institute of Science & Society, and has won over £5M in funding since 1998. Professor Michèle Clarke at Nottingham, who holds a Chair in Environmental Change, has a Chinese Scholarship Council project with Dalian University of Technology on Chinese public perceptions of carbon abatement technologies. Professor Rachel Thomson is Director of the Loughborough University, Materials Research School and leads the Supergen consortium.

Summer schools are a feature of the Centre and one was held in July 2010 at which 70 attendees were present. It was held at the Southeast University, Nanjing, China. A similar event is planned for July 2011 to be held at the Centre for Energy, ITT Guwahati, Assam, India. Anup provided a list of the 2009 and 2010 projects currently being funded through this route. Note: the previous CRF newsletter contained an article with information regarding the EngD programme.

There followed an excellent buffet lunch which provided a welcome break for the attendees and the usual opportunity to catch up with all the latest gossip in the coal research world!

Between 1.30pm and 2.00pm, Session 2 involving the CRF Annual Meeting was held, where a report on the CRF's 2010 activities and the activities of the various Divisions were presented. In addition, the 2010 annual accounts of the CRF were presented and elections were held for a number of the Executive Committee Officer and Members.

The afternoon presentations began with Session 3: Meeting of the Coal Characterisation Division, "What we need to know about coal" chaired by Coal Combustion Division Chairman Ed Lester.

The first paper was given by Richard Plumb, who is the Fuel Buyer for EDF Energy plc, and was entitled "Coal Suitable for Burning at UK Power Stations". Richard has a background in coal preparation having worked previously for the NCB and British Coal. The information Richard provided was related to the coal diet for Cottam and West Burton power stations.

A number of coal procurement issues were highlighted by Richard. For example, whether the coal to be bought is of international or domestic origin; if it is international would there be any issues over whether it can be burned. In addition there are questions regarding the availability of the desired coal, logistics constraints, loading delays and UK port availability. Specific issues to be addressed include the risk of spontaneous combustion and whether it is wise to stock such 'at risk' coals. Details regarding the coal specification and its price, i.e. API Index or fixed, and delivery period, need to be agreed. Richard noted that it was 6 weeks for delivery of international coal from Russia following order placement. Once ordered the coal must be received unless sold on to another user.

Power stations have boilers with different burner configurations which can affect the way in which coals burn. Current UK PF-fired boilers were designed for North Nottinghamshire deep mined coal. The use of imported coals and new regulatory emission requirements have made it necessary to apply retrofit systems to the boilers. Such add-ons like FGD, precipitator improvement and NO<sub>x</sub> abatement equipment adversely affect the plant efficiency. Other coal properties of concern include the heat content (net and gross), volatile matter, sulphur,

chlorine and ash composition for ash depositional and corrosion issues, coal swelling index for burner nozzle build-up and petrography to identify poor burning coals. Like many UK power stations, Cottam has burned and is burning biomass. Types of biomass include wood chip and pellet, sunflower husks, olive cake meal and pellets. Not all biomasses are suitable in all of the power plants. Certain biomass-based liquid fuels have been used such as tall oil in place of heavy fuel oil. However, its use is subject to close scrutiny by the Environment Agency and detailed analytical data must be provided. Options for the use of biomass are either as a blend with coal or by direct injection. Their use is not straightforward and the systems need to be micro managed as high carbon monoxide levels and mill fires have been known to occur.

The second afternoon session talk was a variant on the first with the view of coal quality from the perspective of Drax Power Ltd. It was entitled "What We Need to Know About Coal: The View of a Utility" and was given jointly by Ian Wright, who is the Fuel Procurement Officer and Robert Ghent, who is a Performance Engineer.

Ian began the talk by mentioning some of the key features of Drax Power. Drax Power comprises six flexible units – 660MW each which were commissioned in two phases – 1,980 MW installed by 1976 and 1,980 MW installed by 1986. The station is fully environmentally compliant – FGD & BOFA (Boosted Over Fire Air) systems fitted and is one of the cleanest and most efficient coal-fired power stations in the UK. It generates around 23 to 27TWh per annum, which is approximately 7% of the UK's electricity needs. The station has a coal and alternative fuel burn of around 8.5Mt to 11Mt per annum and employs 760 skilled and experienced employees. It was listed on London Stock Exchange in December 2005.

Coal quality issues of importance to Drax are moisture (free and inherent) and coal size. The coal must not be too coarse (little >50mm) nor should it be too fine. These properties will affect the ability of the coal to be transported to the mills. A 'new' coal will need to be test fired before a large consignment is ordered and the effect of coal ash composition on by-products such as gypsum and pfa quality need to be investigated.

Up to the winter of 2004 Drax was burning 100% of its original design coal from the Selby coalfield. This proved to be unsustainable due to the closure of the mine and impending environmental constraints. Through a comprehensive single fuel trial programme it has been possible to widen the Drax coal specification range and to add generic (Russian Kuzbass, high sulphur US) and specific named coals (RSA, Colombian, Indonesian bituminous and sub-bituminous) to the approved coal list. The current regime uses a ratio of 50% of indigenous and 50% imported coals. Coals which were judged to be NOx 'unfriendly' are no longer burned.

Drax also had the highest renewable output from a single UK facility in 2010. It has the world's biggest co-firing facility of 500MW renewable electricity capacity and at full capacity saves more than 2.5Mt CO<sub>2</sub> per annum. Drax also has the highest UK renewable output (7% total UK) – despite operating at less than full capacity. The 2010 biomass burn was 0.9Mt compared to 0.4Mt in 2009. Drax do not expect full utilisation at current ROC support level. Drax has also commissioned a 70kt port storage and rail loading facility and has new biomass rail wagons in operation. There is also a complementary 100kt per annum straw pellet plant. All biomass is procured against a robust sustainability policy.

Future developments at Drax will be influenced by the Industrial Emissions Directive (IED). [Background information on the IED, which may be useful to some of us! Ed] On 8 November 2010, the European Council approved the revised Industrial Emissions Directive, thus securing its adoption. The Directive will recast the Large Combustion Plants Directive significantly tightening emission limits for large combustion installations operating in Europe. The IED will consolidate seven existing Directives related to industrial installations with the aim of providing a single clear and coherent legislative instrument for controlling pollution from industrial operations. The IED focuses in particular on limiting air pollutants such as sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and dust emissions. The IED is expected to enter into

force before the end of 2010 and will need to be transposed into the national laws of each Member State within two years.

More stringent emissions standards (NO<sub>x</sub> and SO<sub>x</sub>) will be in place from 2016. The timing of closures/plant retrofits will be major determinants of future UK reserve margin. R&D work will continue on technical solutions including SCR; fuel mix – biomass burn level. Clarity is also required over biomass UK Government support levels.

One of the challenges facing Drax is how to widen the Dark Green Spread (DGS). The DGS is the difference between the price available in the market for sales of electricity and the marginal cost of production (being the cost of coal and other fuels including CO<sub>2</sub> emissions allowances). If the gas price is low in Europe alongside a strong coal market the result will be a lower DGS. If the DGS margins are low there is an opportunity for Drax to find value in the fuel diet, i.e. advantaged fuels such as petroleum coke, pond fines and lower heat, higher sulphur fuels. Drax is able to undertake fuel trials at the boundaries of usual quality acceptance criteria. Fuel blending will be used to allow fuels to stay within emissions 'bubbles'. It will be possible to blend 'out of spec' high value fuels to create boiler-ready fuels, in effect having a 'designer fuel' blending option.

At this point Robert took over the proceedings and began by providing a brief overview of the Drax boilers and the normal coal specification for which the boilers were designed. To allow the purchase of a wider suite of world coals Drax uses the EPRI Vista Coal Quality Impact Model which will highlight particular areas for concern from firing a given unknown coal. A test burn will follow before the coal is purchased in bulk.

Robert then mentioned the widely-used compositional ratios for the assessment of fuel quality parameters such as slagging, fouling and corrosion and showed pictures of the damage caused by certain fuel types.

The further development of biomass/coal co-firing will continue and will comprise the prediction and minimisation of slagging, fouling, and corrosion from coal biomass blends. There will also be continued growth of fuel flexibility in terms of materials handling and coal blending. Boiler performance development will focus on improved fuel air distribution, measurement, and control and flame 'eyes' performance. Characterisation of co-firing coal biomass blends will continue and will target NO<sub>x</sub> optimisation and the continuing saleability of by-products.

Robert drew the talk to a close with a summary of the status of Drax by saying that since 2004 considerable progress has been made with coal flexibility including advantaged fuels such as fine coal. Slightly earlier, in 2003 to be exact, a biomass co-firing capability at Drax was developed of up to 500 MW. The Drax team are continuing to develop fuel flexibility and biomass co-firing further, and to optimise boiler performance.

"What we need to know about coal: The view of an equipment manufacturer" was the next paper given by Jacob Roberts of The Greenbank Group Ltd. Jacob is a Project Development Engineer in the Combustion Group. The main activities of Jacob's group are to assist operators of coal fired boilers in improving plant; to improve plant monitoring and measurement; to enhance life-cycle of plant and equipment and to supply replacement plant and equipment.

Greenbank's business is currently being influenced by a number of factors such as the UK's energy strategy and LCPD European legislation; the closure of several existing coal stations; recent coal price increases and the increasing use of biomass and renewable fuels. Many enquiries are coming from overseas with huge interest in combustion optimisation arising from other parts of Europe and China. This is due no doubt in part to the fact that some countries are almost solely dependent on coal for their electricity supply, for example, South Africa 93%, Poland 92% and PR China 79%.

Much of the remainder of Jacob's presentation seemed to be a plea for information to allow him and his team to do their job. He mentioned the parameters necessary for a pulveriser and coal flow optimization exercise and for a combustion upgrade and critically the difficulty that often surrounds getting such information. This remains the major problem area for companies such as Greenbank and others but it has to be said that it is not a new problem. Speaking from personal experience and having worked for a power generation equipment manufacturer myself [Ed.] this was always, and I do mean always, the potential showstopper!

The final presentation was given by Dr Trevor Drage of the University of Nottingham and was called "An overview of coal characterisation research at the University of Nottingham". Trevor gave us a whistle-stop tour of the coal related research facilities and expertise currently residing within his university. Trevor mentioned the Energy Technologies Research Institute (ETRI) with its interest in carbon abatement, hydrogen and fuel cells, renewable energy, electrical infrastructure, built environment and environmental and socio-economics. He also mentioned the EngD activities which had already been described earlier by Anup Patel.

In terms of coal characterisation, (and this is a facility of great value to many of the UK power generators and has been for some considerable time), questions that may be asked are:

- on quality assurance – *is this coal the one that we think we bought?*
- for combustion performance assessment – *will this new coal behave as per proximate spec?*
- for use as post combustion 'forensics' – *something has gone wrong, why?*

Trevor explained that a comprehensive suite of standard test procedures for coals is available together with a number of novel in-house developed techniques which are available to answer the more challenging questions. The use of image analysis and coal reflectance values has been shown to be able to identify the components in a coal blend relatively easily and in a way no other technique can match. A combustion performance indicator, known as '% Unreactives', has been shown to have relevance in predicting coal combustion within full size boiler plant. Ash composition can be determined by sophisticated scanning electron microscope techniques. The mineralogy of unburnt coal can be demonstrated in terms of the nature and size of included minerals in coal.

Trevor then went on to describe some microstructural studies carried out during coal combustion, pyrolysis and carbonisation projects. The coal combustion studies involved Oxyfuel firing conditions and the use of combustion-enhancing additives. The equipment used to carry out these studies was a drop-tube furnace (DTF). Work on providing a better understanding of coal carbonisation, and the use of biomass blend components, involved a high temperature small-amplitude oscillatory shear (SAOS) rheometer and high temperature NMR studies.

Trevor closed his presentation with an example of how coal characterisation can help in the most unlikely circumstances. Parts of Xuan Wei County, Yunnan Province, China have the highest known lung cancer mortality in non-smoking women. This high mortality displayed a clear relationship to the coal from the local mines. Geochemical, petrographic, and grain size analyses were undertaken on a set of coal samples from Xuan Wei. Results demonstrate that the single geochemical property that makes this coal unusual is its high concentration of quartz (13.5 wt %) of which 35–55% occurs as <10 µm grains. To quote the author of this work David Large, "A typical household in Xuan Wei County consumes about three to eight tons of coal each year. So in that period a family could handle a half-ton of fine-grained silica particles, which has recently been classified a carcinogen. The potential health effects of it can't be ignored."

The meeting closed at 4.00pm and Professor Patrick thanked all of the speakers and attendees for making it into what appeared to the editor to be a very enjoyable and entertaining meeting.

## **Report from a PhD student funded by the CRF at the 1<sup>st</sup> International Conference on Clean Energy Science**

This is the report of Mr Qi Liu who was awarded a travel bursary by the Coal Research Forum, to attend the 1st International Conference on Clean Energy Science (ICCES) in Dalian of China on 10th-13th April 2011.

The Conference was co-sponsored by Dalian Institution of Chemical Physics (Chinese Academy of Sciences) and the Royal Society of Chemistry, and it was the first conference in the world to focus on scientific problems of clean energy such as solar energy conversion, biofuels and biomass conversion, and CO<sub>2</sub> capture and storage discussing the latest advances.

More than 300 participants from 25 countries worldwide, including scholars, experts and entrepreneurs from various energy areas inside and outside China, attended the Conference. Exchanges and discussions were carried out in different sessions of the 3-day Conference.

I am a 3rd year PhD student in the Centre for Innovation in Carbon Capture and Storage (CICCS) at the University of Nottingham, and I delivered an oral presentation entitled "Experimental studies of pH control in buffer systems for sequestering CO<sub>2</sub> as mineral carbonates" in ICCES.

I was the only student to give the oral presentation in this conference. This 1st International Conference on Clean Energy offered a unique opportunity for international researchers to discuss the latest developments in clean energy and energy storage research, and the fundamental issues surrounding the scientific challenges to be faced ahead. For more information, please contact Mr Qi Liu: [enxql5@nottingham.ac.uk](mailto:enxql5@nottingham.ac.uk)

## **The Biomass and Fossil Fuel Research Alliance (BF2RA)**

### **Background and Formation of BF2RA**

BF2RA was established in September 2009 following the decision of the British Coal Utilisation Research Association (BCURA) not to fund further R&D projects. Founder Members of BF2RA were all former BCURA Industrial Panel Members but there is no link between BF2RA and BCURA.

The overall aim of BF2RA is to promote research on the production, distribution and use of biomass and fossil fuel and their derivatives. To this end the original intent was to co-fund research arising from joint open calls in conjunction with EPSRC using EPSRC funding previously earmarked for joint EPSRC/BCURA collaboration. In the event EPSRC was unable to proceed on this basis but committed some co-finance ring-fenced for BF2RA projects through its EngD Centre in Efficient Fossil Energy Technologies (EFET) based at Nottingham University.

Whilst welcoming this EPSRC offer, BF2RA Members agreed that projects would primarily be supported as a result of open calls for proposals and that EFET would compete for BF2RA support alongside any other applicants.

### **First BF2RA Projects**

In early 2010 BF2RA Members decided to re-appraise two former BCURA projects that were let in mid-2009 and then almost immediately cancelled due to lack of finance. Re-appraisal suggested that with minor modifications the research proposed was still pertinent and BF2RA grants were offered for these two studies. BF2RA adopted an EngD type funding model with part-funding being offered to each institution. These grants are for doctorate studies on Dynamic Modelling of Super-critical Coal-fired Power Plant (Cranfield University) and Flame Monitoring Technology for Coal and Biomass Fuels (Kent University). The research at Kent

was initiated in late 2010 with a formal kick-off meeting held in December 2010. There was some delay in starting the research at Cranfield University due to a student work permit issue. This has now been resolved and the kick-off meeting for this research was held in April 2011.

Because the opportunity for an open call had been missed in 2010, BF2RA invited EFET to submit outline proposals to BF2RA at short notice. One proposal on Biomass Torrefaction attracted significant Member's interest and was recruited as a 2010 start through the EngD EFET Centre. The kick-off meeting for this research was held in October 2010 and work is now well underway with a first six monthly progress meeting scheduled for May 2011.

In addition BF2RA invited two institutions to bid for a research study on Fluidised Bed Sintering. This is a topic of particular interest to one BF2RA Member organisation and represents follow on work to an earlier BCURA funded activity. BF2RA agreed to support the proposal submitted by Nottingham University and the work will proceed as a 2011 start within the EngD scheme and will attract the EPSRC top-up funding.

### **The 2011 BF2RA Open Call for Proposals**

BF2RA launched its 1<sup>st</sup> Open Call for proposals in late January 2011 with a deadline date of 4<sup>th</sup> March for submission of outline proposals. The interest in this Call was significant with over 30 compliant and high quality outlines received. BF2RA has assessed these outlines and invited submission of a small number of full proposals which are currently being assessed and decisions will be made shortly on those projects to be supported.

### **Future Calls for Proposals**

It is BF2RA's intention to run an annual Open Call for proposals and the 2<sup>nd</sup> Open Call will therefore be launched in early 2012. BF2RA Members will agree later this year on the technical scope of the next Call.

### **Membership of BF2RA**

The continued success of BF2RA is clearly dependent on developing and maintaining a strong membership base that will support a significant and meaningful portfolio of R&D in the biomass and fossil fuel area.

Membership of BF2RA gives Individual Members access to leveraged and targeted R&D. Research is primarily recruited through Open Calls for proposals on specific topics as specified by the BF2RA Members themselves. Typically BF2RA offers grants towards PhD or post-doctoral studies with the balance of funding coming either from internal university sources or from other third parties.

The funding model adopted by BF2RA offers Members extremely advantageous financial gearing for research that is contracted. BF2RA is still at the embryo stage with modest membership numbers but that said financial gearing of circa. 15:1 is currently being realised and this financial gearing ratio will increase as new Members are recruited. In contrast, direct 100% funding of R&D by a single company clearly achieves no financial gearing and funding as a single company through say a Doctorate Training Centre Scheme would only achieve gearing of circa. 3:1. Now is therefore the right time to join BF2RA and to share the benefits of its future growth and associated influence on R&D to Members' benefit in the field of biomass and fossil fuel.

Current membership of BF2RA comprises a mix of electricity supply, equipment manufacturer, user and research organisations. New members are welcomed from all of these categories and from the public sector.

Further details on BF2RA Membership and an application form can be found on the BF2RA web site at [www.bf2ra.org](http://www.bf2ra.org) Alternatively contact Peter Sage the BF2RA Technical Officer at [technical@bf2ra.org](mailto:technical@bf2ra.org) or telephone 07786 918054 for further information.

## ARTICLES FROM THE TECHNICAL PRESS

### **New academy to train technicians for low carbon power sector**

**4<sup>th</sup> January 2011, greenwisebusiness**

A new state-of-the-art training facility has opened in Rugby, Warwickshire, to provide the skills to technicians looking to work in the UK's low carbon power sector. The Power Industry Academy is part of a new £33 million centre at Warwickshire College in Rugby. It provides training and resources for the energy manufacturing supply chain with a focus on turbines and carbon friendly power generation. The Government says that more than £110 billion of investment is needed in new power stations and grid upgrades over the next decade and around a quarter of the UK's generating capacity needs to be replaced by 2020, equivalent to around 20 large power stations.

<http://www.greenwisebusiness.co.uk/news/new-academy-to-train-technicians-for-low-carbon-power-sector-2026.aspx>

### **New award to recognise developments in marine renewable energy**

**5<sup>th</sup> January 2011, BYM Marine & Maritime News**

The Scottish Government has launched the Saltire Prize Green Energy Award to recognise outstanding contributions in the development of wave and tidal power. The Saltire Prize is a £10 million fund provided by the Scottish Government to reward significant innovation in marine renewable energy technology. It is the world's largest single prize for advancement of renewable marine energy, aimed at developing the innovative technologies required to capitalise on Scotland's significant reserves of potential renewable marine energy. The Saltire Prize Green Energy Award is a new annual award to recognise valuable achievements made by individuals and organisations competing for the Saltire Prize.

<http://www.bymnews.com/news/newsDetails.php?id=79638>

### **"Coffee Roaster" Technology Could Speed the Decline of Coal**

**8<sup>th</sup> January 2011, Tina Casey, Clean Technica**

Researchers at the University of Leeds are developing a roasting process that will transform raw biomass from a bulky, water-saturated material into an energy-rich powder that is perfect for burning in coal-fired power plants. Called torrefaction, it is a relatively low-temperature process similar to that used in roasting coffee beans. If the researchers can overcome a few stumbling blocks, the process could lead to a new burst of coal-to-biomass power plant conversions, and consequently to lower greenhouse gas emissions.

<http://cleantechnica.com/2011/01/08/coffee-roaster-technology-could-speed-the-decline-of-coal/>

### **Research to create new wave of clean energy technology**

**9<sup>th</sup> January 2011, CPI Financial**

Designed to be installed at around 10 metres depth, 0.5 km from shore, Aquamarine Power has already installed and tested its Oyster 1 demonstration device at the European Marine Energy Centre in Orkney, Scotland, where it generates electricity which is transmitted to the National Grid to power homes in the local area. BAE Systems has joined forces with wave energy developer Aquamarine Power as part of a project worth almost £1 million to deliver cheaper, more reliable sources of clean energy for homes across the UK and beyond.

<http://www.cpifinancial.net/v2/News.aspx?v=1&aid=6895&sec=Technology>

### **Harvesting energy: body heat to warm buildings**

**9<sup>th</sup> January 2011, Xanthie Hinchey, BBC News**

Body heat is not an energy source that normally springs to mind when companies want to keep down soaring energy costs. But it did spring to the mind of one Swedish company, which decided the warmth that everybody generates naturally was, in fact, a resource that was going to waste. Jernhusen, a real estate company in Stockholm, has found a way to channel the body

heat from the hordes of commuters passing through Stockholm's Central Station to warm another building that is just across the road.

<http://www.bbc.co.uk/news/business-12137680>

## **Small-scale solar helps clean energy investment reach record heights**

**11<sup>th</sup> January 2011, Greenwise Business**

Global investment in clean energy saw a 30% surge in 2010, helped in large part by a massive uptake in rooftop solar generation in Europe, latest figures reveal. Investment in microgeneration projects almost doubled to £38.9 billion last year, largely driven by Government-subsidised small-scale solar projects in Europe, according to Bloomberg New Energy Finance. This 91 per cent increase on 2009 helped overall investment in clean energy around the world soar to £155 billion in 2010, up from £119.4 billion the year before.

<http://www.greenwisebusiness.co.uk/news/smallscale-solar-helps-clean-energy-investment-reach-record-heights-2036.aspx>

## **Centrica puts new power station plans on hold**

**13<sup>th</sup> January 2011, Reuters**

British utility Centrica PLC said it put on hold plans to build a new gas-fired power station in Brigg, North Lincolnshire, as it explores other options for the site, including extending the life of the existing plant. Centrica withdrew its application for a 2,000-megawatt (MW) combined-cycle gas turbine (CCGT) power plant from the Infrastructure Planning Commission (IPC) at the end of December. "We are now assessing a number of options including further investment to extend the life of the existing plant," said a spokesman for Centrica.

<http://af.reuters.com/article/energyOilNews/idAFLDE70C21B20110113>

## **Liverpool University to open its own Energy Research Centre**

**17<sup>th</sup> January 2011, Laura Elahi, Home Heating Guide**

The University of Liverpool has announced that it is to open a new institution that will be dedicated to energy research. The Stephenson Institute for Renewable Energy is to be the first interdisciplinary centre into energy research in the North West. The institute will be used to undertake research into renewable energy sources such as fuel cell technology and bio-fuels. The centre will focus on developing clean and sustainable energy technologies including hydrogen generation and storage, solar harvesting, wind and marine energy and fusion technology.

<http://www.homeheatingguide.co.uk/blog/liverpool-university-to-open-its-own-energy-research-centre.html>

## **UK Coal falls 5% as production rises, but so does its debt**

**17<sup>th</sup> January 2011, Nick Fletcher, The Guardian**

Britain's largest remaining quoted coal company has unveiled a boost in production last year, but debt concerns have seen its shares slump more than 5%. UK Coal said it produced 7.2m tonnes of coal in 2010, of which 5.8m was from deep mines. This compares to a total of 7m tonnes in 2009. But the company's debt rose from £182m to £243m despite property sales of £22.7m taken in the 2010 accounts, with another £3.6m due in 2011.

<http://www.guardian.co.uk/business/marketforceslive/2011/jan/17/uk-coal-production-rise>

## **Baffled homeowners are still unsure of the benefits of renewable energy**

**17<sup>th</sup> January 2011. clickgreen**

Although most UK households believe renewable energy is important, many are still confused about its actual benefits, according to a new research survey. And nearly two-thirds of homeowners admitted they didn't know enough about microgeneration systems, such as solar and wind, to make an informed decision on whether to invest or not. The report, released by Surrey-based energy advice consultants ReEnergise Renewables, highlights the dilemma facing many residents over how to assess the potential for renewable energy systems.

<http://www.clickgreen.org.uk/research/data/121793-baffled-homeowners-are-still-unsure-of-the-benefits-of-renewable-energy.html>

## **Low-cost carbon-capture project sparks interest**

**18<sup>th</sup> January 2011, Jeff Tollefson, [Nature.com](#)**

The Shidongkou No. 2 Power Plant outside Shanghai, China, has hosted a parade of foreign visitors in recent months, from academics and industry officials to US energy secretary Steven Chu. All have had one question on their minds: have Chinese engineers turned a corner on carbon-capture technology? The buzz began in late 2009, after officials at the government-owned Huaneng Group opened a facility that captures some of the carbon dioxide emitted by the existing giant 1,320-megawatt coal-fired Shidongkou power station. The system scrubs roughly 120,000 tonnes of CO<sub>2</sub> a year from 3% of the facility's flue gases, but what has caught everybody's eye is the cost that Huaneng quotes: a mere US\$30–35 per tonne of CO<sub>2</sub>, including the further expense of purifying the captured gas for use in the food and beverage industry.

<http://www.nature.com/news/2011/110118/full/469276a.html>

## **Sasol Abandons \$10B Indonesian Coal-to-Fuels Plan, Focuses on Gas**

**18<sup>th</sup> January 2011, Bambang Djanuarto and Carli Lourens, [Bloomberg](#)**

Sasol Ltd., the largest producer of motor fuels from coal, abandoned a plan to build a \$10 billion coal-to-fuels plant in Indonesia to focus on opportunities in the gas-to-fuels industry. The South African company wants to accelerate talks with the Indonesian government about other gas-to-liquids projects, Sasol said in an e-mailed response to questions today. The company, based in Johannesburg, won't pursue other coal-to-fuels projects after the current ones in China and India, it said. A "structural shift" in gas prices, which are now likely to remain at "depressed" levels, make gas-to-fuels an attractive industry to be in, Sasol said last month.

<http://www.bloomberg.com/news/2011-01-18/sasol-ends-indonesia-coal-fuels-project-official-says-update1-.html>

## **Salmond hails hydrogen energy facility in Fife**

**18<sup>th</sup> January 2011, [BBC News](#)**

A state-of-the-art research facility, powered by stored energy from a wind turbine, has been officially opened by the first minister. Alex Salmond said it was a "hugely exciting" step for the green economy. The £4.7m Hydrogen Office in Fife is expected to become one of Europe's leading centres for the creation and development of renewable technology. It uses surplus electricity from a turbine to electrolyze water, creating hydrogen, which is then stored. The innovative hydrogen and fuel cell system was developed by the Pure Energy Centre in Unst.

<http://www.bbc.co.uk/news/uk-scotland-edinburgh-east-fife-12215386>

## **Europe awards €60m to support emerging green energy projects**

**18<sup>th</sup> January 2011, [Click Green](#)**

Negotiations have begun for the 44 projects that were shortlisted to receive a share of the nearly €58 million available under the 2010 call for project proposals of the Intelligent Energy - Europe programme. These new projects are set to contribute to the wider use of renewable energy sources and increased levels of energy efficiency across Europe.

<http://www.clickgreen.org.uk/news/international-news/121799-europe-awards-%E2%82%AC60m-to-support-emerging-green-energy-projects.html>

## **ExxonMobil warns carbon emissions will rise by 25% in 20 years**

**19<sup>th</sup> January 2011, John Vidal, [The Guardian](#)**

ExxonMobil, the world's largest oil company, expects global carbon emissions to rise by nearly 25% in the next 20 years, in effect dismissing hopes that runaway climate change can be arrested and massive loss of life prevented. According to the company's annual Outlook for Energy report – due to be published in the next few weeks – demand for power will increase by nearly 40% in the next 20 years, lifting emissions by around 0.9% a year at least until 2030.

<http://www.guardian.co.uk/environment/2011/jan/19/exxonmobil-carbon-emissions-rise>

## **EU investigating carbon trading thefts**

**20<sup>th</sup> January 2011, BBC News**

All carbon trading in Europe has been halted as the European Commission looks into thefts of emissions permits. The Czech carbon registry said 7m Euros (£5.9m, \$9.4m) of permits had seemingly been stolen by hackers on Wednesday. It followed a similar security breach in Austria on Tuesday, and prompted five countries to suspend their registries before the entire system was shut down. A Commission spokesman did not rule out the possibility of deliberate sabotage.

<http://www.bbc.co.uk/news/business-12241846>

## **IEA doubles global gas reserves estimates**

**20<sup>th</sup> January 2011, Roger Harrabin, BBC News**

The world may have twice as much natural gas than previously thought, according to the rich nations' think tank the International Energy Agency (IEA). The world may have 250 years of gas usage at current levels thanks to "unconventional gas" from shale and coal beds, Anne-Sophie Corbeau, senior gas expert at the IEA told BBC News. Estimates may even be revised upwards.

<http://www.bbc.co.uk/news/business-12245633>

## **2010 hits global temperature high**

**20<sup>th</sup> January 2011, Richard Black, BBC News**

2010 was the warmest year since global temperature records began in 1850 - although margins of uncertainty make it a statistical tie with 1998 and 2005. The World Meteorological Organization (WMO) concludes 2010 was 0.53C warmer than the average for the period 1961-90 - a period commonly used as a baseline. The 10 warmest years have all occurred since 1998, it notes.

<http://www.bbc.co.uk/news/science-environment-12241692>

## **Nuclear power generators will face £1bn in clean-up costs after an accident**

**23<sup>rd</sup> January 2011, Tim Webb, The Guardian**

Nuclear operators will have to pay the first £1bn towards the cost of any accident in the UK – seven times more than the current cap on their liabilities – the government will propose. Energy secretary Chris Huhne told the *Observer* that he wanted to introduce the new rule to ensure that there would be no public subsidy for nuclear power. Currently, any operator of a nuclear site only has to pay the first £140m towards clean-up costs, with the taxpayer contributing the rest.

<http://www.guardian.co.uk/business/2011/jan/23/nuclear-power-accident-clean-up-costs>

## **Evidence in Canadian Arctic points to volcanoes as cause of massive extinction**

**23<sup>rd</sup> January 2011, Mark Iype and Lea Sorry, 2011 Vancouver Sun.**

A mass extinction 250 million years ago was caused by massive volcanic eruptions that burned significant volumes of coal, causing runaway global warming to impact the temperature and acidity of the world's oceans, Canadian researchers found in new research announced Sunday. "This could literally be the smoking gun that explains the latest Permian extinction," said Steve Grasby, a researcher at the University of Calgary's department of geoscience. During the Permian extinction 95 per cent of life was wiped out in the sea and 70 per cent on land. Unlike the demise of the dinosaurs 65 million years ago, where there is widespread belief that a meteorite was at least the partial cause, it is unclear what caused the Permian mass extinction.

<http://www.vancouversun.com/technology/Evidence+Canadian+Arctic+points+volcanoes+cause+massive+extinction/4152438/story.html>

## **Climate Benefits of Natural Gas May Be Overstated**

**25<sup>th</sup> January 2011, Abraham Lustgarten, ProPublica**

The United States is poised to bet its energy future on natural gas as a clean, plentiful fuel that can supplant coal and oil. But new research by the Environmental Protection Agency—and a growing understanding of the pollution associated with the full “life cycle” of gas production—is casting doubt on the assumption that gas offers a quick and easy solution to climate change. Advocates for natural gas routinely assert that it produces 50 percent less greenhouse gases than coal and is a significant step toward a greener energy future. But those assumptions are based on emissions from the tailpipe or smokestack and don't account for the methane and other pollution emitted when gas is extracted and piped to power plants and other customers.

<http://www.propublica.org/article/natural-gas-and-coal-pollution-gap-in-doubt>

## **UK set for high end climate costs, as floods spread**

**31<sup>st</sup> January 2011, Richard Black, BBC News**

The UK is likely to feel bigger costs from climate change than most other EU countries, a report concludes. Rising sea levels are likely to impact the nation harder than most, negating economic benefits from increased tourism and possibly farm yields. The findings come from a study funded by the European Commission, published in Proceedings of the National Academy of Sciences (PNAS).

<http://www.bbc.co.uk/news/science-environment-12327530>

## **EU calls for double investment in renewable energy**

**31<sup>st</sup> January 2011, Bloomberg**

Investment in renewable energy in the European Union has to be doubled to reach the target of having 20 percent of the region's energy come from renewable sources by 2020, the bloc's executive said Monday. Only three states — Germany, Hungary and Sweden — have met their 2010 interim goals for renewable energy for both electricity and transport, the European Commission said. Portugal, Poland and Lithuania also expect to have met both targets, but the Commission sees their progress as less advanced. Most other states reached their goals in one of the two areas.

<http://www.bloomberg.com/news/2011-01-31/eu-calls-for-double-investment-in-renewable-energy.html>

## **English household recycling rate tops 40 per cent**

**3<sup>rd</sup> February 2011, businessGreen**

More than 40 per cent of England's household waste was recycled, reused or composted last year, representing a new record for the country according to provisional statistics released today by Defra. The government department hailed the record performance as "great news" after the figures showed household recycling rates reached 40.1 per cent last year, narrowly beating the government's target of achieving a 40 per cent recycling rate by June 2010.

<http://www.businessgreen.com/bg/news/2024002/english-household-recycling-rate-tops-cent>

## **GDF Suez completes takeover of International Power**

**3<sup>rd</sup> February 2011, AFP**

French energy giant GDF Suez said Thursday it had completed its takeover of Britain's International Power, creating the world's second-largest electricity producer. "The completion of this transaction creates a high growth, world leading independent power generation company," Sir Neville Simms, Chairman of International Power, was quoted as saying in a statement after the two firms announced the closing of the deal. The European Commission cleared the takeover last week on condition it sell some assets in Belgium to avoid dominating power generation in that country. The deal had already been approved by US, Canadian, Australian, Brazilian and Turkish authorities.

[http://www.google.com/hostednews/afp/article/ALeqM5jtkpcBvhxrtPkfhx0D9\\_CwtcMmNA?dclid=CNG.5059cecfb0aba8394b7f8d99ed739f16.491](http://www.google.com/hostednews/afp/article/ALeqM5jtkpcBvhxrtPkfhx0D9_CwtcMmNA?dclid=CNG.5059cecfb0aba8394b7f8d99ed739f16.491)

## **An Engine that Harnesses Sound Waves**

**4<sup>th</sup> February 2011, Tyler Hamilton, MIT Technology Review**

A startup company has developed a new type of engine that could generate electricity with the efficiency of a fuel cell, but which costs only about as much as an internal combustion engine. Etalim, based in Vancouver, Canada, says its engine, roughly the size of a basketball, could improve the economics of electricity production for the cogeneration of power and heat in homes, and as a way to harness the heat produced at concentrating solar collectors. The company has created a prototype, but has yet to achieve the kind of efficiencies—in excess of 40 percent—that its computer models indicate are within reach.

<http://www.technologyreview.com/energy/32267/?nlid=4088&a=f>

## **A New Twist on Floating Wind Power**

**4<sup>th</sup> February 2011, Phil McKenna, MIT Technology Review**

Wind turbines attached to floating buoys can harness stronger, more sustained winds in the open ocean. But the floats now used for such deep-water installations may prove prohibitively expensive because the buoys needed to keep them above water are enormous. Now a project in France is turning the turbine design on its head for what developers hope will be a low-cost alternative.

<http://www.technologyreview.com/energy/32266/?nlid=4088&a=f>

## **Catastrophic drought in the Amazon**

**4<sup>th</sup> February 2011, Steve Connor, The Independent**

A widespread drought in the Amazon rainforest last year caused the "lungs of the world" to produce more carbon dioxide than they absorbed, potentially leading to a dangerous acceleration of global warming. Scientists have calculated that the 2010 drought was more intense than the "one-in-100-year" drought of 2005. They are predicting it will result in some eight billion tonnes of carbon dioxide being expelled from the Amazon rainforest, which is more than the total annual carbon emissions of the United States. For the second time in less than a decade, the earth's greatest rainforest released more carbon dioxide than it absorbed because many of its trees dried out and died.

<http://www.independent.co.uk/news/science/special-report-catastrophic-drought-in-the-amazon-2203892.html>

## **Preparing for climate change 'will boost economy'**

**8<sup>th</sup> February 2011, Richard Black, BBC News**

Early preparation for climate change impacts would bring economic benefits to the UK, say engineers in a report commissioned by the government. Engineering the Future - an alliance of professional engineering bodies - says companies will be more likely to invest in nations with secure infrastructure. It urges regulators to improve links between sectors for better planning. A climate-constrained future will bring more disruption to energy, transport, water and IT, it warns. This increases the risk of "cascade failures", where a breakdown in one system has knock-on effects on others - such as a flood that takes out the local electricity supply, which in turn affects the mobile phone network.

<http://www.bbc.co.uk/news/science-environment-12384389>

## **Carbon capture schemes bid for EU cash**

**9<sup>th</sup> February 2011, BBC News**

Two Scottish carbon capture and storage (CCS) schemes are bidding for European Union cash. Ayrshire Power wants to use CCS technology when building a new coal-fired power station at the existing Hunterston site. Scottish and Southern Energy (SSE) has also submitted a plan to develop a CCS project at its gas-fired power station in Peterhead, Aberdeenshire.

<http://www.bbc.co.uk/news/uk-scotland-glasgow-west-12406020>

## **New Scottish Energy Laboratory expected to generate up to £3.6m in ten years**

**9<sup>th</sup> February 2011, NewEnergyWorldNetwork .com**

Scotland is to become home to a new national energy laboratory that is anticipated to strengthen collaboration across 50 energy research, test and demonstration facilities. The Scottish Energy Laboratory has been heralded by the Scottish government for offering a hub that is expected to provide international companies with access to the country's test and demonstration assets. The new national laboratory is expected to assist energy technology developers identify, and access test and demonstration facilities, with an eye to development and commercialisation.

<http://www.newenergyworldnetwork.com/renewable-energy-news/by-technology/energy-efficiency/new-scottish-energy-laboratory-expected-to-generate-up-to-3-6m-in-ten-years.html>

## **Powerfuel revives UK clean coal hopes**

**12<sup>th</sup> February 2011, Rowena Mason, The Telegraph**

Britain's hopes of becoming a world leader in "clean coal" have been revived with nine companies bidding for the collapsed British mining company, Powerfuel. But despite the wave of interest in the company's assets, most creditors of Powerfuel – which could be eligible for £800m in subsidies – are likely to lose their money. Administrators believe the Hatfield coal mine and "carbon capture business" could fetch £40m in total, but the company still owes VTB Capital and ING around £88m.

<http://www.telegraph.co.uk/finance/newsbysector/energy/8320389/Powerfuel-revives-UK-clean-coal-hopes.html>

## **EU could meet carbon targets more cheaply with gas than renewables, say gas firms**

**13<sup>th</sup> February 2011, Tim Webb, The Guardian**

Savings would be €900bn, gas producers tell European commission ahead of next month's energy policy road map. Europe could save €900bn (£762bn) and still hit its 2050 carbon reduction targets if it built fewer wind farms and more gas plants, a coalition of gas producers including Gazprom, Centrica and Qatar Petroleum has told the European commission.

<http://www.guardian.co.uk/business/2011/feb/13/gas-firms-lobby-europe-on-emissions>

## **UK renewables join CCS in race for €4bn EU funding**

**17<sup>th</sup> February 2011, businessGreen.**

Five renewables projects and nine carbon capture and storage applications to compete for Brussels' funding. The UK government is considering 14 applications from carbon capture and storage (CCS) and renewable energy projects all seeking a share of European funding worth an initial €4.4bn. The Department of Energy and Climate Change (DECC) has today released further information on the nine submissions for CCS projects across the country, including proposals from SSE, Drax, Peel Energy and Powerfuel.

<http://www.businessgreen.com/bg/news/2027070/uk-renewables-join-ccs-race-eur4bn-eu-funding>

## **SSE closing Fife Power Station with loss of 21 jobs**

**18 February 2011, Marjorie Inglis, the courier.co.uk,**

Fife Power Station at Cardenden bought by Scottish and Southern Energy seven years ago is to close at the end of March with the loss of 21 jobs. Workers have been told efforts will be made to redeploy them elsewhere, but there is scepticism about the practicality of moving settled families, with children attending local schools.

<http://www.thecourier.co.uk/News/Fife/article/10971/scottish-and-southern-energy-closing-fife-power-station-with-loss-of-21-jobs.html>

## **Friends of the Earth £1bn Pembroke power station complaint examined** **21<sup>st</sup> February 2010, BBC News South West Wales**

An environment lobby group's complaint over a £1bn gas-fired power station being built in Pembrokeshire is being considered by the European Commission. Friends of the Earth Cymru (FoE) says the Pembroke plant, due to supply energy to some 3m homes, had planning consent before assessments were ready. It wants the planning process halted for the investigation. But developer RWE npower said it was confident the 2000 Mw plant would receive all the necessary permits.

<http://www.bbc.co.uk/news/uk-wales-south-west-wales-12518246>

## **Research project on UCG with CCS in Bulgaria**

**21<sup>st</sup> February 2011, Bellona**

The University of Leeds, together with European partners from different private entities and research institutions are working together on combining underground coal gasification (UCG) with CCS in Bulgarian deep lying coals, with the objective to produce a cost-effective and "near zero carbon footprint" energy.

[http://www.bellona.org/news/news\\_2011/UCG\\_CCS\\_bulgaria](http://www.bellona.org/news/news_2011/UCG_CCS_bulgaria)

## **China Is Far Behind Its CBM Planned Production Target**

**21<sup>st</sup> February 2011, Business Wire**

Increasing demand for gas and pressure to reduce carbon emissions has prompted China to develop its coal bed methane (CBM) resources. Therefore, China had set an ambitious target for its eleventh five year plan from 2006-2010 to produce five billion cubic meters (bcm) of CBM a year by 2010. However, currently the country has achieved less than a quarter of its target. Challenges faced by the CBM development industry are economic viability, infrastructural availability and technological development. PetroChina is an emerging leader since China opened up foreign participation in CBM development. The country is seeking foreign collaborations mainly for technical expertise, especially with the North American oil and gas companies.

<http://www.businesswire.com/news/home/20110221005061/en/Research-Markets-China-CBM-Production-Target-Set>

## **DECC gives nod for new gas plant & NOx reduction at coal plant**

**23<sup>rd</sup> February 2011. Utility Week.**

The Department of Energy & Climate Change has given the go-ahead for SSE to build an 870 megawatt gas-fired power station near Port Talbot. However, SSE said it does not plan to proceed with the installation of (SCR) technology at the plant. A spokesperson said this was because "The IED means [we] have the option of operating the station for 17,500 hours between 1 January 2016 and 31 December 2023, even if SCR is not fitted to tackle emissions of nitrogen oxides".

[http://www.utilityweek.co.uk/news/news\\_story.asp?id=195112&title=Decc+gives+nod+for+new+gas+plant+%26+NOx+reduction+at+coal+plant+\(but+SSE+won't+use+it\)](http://www.utilityweek.co.uk/news/news_story.asp?id=195112&title=Decc+gives+nod+for+new+gas+plant+%26+NOx+reduction+at+coal+plant+(but+SSE+won't+use+it))

## **Newcastle borehole drilling starts in search of heat**

**23<sup>rd</sup> February 2011, BBC News**

Engineers have started drilling a hole deep below Newcastle in the search for a renewable energy source. The Newcastle and Durham Universities team plans to sink a hole 2,000m (6,562ft) below the planned Science Central site, in the city centre. Scientists hope the £900,000 project will result in water at a temperature of about 80C (176F) being pumped out. The plan is the water could be used to heat the site and surrounding city centre buildings. The project, which started on Wednesday, is expected to last six months with the team hoping to pump out the first hot water in June.

<http://www.bbc.co.uk/news/uk-england-tyne-12547313>

## **Target 'black carbon' to tackle climate change, recommends UN**

**23<sup>rd</sup> February 2011, Fiona Harvey, The Guardian**

Cutting the amount of soot we pour into the atmosphere, and emissions of methane from agriculture, would be one of the most powerful ways to tackle climate change (pdf) , a new report from the United Nations environment programme (Unep) has concluded. Preventing "black carbon" – particles of soot from industry and cooking fires – from polluting the air would help to cut global warming by as much as 0.5C, and reduce warming in the Arctic by about two thirds by 2030. Scientists say a rise in temperature of about 2C is the limit of safety, beyond which climate change would become catastrophic and irreversible.

<http://www.guardian.co.uk/environment/2011/feb/23/target-black-carbon-climate-change>

## **Scottish Power to open research centre in Scotland**

**28<sup>th</sup> February 2011 istockAnalyst.com**

Scottish Power Ltd has announced a research center that will accelerate the adoption of new, smart technologies, from advanced power grids to electric cars and household appliances. The £12.5 million Power Network Demonstration Center is being created by the University of Strathclyde and energy companies including Scottish Power and Scottish and Southern Energy, with support from Scottish Enterprise and the Scottish Funding Council. The Center will play a key role in increasing the UK electricity grid's efficiency and reliability, as well as testing the next generation of smart electrical technologies. This will support the integration of new renewable energy sources, electric vehicles and smart household appliances with the grid, such that emissions and cost can be minimised.

<http://www.istockanalyst.com/business/news/4925694/scottish-power-to-open-research-center-in-scotland>

## **EU urges to strengthen security in European carbon market**

**28<sup>th</sup> February 2011, Steel Guru**

The European Commission said that it will push European governments to strengthen security in the European carbon market, which was forced to shut a month ago because of repeated thefts worth tens of millions of euros. The Commission, which oversees the functioning of the Emissions Trading System, the market to trade allowances to emit carbon dioxide, said that it will later recommend government representatives review more thoroughly the accounts of market operators and increase screening of new ones. It will also propose changes to existing rules to provide more legal certainty.

[http://www.steelguru.com/international\\_news/EU\\_urges\\_to\\_strengthen\\_security\\_in\\_European\\_carbon\\_market/193452.html](http://www.steelguru.com/international_news/EU_urges_to_strengthen_security_in_European_carbon_market/193452.html)

## **E.ON sells UK electricity network to US firm PPL**

**2<sup>nd</sup> March 2011, BBC News**

German energy firm E.ON is to sell its UK power network to US business Pennsylvania Power and Light (PPL) in deal worth £4bn. E.ON UK is selling its Central Network's division, which operates an 80,000 mile power grid in the Midlands supplying electricity to more than five million people. It is part of E.ON's plan to sell off 15bn euros of assets by 2013.

<http://www.bbc.co.uk/news/business-12617668>

## **Indonesia thermal coal export ban proposal worries India**

**3<sup>rd</sup> March 2011, Devjyot Ghoshal, Business Standard**

Indonesia may be looking to ban the exports of low-grade thermal coal by 2014, a move, which if undertaken, could have an impact on the domestic power sector that is dependent on the Southeast Asian country to bridge the coal supply shortfall in India. "There are domestic market obligations, as we need coal for our own power producers. From 2014 onwards, we will only export value-added coal of more than 5,600 kilocalories (kcal)," Djunaedi, deputy director of oil, gas and mine products at Indonesia's Ministry of Trade, said on the sidelines of the ninth Annual Coal Markets Conference.

<http://www.business-standard.com/india/news/indonesia-thermal-coal-export-ban-proposal-worries-india/427289/>

## **Mexican Scientists Developing Eco-friendly Cement**

**4<sup>th</sup> March 2011, Fox News**

Scientists at Mexico's Research and Advanced Studies Center, or Cinvestav, are developing a new type of cement that they say will reduce carbon-dioxide emissions by up to 80 percent while lowering the amount of energy consumed in the production process by as much as 50 percent. "Cement is the second most consumed product in the world after water, due to population growth that in many cities requires the development of infrastructure, buildings and homes," Cinvestav, which depends on the National Polytechnic Institute, said Thursday in a statement.

<http://latino.foxnews.com/latino/news/2011/03/04/mexican-scientists-developing-eco-friendly-cement/>

## **Enel opens CCS pilot in Brindisi**

**4<sup>th</sup> March 2011, Carbon Capture Journal**

The pilot plant in Brindisi is part of joint activities set forth by the strategic agreement signed with ENI in 2008. It will be able to treat 10,000 cubic meters per hour of fumes from the Federico II coal plant, separating out 2.5 metric tons of carbon dioxide (CO<sub>2</sub>) per hour, up to a maximum of 8,000 metric tons per year, equivalent to the CO<sub>2</sub> absorbed by around 800,000 trees or a 10 Km<sup>2</sup> forest.

[http://online.wsj.com/article/SB10001424052748704506004576174642618364856.html?mod=WSJ\\_Energy\\_leftHeadlines](http://online.wsj.com/article/SB10001424052748704506004576174642618364856.html?mod=WSJ_Energy_leftHeadlines)

## **UK approves RWE 2,400 MW gas plant**

**4<sup>th</sup> March 2011, Reuters**

Britain's energy ministry on Friday approved the construction of RWE npower's 2,400 megawatt (MW) combined-cycle gas turbine (CCGT) plant at Willington in South Derbyshire, it said. The one-billion-pound gas-fired power plant will not come into service before 2016, an RWE npower spokesman said.

<http://uk.reuters.com/article/2011/03/04/us-britain-rwe-approval-idUKTRE7232PD20110304>

## **20% More Efficient CCS Cleaning Up Coal Plants – With Rust!**

**5<sup>th</sup> March 2011, CleanTechnica**

Among presenters at the recent ARPA-E summit were researchers trying rust to capture carbon dioxide more economically from Ohio State University. Last year's \$5 million grant from ARPA-E had enabled their research to the point where a 250 kilowatt demonstration plant is ready to test how well it works and what it costs. Instead of exposing the coal to air, using a technology already proved in the lab, the team, led by Professor Liang-Shih Fan of the Department of Chemical and Biomolecular Engineering, is producing a highly concentrated stream of carbon dioxide using chemical looping, making it easier to capture. In this case, they will use iron, cycling it between iron oxide (rust), and metallic iron – in a chemical loop.

<http://cleantechnica.com/2011/03/05/20-more-efficient-ccs-cleaning-up-coal-plants-with-rust/>

## **Research Shows That 20 MW Turbines Are Feasible**

**15<sup>th</sup> March 2011, North American Windpower**

Twenty-megawatt wind turbines are feasible, according to a new report from the European Union-funded UpWind project and published at the European Wind Energy Association (EWEA) 2011 conference in Brussels. The UpWind project explored the design limits of upscaling wind turbines to 20 MW and found that they would have rotor diameters of around 200 meters, compared to some 120 meters on today's 5 MW turbines. Such turbines could be a solution for expanding Europe's offshore wind energy capacity, providing several times more electricity at lower costs than today's turbines. EWEA forecasts that wind energy will meet 26%

to 34% of Europe's electricity demand power by 2030, with almost as much electricity coming from offshore turbines as from those onshore.

[http://www.nawindpower.com/naw/e107\\_plugins/content/content.php?content.7491](http://www.nawindpower.com/naw/e107_plugins/content/content.php?content.7491)

### **EPA proposes 'first ever' emissions standards for power plants 16<sup>th</sup> March 2011, Darryl Fears, The Washington Post**

The Environmental Protection Agency released a plan Wednesday that would reduce emissions of mercury and other toxins from coal-burning power plants, drawing praise from health officials and condemnation from some industry representatives and lawmakers. EPA Administrator Lisa P. Jackson said the "first ever" national standard for harmful power plant emissions "was 20 years in the making" and was required by the 1990 Clean Air Act. The plan would force plants to purchase scrubbers and other equipment to prevent 91 percent of mercury from coal from being released into the air.

[http://www.washingtonpost.com/national/epa-proposes-first-ever-emissions-standards-for-power-plants/2011/03/16/ABWy7Mh\\_story.html?wprss=rss\\_homepage](http://www.washingtonpost.com/national/epa-proposes-first-ever-emissions-standards-for-power-plants/2011/03/16/ABWy7Mh_story.html?wprss=rss_homepage)

### **Safe nuclear does exist, and China is leading the way with thorium 20<sup>th</sup> March 2011, Ambrose Evans-Pritchard, The Telegraph**

A few weeks before the tsunami struck Fukushima's uranium reactors and shattered public faith in nuclear power, China revealed that it was launching a rival technology to build a safer, cleaner, and ultimately cheaper network of reactors based on thorium. This passed unnoticed – except by a small band of thorium enthusiasts – but it may mark the passage of strategic leadership in energy policy from an inert and status-quo West to a rising technological power willing to break the mould. If China's dash for thorium power succeeds, it will vastly alter the global energy landscape and may avert a calamitous conflict over resources as Asia's industrial revolutions clash head-on with the West's entrenched consumption.

[http://www.telegraph.co.uk/finance/comment/ambroseevans\\_pritchard/8393984/Safe-nuclear-does-exist-and-China-is-leading-the-way-with-thorium.html](http://www.telegraph.co.uk/finance/comment/ambroseevans_pritchard/8393984/Safe-nuclear-does-exist-and-China-is-leading-the-way-with-thorium.html)

### **£16.5million bioenergy laboratories to develop low carbon technologies 21<sup>st</sup> March 2011, Laura Hopperton, Eureka**

Aston University is developing new £16.5million engineering laboratories to showcase and develop renewable low carbon technologies including a biomass fuelled power plant. Due to open on Aston's campus in Birmingham in October 2012, the facility will include giant photo bioreactors harnessing algae and a 0.4MWel small scale industrial power plant fuelled by biomass. According to the university, the plant will generate heat and power from biomass using algae, sewage sludge, wood and agricultural waste as sources of fuel. It will also generate biomass by products including hydrogen power for low carbon vehicles or fuel cells and Biochar for use as an agricultural fertiliser and a source for decentralised hydrogen production.

<http://www.eurekamagazine.co.uk/article/32428/165million-bioenergy-laboratories-to-develop-low-carbon-technologies.aspx>

### **Doosan Power to invest £170m in Scottish wind energy 22<sup>nd</sup> March 2011, Emily Smoucha, Greenwise business**

Energy technology and engineering company Doosan Power Systems Ltd has announced plans to invest £170 million in Scottish wind power research and development and manufacturing over the next 10 years. An initial investment will go towards developing offshore wind turbines at a new research and development Centre of Excellence for Renewables being opened by Doosan Power in Renfrew, near Glasgow, with plans to invest in wind turbine manufacturing further down the line.

<http://www.greenwisebusiness.co.uk/news/doosan-power-to-invest-170m-in-scottish-wind-energy-2209.aspx>

## **Companies use microbes to turn Wyoming coal into gas**

**5<sup>th</sup> April 2011, Mead Gruver, Bloomberg Businessweek**

New scientific research has a pair of energy companies betting that the future of the U.S. natural gas industry lies in persuading microscopic bugs to treat old coal deposits like all-you-can eat buffets. Coal, researchers have found, is full of microbes that consume the fossil fuel and break it down into methane gas. Two companies want to take advantage of this naturally occurring phenomenon on a large scale to create vast amounts of natural gas in energy-rich places like Wyoming.

<http://www.businessweek.com/ap/financialnews/D9MDM5TO1.htm>

## **Solar Costs May Already Rival Coal, Spurring Boom in Panel Installations**

**6<sup>th</sup> April 2011, Ehren Goossens, Bloomberg**

Solar panel installations may surge in the next two years as the cost of generating electricity from the sun rivals coal-fuelled plants, industry executives and analysts said. Large photovoltaic projects will cost \$1.45 a watt to build by 2020, half the current price, Bloomberg New Energy Finance estimated today. The London-based research company says solar is viable against fossil fuels on the electric grid in the most sunny regions such as the Middle East.

<http://www.bloomberg.com/news/2011-04-05/solar-energy-costs-may-already-rival-coal-spurring-installation-boom.html>

## **Study: Gas from 'fracking' worse than coal on climate**

**10<sup>th</sup> April 2011, Ben Geman, The Hill, E<sup>2</sup> Wire**

Cornell University professors will soon publish research that concludes natural gas produced with a drilling method called "hydraulic fracturing" contributes to global warming as much as coal, or even more. The conclusion is explosive because natural gas enjoys broad political support – including White House backing – due to its domestic abundance and lower carbon dioxide emissions when burned than other fossil fuels. Cornell Prof. Robert Howarth, however, argues that development of gas from shale rock formations produced through hydraulic fracturing – dubbed "fracking" – brings far more methane emissions than conventional gas production.

<http://thehill.com/blogs/e2-wire/677-e2-wire/155101-report-gas-from-fracking-worse-than-coal-on-climate>

## **After Turning Coal to Heavy Crude, US University Works on Refinement**

**13<sup>th</sup> April 2011, Pam Kasey, WTRF**

Energy research takes many forms in West Virginia University's Advanced Energy Initiative. Some projects create entirely new processes, while others simply improve processes already in use. Elliot Kennel's Carbon Products Group is doing some of both. Entirely new is the group's process for converting coal to crude oil. "What we're doing is very simple: regarding coal as solid crude oil," said Kennel, a chemical engineer in WVU's College of Engineering and Mineral Resources. "And we're asking how can we get that in shape so an American refinery can process it with a minimum of time, energy and money. We want to convert it to a liquid. Once it flows, refineries in Texas and Canada can handle it."

<http://www.wtrf.com/story.cfm?func=viewstory&storyid=97651>

## **TSI Launches GEO-COAL Upgrading Technology**

**20<sup>th</sup> April 2011, Vishwajeet Ganpate, BusinessWireIndia**

Total Sinergy International (TSI) today announced the launch of GEO-COAL technology, a simple and economical process of upgrading the energy content of low rank coal by 50 to 100 percent. A patent has been filed and TSI has also signed an agreement with a subsidiary of Indonesian national utility company, PT Perusahaan Listrik Negara, on their joint research and development to use GEO-COAL technology in one of its power generation plants in Indonesia. GEO-COAL processes raw brown coal with superheated steam, removing 60 to 80 percent of the moisture and increasing the energy content of the initial low rank coal feedstock by 50 to 100 percent. GEO-COAL technology also maintains the inherently low sulphur and ash levels of

the low rank coal feedstock, helping power generation plants meet today's strict emissions standards.

<http://www.businesswireindia.com/PressRelease.asp?b2mid=26579>

## Using the Energy in Oil Shale Without Releasing Carbon Dioxide in a Greenhouse World

20<sup>th</sup> April 2011, Science Daily

New technology that combines production of electricity with capture of carbon dioxide could make billions of barrels of oil shale -- now regarded as off-limits because of the huge amounts of carbon dioxide released in its production -- available as an energy source in a greenhouse world of the future. That's the conclusion of a report on "electricity production with in situ carbon capture" (EPICC) in ACS' journal *Energy & Fuels*. Their answer is EPICC -- a self-fueled method that generates electricity, as well as the heat needed to produce that electricity from shale. The report describes how EPIC could generate large amounts of electricity without releasing into the atmosphere carbon dioxide from burning the shale. That carbon would be captured and stored underground as part of the production process.

<http://www.sciencedaily.com/releases/2011/04/110420112104.htm>

## Alstom and Shanghai Electric in coal-power deal

21<sup>st</sup> April 2011, AFP

French engineering group Alstom announced a big strategic development on a global scale with Chinese partner SEC, in the field of coal-fired power generation, on Thursday. Alstom and Shanghai Electric Group (SEC) are to create a joint venture for their global activities in supplying boilers for such power generating facilities, the company said. Many experts see new, so-called "clean", technologies for coal-fired power generation as a solution to energy provision, and China is particularly dependent on coal-fired power generation, having big resources of coal.

<http://www.google.com/hostednews/afp/article/ALeqM5h6cQyf7GS0M1gr8hVITTCZ0Mn4Zg?dclid=CNG.18cb5b2874eb9c4386cf10d3192d45f3.381>

## CALENDAR OF COAL RESEARCH MEETINGS AND EVENTS

Date	Title	Location	Contact
6 <sup>th</sup> to 7 <sup>th</sup> June 2011	4th Annual Gasification Conference.	Crowne Plaza - The City, London, United Kingdom.	Andrew Gibbons SMi Group Ltd., Great Guildford Business Square, 30 Great Guildford Street, London SE1 0HS, UK Tel: +44 0870 9090 711 Fax: +44 0870 9090 712 Email: <a href="mailto:agibbons@smi-online.co.uk">agibbons@smi-online.co.uk</a> <a href="http://www.smi-online.co.uk/events/overview.asp?is=5&amp;ref=3478">http://www.smi-online.co.uk/events/overview.asp?is=5&amp;ref=3478</a>
5 <sup>th</sup> to 9 <sup>th</sup> June 2011	The 36th International Technical Conference on Clean Coal & Fuel Systems	Clearwater, Florida, USA	<a href="http://www.coaltechnologies.com/">http://www.coaltechnologies.com/</a> The Clearwater Clean Coal Conference, Barbara Sakkestad, 928 Beacon Square Court #13.6 Gaithersburg, MD 20878 301-330-2256 <a href="mailto:barbarasak@aol.com">barbarasak@aol.com</a>
28 <sup>th</sup> June to 1 <sup>st</sup> July 2011	5th European combustion meeting	Cardiff, UK,	Tony Griffiths, Cardiff University, Southgate House, PO Box 533, Cardiff CF14 3XZ, UK Tel: +44 29 2087 6365 Fax: +44 29 2087 4990

			Email: <a href="mailto:ecm2011@cardiff.ac.uk">ecm2011@cardiff.ac.uk</a> Internet: <a href="http://www.ecm2011.org">www.ecm2011.org</a>
28 <sup>th</sup> to 29 <sup>th</sup> June 2011	2011 Utility Coal Conference (formerly Fuel Flexibility)	Minneapolis, Minnesota, USA	American Coal Council, 1101 Pennsylvania Ave., NW, Suite 600, Washington, DC 20004, USA Tel: +1 202 756 4540 Fax: +1 202 756 7323 Email: <a href="mailto:info@americancoalcouncil.org">info@americancoalcouncil.org</a> Internet: <a href="http://www.americancoalcouncil.org/cde.cfm?event=336339">www.americancoalcouncil.org/cde.cfm?event=336339</a> <a href="http://www.accevents.org/index.php/fuelflexibility">http://www.accevents.org/index.php/fuelflexibility</a>
17 <sup>th</sup> to 20 <sup>th</sup> July 2011	7th international symposium on coal combustion	Harbin, China	Shaoyang Sun, Harbin Institute of Technology, 92 West Dazhi Street, Nan Gang District, Harbin 150001, China Tel: +86 451 86412238 Fax: +86 451 86412528 Email: <a href="mailto:sunsz@hit.edu.cn">sunsz@hit.edu.cn</a> Internet: <a href="http://www.7thiscc.net/">http://www.7thiscc.net/</a>
17 <sup>th</sup> to 19 <sup>th</sup> August 2011	Coal-Gen	Columbus, Ohio, USA	Fax: Direct: +1-918-831-9161 Toll-Free: +1-888-299-8057 Mail: COAL-GEN 2011 Registration Department 1421 South Sheridan Road Tulsa, OK 74112-6600 USA <a href="http://www.coal-gen.com/index.html">http://www.coal-gen.com/index.html</a>
12 <sup>th</sup> to 15 <sup>th</sup> September 2011	2011 Pittsburgh Coal Conference	Pittsburgh, PA, USA	<a href="http://webster.engr.pitt.edu/pcc/index.html">http://webster.engr.pitt.edu/pcc/index.html</a>
<b>Provisionally 20<sup>th</sup> or 22<sup>nd</sup> September 2011</b>	<b>The European Industrial Emissions Directive (IED) Coal Research Forum (Environment Division)</b> joint with the Combustion Engineering Association and the Royal Society of Chemistry Energy Sector	<b>Department of Chemical Engineering, Imperial College London</b>	<b>Dr Trevor Drage</b> <b>E-mail:</b> <a href="mailto:trevor.drage@nottingham.ac.uk">trevor.drage@nottingham.ac.uk</a> <b>Tel: 0115 951 4099</b>
9 <sup>th</sup> to 13 <sup>th</sup> October 2011	International Conference on Coal Science & Technology	Oviedo, Spain	Contact Information: Angeles G. Borrego, INCAR-CSIC Tel: +34985118979 Email: <a href="mailto:info@CCST@incar.csic.es">info@CCST@incar.csic.es</a> <a href="http://www.iccst.info/live/index.php?ie=UTF-8&amp;rlz=1T4ADRA_enGB373GB377&amp;q=coal+conferences+2011">http://www.iccst.info/live/index.php?ie=UTF-8&amp;rlz=1T4ADRA_enGB373GB377&amp;q=coal+conferences+2011</a>
13 <sup>th</sup> October 2011	<b>"The UK Minerals Industry and the Use of their Products in Everyday Life"</b> Coal Research Forum (Coal Preparation Division) joint with the Mineral Engineering Society Southern Group and the South Midlands Institute of Materials, Minerals and Mining	<b>Yew Tree Lodge Hotel, Kegworth, Nottinghamshire</b>	<b>Mr Andrew Howells</b> <b>E-mail:</b> <a href="mailto:hon.sec.mes@lineone.net">hon.sec.mes@lineone.net</a>