

# NEWSLETTER



*of  
the  
Coal Research Forum*

**EDITOR'S MUSINGS:**

The committee of the Coal Research Forum would like to take this opportunity to wish all of our readers a Happy New Year.

As we move into the New Year I wonder what 2014 will hold in store for the coal community. Starting on a rather parochial note it means that we are now that little bit closer to ECCRIA 10, our biennial conference, which is to be held at the University of Hull. Please note the dates, 15<sup>th</sup> to 17<sup>th</sup> September 2014; we look forward to seeing you there - presenters, attendees, regulars as well as newcomers! Important dates and contact details are to be found at [www.constableandsmith.com/coalresearch](http://www.constableandsmith.com/coalresearch). Academics please note the availability of travel bursaries for your student attendees, see page 2 of this newsletter.

Looking further a field, this is the first time in 46 years that Kent's kettles are bubbling away without the help of Tilbury power station's considerable coal power. On Tuesday 13<sup>th</sup> August 2013, amid little fanfare, Tilbury's turbines spun for the last time. About 6.1 gigawatts of UK coal plant capacity is expected to shut down by 2015 due to the requirements of the LCPD. Other stations that closed this year include Cockenzie and Didcot A. This has highlighted concerns that our generating reserve will be squeezed and power cuts may occur. I wonder whether the government will try to use this fear of potential blackouts in its future energy plans. It might help to smooth the way for the introduction of new nuclear power stations and possibly the development of fracking, despite public objections and higher costs. And what of climate change? Is it real and simply paused at the moment - or is it all just a myth?

This issue contains a report of a Biomass and Fossil Fuel Research Alliance (BF2RA) seminar held at the University of Nottingham in October and a review of the Coal Science lecture given by Professor Colin Snape at the Institute of Physics in London. A summary of the RSC Energy Sector Early Career Chemists Symposium is also provided. The CRF provided a prize at this event. New RFCS projects which started in 2013 are also tabulated in this issue.

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## **Student Bursaries for 2014-2015**

Up to six 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 requirements for eligibility for award of a bursary are that the recipient will submit a short report about his or her impressions of the conference to the Newsletter Editor for inclusion in the next edition. In addition, the report will provide some brief details of the beneficiary, their topic of study and the reasons for wishing to attend the conference.

### **BF2RA Coal Science Lecture Institute of Physics London 7th October 2013**

This 2013 event was organised by the Biomass & Fossil Fuel Research Alliance (BF2RA) with sponsorship from the British Coal Utilisation Research Association (BCURA), the Coal Research Forum (CRF), the IEA Clean Coal Centre, the Royal Society of Chemistry (RSC) Energy Sector and the Energy Generation and Supply Knowledge Transfer Network.

Paul Baruya from IEA Clean Coal Centre, [www.iea-coal.org](http://www.iea-coal.org) has kindly allowed us to reproduce his impressions of this year's Coal Science Lecture.

"How the advanced structural characterisation of coal has benefited coal utilisation" was the subject of the Annual Coal Science lecture, delivered by Professor Colin Snape (University of Nottingham).

Beautiful Monday evening in London at the Institute of Physics, and the Biomass & Fossil Fuel Research Alliance (BF2RA) was hosting its annual Coal Science lecture which is co-sponsored by the Clean Coal Centre and attended by a small group of the Centre's technical authors. In a time when fracking and renewables seem to hog the headlines, it's refreshing to see that there's still science going on in the UK universities, and in the case of Professor Colin Snape, he's been studying the molecular properties of coal for 40 years, part of which was spent at the UK Coal Research Establishment. His infectious enthusiasm came across in spades when describing his life's work in academia. His lifelong commitment to coal science started with his lineage, which is rich in coal heritage. It seemed fitting that coal would become part of his own professional life.

Colin is somewhat of a coal breaker, using extensive and varied techniques of NMR (nuclear magnetic resonance) spectroscopy to understand the composition of coal. His lecture included the research and development of methods of testing and experimentation to identify the characteristics and behaviour of fossil fuels. His list of research is varied including: adsorbents for CO<sub>2</sub> and other pollutants, such as Hg, in combustion and gasification; pyrolysis experiments to simulate petroleum basins; hydrolysis techniques detect and quantify materials emanating from dumped tar sands in the environment.

The lecture also included some fascinating research into biomass injection into coke works; work on oxyfuel combustion, and extremely high temperature and pressure testing for high volatile coal. As well as organising a coal science summer school, Colin touched on many subjects briefly, along with demonstrations on hydrogen absorption and explanations of the

structure of carbon in coal. His conclusions on the future of coal included a great deal of encouragement for novel coal utilisation techniques, not least IGCC, UGC (as mentioned earlier), and also the importance of training young engineers.

The whole evening was spent mingling with lots of friendly faces from the world of UK coal research and industry, not least some of our very own ex Clean Coal Centre friends from years gone by. All in all, a splendid evening spent with colleagues, wine and good food.

**Coal Research Forum (CRF) and Biomass and Fossil Fuel Research  
Alliance (BF2RA) Research Seminar,  
University of Nottingham,  
15 October 2013**

This seminar organised by the CRF in cooperation with BF2RA presented the aims, objectives and progress made to date on selected BF2RA projects. The audience included BF2RA Members, potential new members, recipients of current BF2RA grants and both Industrial and Academic Members of the CRF and others. This report was prepared by Peter Sage, who is the Technical officer of the BF2RA.

The main purpose of this event was to demonstrate the value of the current BF2RA research programme, to identify priority research needs and to encourage proposals from the academic community that are more in line with BF2RA's requirements. It also showcased BF2RA to potential new members. Further it gave potential proposers an opportunity to hear about current BF2RA projects and to meet BF2RA Board Members.

Delegates were treated to high calibre presentations both from industrialists and BF2RA students. The number of participants at just fewer than 40 was a little disappointing.

There follows a summary of the presentations, Q&A sessions and the Panel Discussion Session. A detailed account is not included here as all of the presentations are available on the BF2RA ([www.bf2ra.org](http://www.bf2ra.org)) and CRF ([www.coalresearchforum.org](http://www.coalresearchforum.org)) websites.

**Introductory Session**

**Professor Colin Snape** welcomed all to the University of Nottingham for this Research Seminar and introduced Greg Kelsall, Chairman of the BF2RA Members Board, to give the introductory presentation.

**Greg Kelsall – An introduction to the BF2RA and an Overview of its Project Portfolio.**

Greg described the history of BF2RA and its objectives. These include sponsoring of research in the biomass and fossil fuel areas and also organising the annual Coal Science Lecture. Greg noted that membership of BF2RA comprises 7 “world class” energy, equipment supplier and coal utilisation companies, namely, EDF Energy, E.ON New Build and Technology, EPRI, Alstom Power, Doosan Power Systems and British Sugar. Drax Group plc has confirmed as a new member for 2014.

Greg described the BF2RA funding model and presented the priority research themes for the last BF2RA Call for Proposals. He then went on to review the BF2RA project portfolio that currently comprises 11 projects with a further three starting in late 2013. Five of the current projects were presented later in the programme so Greg gave details on the other 6 ongoing ones, namely:-

- **Impact of Biomass Torrefaction on Combustion Behaviour in Co-firing** – University of Nottingham (2010-2014). The aim of this research is to investigate key fundamental issues associated with the development of torrefaction technology to help to promote its more widespread use. Torrefaction of a wide range of biomasses has been undertaken. Ongoing work is looking at burnout, nitrogen partitioning, char morphology and BET analysis. Future work will include slagging and fouling studies.
- **Avoiding the Sintering of Coal-fired Fluidised Beds** – University of Nottingham (2011-2015). This research aims to investigate the causes of fluidised bed sintering in biomass

co-fire to define safe operating modes to avoid sintering. A fluidised bed rig has been designed, built and commissioned and is now being used for the test programme. Future work will look at agglomerated samples, will define strategies to avoid sintering and undertake an economic appraisal.

- **Milling and Conveyance of Biomass** – University of Nottingham (2011-2015). The aim of this research is to rank and classify grinding, erosion and abrasion behaviour of biomass types to different mills. Studies are being undertaken both at the University and on site. This research has generated considerable interest amongst BF2RA Members and progress to date has been widely reported at conferences.
- **Development of a Novel Feeder for Pressurised Systems** – University of Sheffield (2012-2015). The aim of this work is to develop a novel and reliable feeder to feed continuously solid fuel into high pressure environments to enhance the commercial viability of high pressure combustion/gasification. A lock-hopper test rig has been built and operated. A key result to date is a theoretical energy saving of over 80% at 50 bar compared with a conventional lock-hopper system.
- **Development of Novel Coatings to Resist Fireside Corrosion in Biomass-fired Power Plants** - Cranfield University (2012-2015). The aim of this research is to develop the best coating composition resistant to fireside corrosion in power plants using a multi-target magnetron sputtering system. The best coating will be exposed in a specially designed furnace and the influence of elements including Co, Cr, Al, Ni and Fe will be investigated. Alternative methods for applying coatings will also be evaluated.
- **Integrity of Coated Ferritic Alloys under High Temperature Creep and Fatigue** University of Nottingham (2012-2016). The aim of this research is to investigate the mechanical and chemical integrity of coated samples subjected to high temperature exposure and steady/cyclic mechanical loadings. Specific objectives include a better understanding of currently available coatings, ranking of potential coatings based on test results and understanding of factors that limit service life.

Greg identified the three new projects that are about to start, namely:-

- **Biomass Exacerbated Cyclic Oxidation of Steels in Steam (BECOSS)** – University of Birmingham.
- **Biomass Co-firing with Low Volatile Matter Coals** – University of Nottingham.
- **Modelling Milling of Biomass** – University of Nottingham.

Finally Greg referred to the structure of the BF2RA website and illustrated the level of information that is available with the Members' areas.

### **Session 1: Generic and Cross-cutting Research**

This Session was chaired by **Dr Will Quick**, BF2RA Board Member and CRF Executive Committee Member.

#### **Keynote Industrial Presentation: Dr David Waldron, Alstom Power.**

Dave Waldron presented generic and cross-cutting research with reference to drivers, current technologies, future requirements, the path to commercial deployment and carbon capture and storage. Drivers are increasing flexibility/reliability, lowering the environmental footprint and reducing the cost of electricity.

David looked at future energy demand through to 2050 and noted that CCS is needed alongside renewable energy sources. He also noted the increased flexibility required because of the intermittent nature of some renewables. For thermal power plant Dave referred to the twin track approach of increasing efficiency (including biomass co-firing) and CO<sub>2</sub> emission reduction via CCS. Dave summarised the scope for efficiency improvement for new and retrofit situations and noted that 60% of the projected 2030 installed capacity base is yet to be built.

Dave summarised Alstom's CCS roadmap with reference to amine scrubbing and chilled ammonia process developments. He also referred to oxy-firing and the White Rose commercial demonstration in conjunction with Drax, BOC-Linde and National Grid.

Finally David referred to 2<sup>nd</sup> generation technologies such as chemical and carbonate looping.

**Dynamic Modelling and Simulation of Supercritical Coal-fired Power Plant with CO<sub>2</sub> Capture - Akeem Olaleye, University of Hull (2011-2014).**

Akeem Olaleye reviewed progress on this research to date. In 2012 he undertook a literature review and did some steady state modelling work. This year has been spent on dynamic component modelling, a whole plant dynamic model and steady state validation. Future work will focus on dynamic validation, a dynamic model for CO<sub>2</sub> capture, model integration and evaluation for grid compliance.

Akeem presented a suite of detailed results for specific modelling activities using the gPROMS model and presented results comparisons with actual plant data.

During the ensuing Q&A session Will Quick acknowledged the importance and complexity of this research. Dave Waldron asked about the extent of breakdown of plant components. Akeem replied that individual plant components are modelled as well as interconnecting pipework, etc. Greg Kelsall commented on the use of gPROMS and asked about Matlab. Akeem justified the use of gPROMS because of the larger dynamic base.

**Intelligent Flame Detection Incorporating Burner Condition Monitoring and On-Line Fuel Tracking - Danny Sun, University of Kent (2011-2014).**

Danny Sun reviewed the aims of the research and summarised current progress relating to system design/implementation, testing on plant, intelligent burner condition monitoring and intelligent on-line fuel tracking.

Danny described the monitoring system used that incorporates an optical fibre bundle linked to an imaging camera and data processing system. Following commissioning in the laboratory the system has been evaluated on a large coal/biomass fired boiler in the UK and a smaller oil-fired combustion test facility (CTF) at Zhejiang University in China. Danny presented images of coal and biomass flames and also temperature distribution data within the flames. The results showed greater instability of the biomass flames.

The CTF results have enabled the use of flame parameters as a signature for a particular combustion condition. Danny compared results of different modelling approaches for estimating factors such as abnormal condition detection, NO<sub>x</sub> formation and flame state identification.

Future research will include further field trials in the UK on both coal and coal/biomass fired power plant and oxy-firing using the University of Leeds CTF.

In the Q&A session both David Allen of E.ON and Greg Kelsall of Alstom Power focused on the commercial potential of the system and commercialisation plans. Danny responded that more test work is required and that the system needs to be more reliable and robust.

**Modelling Chemical and Micro-structural Evolution across Dissimilar Interfaces in Power Plant Alloys - John Clark, University of Nottingham (2011-2015).**

John Clark described the background and need for work in this area with the move towards higher temperature and pressure operation and the requirement to join different types of materials. For lower temperature operation cheaper low-chromium steel can be used but with temperature increase there is the move to high-chromium steel and to nickel alloys.

John explained how metals are joined using multi-pass fusion welding and how this creates heat affected zones that may be subject to failure in service. He then presented modelling results that simulate steel-steel and steel-nickel interfaces and discussed the wider applicability of software methods. John presented measured data and compared with simulation using DICTRA software. To date studies have focused on ferritic-ferritic interfaces. This will now be extended

to ferritic-nickel interfaces which will introduce the ferrite-austenitic problem due to the differing crystal structures.

Further research will focus on wider application in power plant technology and the extension to other industries and alloys.

During the Q&A session it was noted that the real problem relates to carbide precipitates. John acknowledged that these are caused during diffusion welding. The discussion concluded that modelling could be used to determine conditions for carbide formation and that this could be the subject of a future research project.

### **Session 2: Biomass Research**

This Session was chaired by **Mr Karl Bindemann**, BF2RA Board Member.

#### **Industrial Keynote Presentation: Mr Ralph Chamberlain, E.ON Energy**

Whilst Ralph's presentation was on Biomass R&D from an E.ON perspective, he invited others present to interject and contribute.

Ralph provided an overview of E.ON's business before focusing on Technology and Innovation (R&D). He then introduced E.ON's biomass activities relating to fleet conversion, fleet new build and heat plant in Sweden. Ralph stated that E.ON has some 20 years experience in biomass energy and more recently has run several co-firing trials. The challenges today are scale, storage issues, pellet variability, milling, PF transport, corrosion and combustion monitoring and future emission limits. Further areas of research include sustainability, health and safety and finally ash treatment/re-use.

Ralph presented examples in practice including temperature measurement in pellet piles, the fire behaviour of wood pellets and dry wood chip at the large scale and pellet quality management. The last he cited as a topic for cross-industry collaboration.

#### **A New Classification System for Biomass and Waste Materials for Use in Combustion Philip Jenkinson - University of Nottingham (2011-2015).**

Philip Jenkinson summarised the background to the research and presented the objectives, namely, to develop a new classification system to be used as a predictive tool for combustion; to provide an effective guide to combustion characteristics of different biomasses and waste fuels and to facilitate biomass and waste utilisation.

Philip described key differences between coal and biomass structure. With coal, maceral analysis provides a guide to combustion performance and for biomass, lignin, hemicelluloses and cellulose content provides a starting point.

Philip referred to the analytical techniques used for biomass including  $^{13}\text{C}$  NMR, elemental analysis and ICP-OES to enable an understanding of structure and TGA to determine behaviour during devolatilisation and combustion. Philip went on to discuss aromatic carbon and char yield for different biomasses and the influence of inorganic minerals.

Philip presented results of char reactivity studies that showed long burn-out times for lignin chars compared to other char material for a range of biomass types.

Results to date indicate that lignocellulosic composition impacts significantly on the combustion performance of biomass fuels. This will impact on burner design and other combustion infrastructure. Finally there is some evidence that synergistic interactions of biomass constituents during combustion could help in co-combustion with unreactive coals

Discussion reinforced the importance of this research to develop a predictive tool for biomasses alongside the established coal classification procedures. The significance of inorganic elements on biomass char combustion was also noted.

## **Low Temperature Ignition of Biomass**

### **Professor Jenny Jones - University of Leeds (2012-2013).**

Professor Jenny Jones presented the findings from a recently completed one-year post-doctoral study. The lead researcher was Dr Abby Saddawi, formerly of University of Leeds (now at Lincoln University).

The aims of this study were to develop laboratory methods for assessing ignition risk, to measure the ignition properties of a range of biomass fuels and to rank biomasses based on ignition risk during storage and conveying.

Jenny noted that techniques used for the research included ignition of dust layers, thermal analysis methods, FTIR and pyrolysis-GC-MS, single particle ignition and the BS method for dust accumulation. A wide range of biomass fuels were evaluated and Jenny presented the results for each technique. Based on activation energies high risk materials include wheat, miscanthus, sunflower husk and olive cake; medium risk materials include pine, red berry juniper, plane, mesquite and olive residue.

Discussion centred on the reason why dust explosion was excluded from the scope of the study. Jenny noted that a separate EngD study at the University of Leeds was looking at this.

### **Session 3: Panel Discussion – BF2RA's Role in Meeting Research Needs**

**Peter Sage**, Technical Officer of BF2RA lead the panel discussion assisted by the BF2RA Board Members present who were **Greg Kelsall, Will Quick, David Gent** and **Karl Bindemann**.

Peter stated that BF2RA will hold a call for proposals in early 2014 and that the BF2RA Members Board is currently discussing the technical scope of this call. Peter referred to the current portfolio of 11 projects and the 3 new starts this year. There is the need to build on and complement current research and meet any priority research needs. Peter then presented five general themes for research that had been debated by BF2RA Members and invited suggestions for priority topics and/or specific projects. The 5 themes are:-

- Utilisation of fossil fuel and biomass
- Plant operation and control
- Materials development
- Advanced cycles for fossil fuel/biomass utilisation
- Control of emissions and products arising from fossil fuel and biomass utilisation

There then followed a lively discussion with several suggestions both from the floor and from the panel. These included:-

- Development of correlations to model corrosion
- The fundamentals of biomass corrosion – currently lacking analysis of existing information, how does industry make use of information
- Production of liquid fuels – biogas, biofuels
- Emissions from biomass as a function of plant corrosion
- Generic approach to improvement of overall performance to include materials, efficiency, flexibility and operational issues
- CFD modelling on fuel switching (coal to biomass to torrefied biomass)
- The use of kinetic parameters
- Use of torrefied fuels and benefits of using existing mills
- Combustion monitoring and control – a possible follow on to the current University of Kent research
- Expanding the fuel base to include cheaper, low quality fuels and associated safety issues

Finally there was a discussion on the mix of project timescales (3/4 year EngDs, 3 year PhDs and shorter RAs, etc.). Agreed that should identify best timescale on case by case basis. Also it was

suggested that BF2RA should define specific projects based on BF2RA projects done to date (to fill gaps).

Peter thanked all for their contributions to the panel discussion and invited any further ideas to him by email before 31<sup>st</sup> October.

### **Concluding Remarks – Professor John Patrick, Chairman (Academe), Coal Research Forum**

John thanked all the speakers and participants for their contributions towards a successful day that informed about BF2RA and its research activities and continued the discussion on research needs and priority. John also wished everyone a safe journey home.

*Press release from the Department for Energy & Climate Change 9<sup>th</sup> December 2013*

### **Cleaner, greener future for British coal plants**

Drax, Britain's largest coal-fired power stations, is set to become one of Europe's biggest renewable electricity generators today, with the potential for new future generation on the site to be based on truly clean coal. Energy and Climate Change Secretary Edward Davey opened the Drax coal-to-biomass conversion plant, and announced the Government was awarding funding to further the White Rose CCS project, also based at the site.

At Drax, the £700 million planned conversion project will burn wood pellets rather than coal. Drax calculates that this will reduce carbon emissions by 80 per cent compared to coal. The facilities opened today will provide enough low carbon power to supply the equivalent of around 1 million homes, and help to safeguard 1,200 jobs and many more in the supply chain and in local communities. Today 40% of our electricity comes from coal. 20% is from old nuclear. Most of that is due to come off line in the next decade.

We need to fill this emerging energy gap with low-carbon electricity that will keep the lights on, bring bills down and reduce emissions to tackle climate change. So we need a mix – of renewables (biomass and coal to biomass conversions, onshore and offshore wind and solar), Carbon Capture and Storage technology, nuclear and some gas. This will help to protect consumers from price spikes caused by importing expensive gas, and will lower people's bills in the long-run with households getting £50 off their bills a year by early next year.

The multi-million pound FEED (front end engineering design) study funding will support the White Rose project, which is designing a c.£2 billion state-of-the-art coal power plant with full CCS that will be able to provide clean electricity to more than 630,000 homes. It also includes the planned development of a CO<sub>2</sub> transport and storage network – the Yorkshire Humber CCS Trunkline – which would have capacity for additional CCS projects in the area. This innovative project has the potential to create up to 2,000 jobs and safely capture 90% of the plant's emissions. Together, the two projects could support 3,200 jobs in Yorkshire and the Humber, and provide carbon transport infrastructure to help build a clean energy industry in the region.

Mr Davey said: "It's crucial that we safeguard our energy security by generating green electricity on UK soil that protects bill payers from volatile foreign energy imports. "Our coal industry has powered Britain for more than a century, and today we're seeing a clear roadmap for its future – whether by converting existing coal plants to cleaner fuels, or building state-of-the-art power stations that mean coal is truly clean, while at the same time creating new green jobs for Yorkshire. "I'm proud that the UK is at the forefront of developing Carbon Capture and Storage – which could be a game-changer in tackling climate change and provide a huge economic advantage not just to this region, but to the whole country."

White Rose is the first project to be allocated funds under Government's £1 billion CCS Commercialisation Programme. CCS allows the safe removal and permanent storage of carbon dioxide emissions from coal and gas power stations, as well as from industrial processes. Old and polluting coal plants are being phased out and will be replaced by 2030 with clean coal or

sustainably sourced biomass that has been fitted with CCS. We anticipate up to 12GW of CCS could be deployed by 2030, rising to 40GW by 2050. This could well be generating more electricity than total domestic electricity demand, and provide 22% of the UK's energy by 2050. This will help reduce emissions to tackle climate change and will form a crucial part of the UK's power mix, alongside renewables and new nuclear.

The White Rose proposal is to build a new state-of-the-art 426MW (gross) clean coal power plant with full carbon capture and storage. It will be the largest oxy combustion plant in the world and will also have the potential to co-fire biomass. It will capture approximately 2 million tonnes of CO<sub>2</sub> per year, some 90% of all CO<sub>2</sub> emissions produced by the plant. The CO<sub>2</sub> will be transported through National Grid's proposed Yorkshire/Humber CCS Trunkline for permanent undersea storage in the North Sea.

Alstom, Drax and BOC are the project co-developers. The three partners have formed a company called Capture Power limited that will be responsible for the development, implementation and operation of the proposed new plant. As part of this cooperation, Alstom will have responsibility for construction of the power plant together with the CO<sub>2</sub> processing unit and BOC will have responsibility for the construction of the air separation unit that supplies oxygen for combustion. Drax will have responsibility for the operation and maintenance (O&M) of the power plant and the CO<sub>2</sub> processing facility with BOC having responsibility for the O&M of the air separation unit. The National Grid would construct and operate a large capacity CO<sub>2</sub> transport pipeline and permanent CO<sub>2</sub> undersea storage facilities at a North Sea site. This work would take forward a proposal which has benefited from the European Commission's European Energy Reform Programme (EEPR) fund.

*(The following event report has been reproduced with the permission of the RSC Energy Sector from their latest newsletter.)*

**RSC Energy Sector Early Career Chemists Symposium 2013**  
**UK Energy Research Centre,**  
**Thursday 21st November 2013**

Following the success of the Energy Sector's first Early Career Chemists Symposium in 2012, the Energy Sector Executive Committee decided to make this annual event. The 2013 symposium took place last month at UKERC's headquarters in London. The event was oversubscribed, attended by 46 scientists from academia and industry. The symposium aimed to bring together early career chemists so that they could share ideas and knowledge. The committee hoped that the event would help to provide the attendees with the skills and support required to develop their careers and, of course, we also wanted to recognise and reward excellent science!

This year the event was split into two halves. The first part of the day focused on the science undertaken by many of the event attendees through scientific posters and presentations (from 15 minutes scientific overviews to challenging two minute flash presentations). To set the scene our keynote speaker James Watson (Research Director, UKERC) provided an overview of how this science fits into the broader context of energy policy development and what the priorities for UK energy research development are likely to be in the future. The second half of the day focused on career development, using real life case studies from academia and industry. James Durrant (Imperial College) and Richard Wain (Rolls Royce) both gave fascinating and very valuable insights into what a day in their work life looks like, how they ended up in their current positions and their sometimes unexpected careers path turns along the way. Laura Woodward from the RSC careers team also provided career advice and one to one drop in sessions.

Members of the Energy Sector Executive Committee had the challenging role of judging the flash presentations and posters and selecting the entries to receive prizes. The standards were extremely high and making our decisions took a great deal of time and debate. This year's well-deserved winners included:

- 1<sup>st</sup> prize: Alexander Kilpatrick (University of Sussex)
- 2<sup>nd</sup> prize: Sarah Mallinson (University of Surrey)
- Joint 3<sup>rd</sup> prize: Jo Humphrey (Bristol University), Chris Hendon (University of Bath), Lee Burton (University of Bath)
- Coal Research Forum prize: Dawid Hanak (Cranfield University)

The Energy Sector Executive Committee would like to thank all those who participated in the event, the excellent speakers and UKERC for hosting the event.

Report prepared by Anna Weston (RSC Energy Sector Executive Committee Member)

*(The following press release and a short description of their activities, has been included following contact between the CRF and the BIA -Ed.)*

### **Brown Coal Innovation Australia**

Brown Coal Innovation Australia (BCIA) is a not-for-profit company with a mandate to co-invest with stakeholders in brown coal innovation and emissions reduction technologies. BCIA aims to secure a sustainable future for Australia's world-class brown coal resource. We will do this by progressing brown coal innovation and emissions reduction research and development and by serving as a focal point for programs and projects already underway. BCIA funds and facilitates multi-million dollar investments to drive innovation in the brown coal value-chain, from mine-mouth to the capture of CO<sub>2</sub>. They strategically manage their investment portfolio. Their mission is to invest proactively in the development of technologies and people that broadens the use of brown coal for a sustainable future. They provide a key entry point to progress shared research and development activity between industry, research and government stakeholders and focus strongly on skills-development and the expansion of training opportunities to secure the scientific, engineering and trades expertise needed for development of new low-emissions brown coal technologies.

- See more at: <http://www.bcinnovation.com.au/AboutUs#sthash.yVJ4xEma.dpuf>

*Brown Coal Innovation Australia (BCIA) issued the following news release 6<sup>th</sup> December 2013.*

### **Victoria has huge potential for development of chemicals from brown coal**

China is likely to play a critical role in disseminating new technologies for the conversion of lignite coals to chemicals, gaseous and liquid fuels according to an IEA Clean Coal Centre report launched today at a Brown Coal Innovation Australia (BCIA) research seminar in Melbourne.

IEA Clean Coal Centre General Manager, Dr Andrew Minchener - author of the report - told the seminar: "China has a major government backed coal-conversion development and deployment program. Building on new technologies from a strategic R&D program, coal-to-chemicals processes are set to become a significant, large scale commercial element in China's economy. Victoria's world-class brown coal deposits also provide major opportunities for the deployment of large scale coal gasification technologies that could convert brown coal to fertilisers, liquid fuels and fine chemicals."

Dr Minchener delivered the keynote address '*Coal gasification for chemicals, gaseous and liquid fuels in Asia*' at the BCIA seminar. Dr Minchener said: "While today South Africa has established the world's only commercial scale coal to liquids facilities, China's activities are growing rapidly. It can also provide the technical expertise and financially underpin coal conversion projects, including associated infrastructure needs, in other countries."

Dr Minchener told the audience of more than 130 Australian and international delegates at the BCIA seminar: "Coal gasification can fulfil an important strategic need in countries where coal is the primary fuel source and oil and gas energy security is an issue." Dr Minchener's report shows several Australian-based companies are exploring coal conversion projects in developing countries including Mongolia, China, Vietnam, Turkey and the Ukraine.

BCIA Chief Executive Officer, Dr Phil Gurney, said "As demonstrated through attendance at this seminar and participation in our competitive R&D funding rounds, there is strong domestic and international interest in capturing full value from Australia's world class brown coal resource through low-emissions technology innovation for the conversion of coal to high value chemical and fuel products.

"There have been significant developments in improving the technical and environmental performance of coal-to-chemicals processes in recent years and BCIA intends facilitating further discussion on utilisation of brown coal – this will include a seminar in 2014 on capture technology. BCIA is delighted that the CarbonNet Project, the sponsor for this seminar, will also sponsor the 2014 seminar," said Dr Gurney.

The BCIA seminar on '*Coal to Products – Gasification, Pyrolysis and Beyond*' was sponsored by the CarbonNet Project which is investigating the potential for establishing a large-scale, multi-user carbon capture and storage network in Victoria's Gippsland region. The seminar covered gasification technologies ready for commercial deployment on Victorian brown coal, through to potential projects and markets and future research and development in brown coal.

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## ARTICLES FROM THE TECHNICAL PRESS

### News alerts in coal and energy research

Please be aware that links to some of the news articles are not retained on the web indefinitely. Consequently, links which were active when the newsletter was written may, in time, become unavailable. It is hoped that this will not detract from the value of the article.

#### **National Grid completes successful carbon capture and storage drilling 8<sup>th</sup> August, 2013, unattributed, GreenClick**

National Grid has successfully completed test drilling of a carbon dioxide storage site in the North Sea – a major milestone in delivering a [storage solution](#) for Carbon Capture and Storage (CCS). Early indications are that the undersea site 65 kilometres off the Yorkshire coast is viable for carbon dioxide storage and will be able to hold around 200 million tonnes permanently. This is equivalent to taking ten million cars off the road for 10 years. The drilling is a major milestone in its Don Valley storage work programme funded by an EU grant to advance CCS in Europe. The findings are significant as this type of storage site is common in Europe. Peter Boreham, National Grid's director of European Business Development said: "Global energy demand is likely to double in the next twenty years and CCS is the only [technology](#) that can turn high carbon fuels into genuinely low carbon electricity and keep costs low for consumers".

<http://www.clickgreen.org.uk/news/national-news/123938-national-grid-completes-successful-carbon-capture-and-storage-drilling.html>

#### **Research could help scientists predict how carbon is stored underground 23<sup>rd</sup> August, 2013, unattributed, red Orbit**

[Computer simulations](#) conducted at the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) could help scientists make sense of a recently observed and puzzling wrinkle in one of nature's most important chemical processes. It turns out that calcium carbonate—the ubiquitous compound that is a major component of seashells, limestone, concrete, antacids and myriad other naturally and industrially produced substances—may momentarily exist in liquid form as it crystallizes from solution.

Calcium carbonate is a huge player in the planet's carbon cycle, so any new insight into how it behaves is potentially big news. The prediction of a dense liquid phase during the conversion of

calcium carbonate to a solid could help scientists understand the response of marine organisms to changes in seawater chemistry due to rising atmospheric CO<sub>2</sub> levels. It could also help them predict the extent to which geological formations can act as carbon storage reservoirs, among other examples.

The [research](#) is published in the August 23 issue of the journal *Science*. It was performed in support of the Center for Nanoscale Control of Geologic CO<sub>2</sub>, an Energy Frontier Research Center established at Berkeley Lab by the U.S. Department of Energy.

The research may also reconcile some confounding experimental observations. For more than a century, scientists believed that crystals nucleate from solution by overcoming an energy barrier. But recent studies of calcium carbonate revealed the presence of nanoscopic clusters which, under certain conditions, appear to circumvent the barrier by following an alternative aggregation-based crystallization pathway.

<http://www.redorbit.com/news/science/1112930473/research-help-scientists-predict-how-carbon-stored-underground-082313/>

### **Australian company bent on solving coal plants' CO<sub>2</sub> emissions woes 26<sup>th</sup> August 2013, unattributed, Environmental Protection**

Chemical company Orica, along with the Australian and the New South Wales Governments, will fund the construction of a CO<sub>2</sub> mineral carbonation research pilot plant at the University of Newcastle, Australia.

Leaders of Orica, an Australian chemical company, [announced](#) Aug. 23 their company will support a groundbreaking research pilot plant to test a technology that transforms captured carbon dioxide emissions into forms of solid carbonate for future safe disposal or use in green building materials. The Australian government and the New South Wales government are joining Orica to fund the establishment of the CO<sub>2</sub> mineral carbonation research pilot plant at the University of Newcastle, Australia. Their announcement said mineral carbonation technology "mimics and accelerates the Earth's own natural carbon sink mechanism by combining CO<sub>2</sub> with low grade minerals to create inert carbonates, which are similar to common baking soda."

Mineral Carbonation International Pty Ltd will receive \$3.04 million from Orica over four years, equally matched by both governments, to build the plant and undertake the research. Orica scientists have been researching the technology for the past six years.

The plant will use CO<sub>2</sub> captured at Orica's nearby Kooragang Island manufacturing facility in Newcastle. Orica Managing Director and CEO Ian Smith said Orica is a strong supporter of the research initiative, which holds the promise of a permanent and safe solution in the field of carbon abatement because every coal-fired power plant in the world could capture its CO<sub>2</sub> emissions. He joined NSW Resources and Energy Minister, Hon. Chris Hartcher MP, Chief Scientist of Geosciences Australia, Dr. Clinton Foster, and representatives from the University of Newcastle to publicly launch the project.

<http://eponline.com/articles/2013/08/26/australian-company-bent-on-solving-coal-plants-c02-emissions-woes.aspx>

### **More coal power sends EDF into reverse on CO<sub>2</sub> 28<sup>th</sup> August 2013, Jim Armitage, The Independent**

EDF Energy admitted last night that its power stations were pumping out more carbon dioxide than in previous years as it cranked up output from its coal-fired generators. For every gigawatt-hour of electricity produced, its power stations churned out 251.7 tonnes of CO<sub>2</sub> in 2012, a sharp increase from the previous year's 208.1 tonnes. It also marked a change in direction, for the worse, because the 2011 figure had been an improvement on 2010. EDF's total carbon footprint also increased during the period. The performance on greenhouse gas emissions meant EDF was behind its stated target of reducing emissions by 60 per cent by 2020.

EDF admitted it had missed its targets for improving its green credentials, but said the situation would improve as it built more nuclear generating capacity. It has said it plans to build four new reactors at Hinkley point in Somerset and Sizewell in Suffolk, although the projects are behind schedule due to concerns over the investment terms. Centrica pulled out of involvement with the Hinkley Point plan after the £14bn project's costs rocketed.

<http://www.independent.co.uk/news/business/news/more-coal-power-sends-edf-into-reverse-on-co2-8786922.html>

## **Newport News shipbuilding workers face a hidden toxin**

**31<sup>st</sup> August 2013, Michael Welles Shapiro, Daily Press**

For decades, a gritty byproduct made at coal-burning power plants has been recycled and sold to shipyards, where it is used to "sandblast" rust and paint off the hulls, tanks and other steel surfaces of commercial and military vessels.

At Newport News Shipbuilding, the country's largest shipyard, the product, called coal slag, has long been the product of choice when blast abrasion workers overhaul aircraft carriers and prepare the ships for new coats of paint. So it came as a surprise to shipyard workers and union safety officials at the yard that coal slag contains trace amounts of highly toxic beryllium — an element that can cause cancer and a potentially fatal lung disease.

According to the National Institute for Occupational Safety and Health, producers of coal slag and shipyard executives have long known that the slag contained small amounts of beryllium, a trace mineral found in rock formations, but until last year the companies that sell the product did not flag the toxic metal on accompanying safety data sheets. For more see.....

[http://articles.dailypress.com/2013-08-31/business/dp-nws-shipyard-beryllium-20130831\\_1\\_beryllium-shipyard-workers-slag](http://articles.dailypress.com/2013-08-31/business/dp-nws-shipyard-beryllium-20130831_1_beryllium-shipyard-workers-slag)

## **Coal soot responsible for melting glaciers in European Alps**

**4<sup>th</sup> September 2013, Kay Rivero, Latin Post**

New scientific research suggests that coal soot may have been responsible for melting glaciers in the Alps during the Industrial Revolution.

[Live Science reports](#) that during the "Little Ice Age," a period of cool climates in the 19th century, coal soot surged across Western Europe, causing the abrupt and destructive retreat of ice glaciers between 1860 and 1930.

For years, scientists strove to discover the cause for the unexpected retreat, failing to find answers in the climate record. This time, researchers based at NASA's Jet Propulsion Laboratory in Pasadena, California focused on the human factor of the cause, and they found that coal soot or carbon has quite a potential impact on snow melt. With the Industrial Revolution's coal burning at its peak, coal soot was a major pollutant at the time of the Little Ice Age.

Live Science explains that the glacier retreat is prompted when soot settles on snow in mass quantities, creating "dark, heat-absorbent film on the otherwise reflective white surface of the snow." As a result, the snowy surface soaks up heat more than it normally would, causing the glacial ice right below the surface to thin down and to retreat.

To determine their hypothesis, the team examined the level of soot in various ice cores brought in from European mountain glaciers. The measured soot quantities were used as the basis for estimating the carbon deposit that would have affected the ice glaciers in the Alps and with the data gathered the team came up with a "computer model of glacial behavior." The conclusion is that coal soot have had been potent enough to melt the ice glacier and cause them to retreat.

Author of the study Waleed Abdalati says that, "this study uncovers some likely human fingerprints on our changing environment," according to Live Science. Abdalati also stressed that the study indeed puts emphasis on the fact that destructive human behavior has a potent

effect on the environment. "It's a reminder that the actions we take have far-reaching impacts on the environment in which we live," he said.

The research study was published in the *Journal Proceedings of the National Academy of Sciences*, Sept. 2 issue.

<http://www.latinpost.com/articles/1895/20130904/coal-soot-responsible-melting-glaciers-european-alps.htm>

### **1 % of America's power plants emit 33 % of energy industry's carbon** **11<sup>th</sup> September 2013, Thomas Stackpole, Mother Jones**

Less than 1 percent of US power plants produce nearly a third of the energy industry's carbon emissions, according to a new report released Tuesday. "If the 50 most-polluting U.S. power plants were an independent nation," reads the report from Environment America Research & Policy Center, an independent nonprofit, "they would be the seventh-largest emitter of carbon dioxide in the world, behind Germany and ahead of South Korea." The vast majority of the top 100 offenders—98 of them in fact—are coal plants.

The report, which comes in advance of an Environmental Protection Agency proposal on emissions standards for new power plants expected later this month, claims that cleaning up the biggest polluters could have an outsized impact on reducing greenhouse gases. A March EPA proposal suggested capping carbon production at 1,000 pounds of CO<sub>2</sub> per megawatt-hour produced for new plants. That's well below the 3,000 pounds of CO<sub>2</sub> per megawatt-hour the dirtiest existing plants produce. Standards for existing plants are in the works, too—the EPA's proposal is supposed to be submitted by June 2014 and finalized the following year. Even if the standards are weakened in the approval process, the average coal plant still produces more than twice as much carbon than allowed by the cap. That means new coal plants are "highly unlikely" to meet the EPA's target, according to the report. For more see...

<http://www.motherjones.com/blue-marble/2013/09/50-dirtiest-power-plants-us>

### **New methane study is encouraging for fracking backers** **16<sup>th</sup> September 2013, Timothy Pucko, TRIBlive.com**

A nationwide study has made what may be a big first step in settling important questions over the gas boom's impact on climate change, suggesting that natural gas wells probably don't leak as much air pollution as previous worst-case estimates indicated.

The findings, which were published Monday by the Proceedings of National Academy of Sciences, imply that the gas industry's emissions may be low enough that the world could reduce its heat-trapping pollution in the atmosphere by burning more gas and less coal.

Although the news is encouraging, there still is a lot of work left to draw a more definitive conclusion, said officials at the Environmental Defense Fund, an environmental group that collaborated with the gas drilling industry to do the research.

The study is the first of 16 the group is coordinating on methane leaks from the expanding natural gas industry. Researchers still have to finish studying leaks from other vulnerable parts of the industry — from processing plants to pipes.

"In order to definitively answer the question 'Is this better than coal?' we need to have the information from the time it comes out of the ground to the time you burn it," said Drew Nelson, the group's clean energy project manager. "We don't have that information yet."

Nelson said the results were encouraging, in part, for the environment, but he said that the research pointed out other parts of a well site that were more vulnerable to leaks than previously expected. "You're getting at the heart of one of the central questions," said Andrew Place, an industry scientist who is interim director of the Center for Sustainable Shale

Development, Downtown. "It's not the end of the story, but it's an important initial piece for the public's understanding of the importance of natural gas, shale gas in particular."

The results generally agree with earlier Environmental Protection Agency estimates. For more see.....

<http://triblive.com/state/marcellusshale/4716393-74/gas-fracking-industry#axzz2mal3UQ00>

## **Number of climate change sceptics soars as support for alternative energy wanes**

**19<sup>th</sup> September 2013, Ben Webster, The Times**

The proportion of people who do not believe in climate change has more than quadrupled since 2005, according to a government-funded survey. Public support for wind and solar power as an alternative to fossil fuels has fallen sharply over the same period, with gas the only form of electricity production now perceived more favourably. The findings, [published today by the UK Energy Research Centre \(UKERC\)](#), come as hundreds of climate scientists and government officials from around the world head to Stockholm to finalise next week's report on climate change.

<http://www.thetimes.co.uk/tto/environment/article3872989.ece>

## **EPA admits banning coal plants won't impact global warming**

**25<sup>th</sup> September 2013, Michael Bastasch, The Daily Caller**

The Obama administration is effectively banning the construction of new coal-fired power plants, a move officials admit will have little to no impact on global warming. "The EPA does not anticipate that this proposed rule will result in notable CO2 emission change ... by 2022," the agency [writes](#) in its proposal to limit greenhouse gas emissions.

"EPA knows there aren't benefits," Dan Simmons, director of regulatory and state affairs at the Institute for Energy Research, told The Daily Caller News Foundation. "EPA and environmentalists are being disingenuous when they claim this rule will have an impact on the climate or the environment." Last week, the EPA unveiled the first ever carbon emissions limits for new power plants, hailing them as the first step to combating global warming and protecting future generations.

"Climate change is one of the most significant public health challenges of our time. By taking commonsense action to limit carbon pollution from new power plants, we can slow the effects of climate change and fulfill our obligation to ensure a safe and healthy environment for our children," said EPA Administrator Gina McCarthy.

The rule "will contribute to the actions required to slow or reverse the accumulation of GHG concentrations in the atmosphere, which is necessary to protect against projected climate change impacts and risks." Why ban coal power if it won't even put a dent in global warming? Critics say this is because the EPA is trying to mask the high costs of compliance by not claiming that the proposal would create any benefits.

"They don't want to quantify the damages," Simmons said. "They know the rule will create large harms, but they don't want to be held liable." By claiming monetized benefits from cutting carbon emissions from power plants, the EPA would also have to calculate the costs — meaning how the rule would impact the coal industry, employment and the economy.

For more visit.....

<http://dailycaller.com/2013/09/25/epa-admits-banning-coal-plants-wont-impact-global-warming/2/>

## **China's synthetic gas plants would be greenhouse giants**

**25<sup>th</sup> September, unattributed, Science Daily**

Coal-powered synthetic natural gas plants being planned in China would produce seven times more greenhouse gas emissions than conventional natural gas plants, and use up to 100 times the water as shale gas production, according to a new study by Duke University researchers.

These environmental costs have been largely neglected in the drive to meet the nation's growing energy needs, the researchers say, and might lock China on an irreversible and unsustainable path for decades to come.

"Using coal to make natural gas may be good for China's energy security, but it's an environmental disaster in the making," said Robert B. Jackson, Nicholas Professor of Environmental Sciences and director of the Duke Center on Global Change.

"At a minimum, Chinese policymakers should delay implementing their synthetic natural gas plan to avoid a potentially costly and environmentally damaging outcome," said Chi-Jen Yang, a research scientist at Duke's Center on Global Change. "An even better decision would be to cancel the program entirely."

Yang is lead author of the new study, which was published Thursday in the peer-reviewed journal *Nature Climate Change*.

For more visit...

[http://www.sciencedaily.com/releases/2013/09/130925092224.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy%2Ffossil\\_fuels+%28ScienceDaily%3A+Matter+%26+Energy+News+--+Fossil+Fuels%29](http://www.sciencedaily.com/releases/2013/09/130925092224.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy%2Ffossil_fuels+%28ScienceDaily%3A+Matter+%26+Energy+News+--+Fossil+Fuels%29)

## Using algae to lock away greenhouse gas

**3<sup>rd</sup> October 2013, Keith Hautala et al., Phy.Org News**

The University of Kentucky Center for Applied Energy Research is developing green technology to capture carbon dioxide emissions from coal-fired power plants, using algae.

Four years ago, CAER and UK's Biosystems and Agricultural Engineering Department set out to demonstrate that an algae-based system could recycle the carbon dioxide in [flue gas](#). Now, with \$1.8 million in funding from the Kentucky Energy and Environment Cabinet, CAER is partnering with Duke Energy to test a pilot-scale algae system at East Bend Station in Northern Kentucky.

Scientists looking for ways to curb [carbon dioxide emissions](#) have taken a keen interest in algae. These simple, plant-like, aquatic organisms—their family includes both pond scum and seaweed—are among the oldest forms of life on Earth. Like plants, they draw [energy](#) from photosynthesis, using light from the sun and carbon dioxide from the air.

More than 90% of Kentucky's power comes from [coal](#), which when burned produces carbon dioxide as a waste product. With federally mandated carbon emissions limits on the horizon, the work underway at CAER is more critical than ever. Algae do an efficient job of sequestering carbon, taking it out of the air and locking it away in solid biomass. That biomass could, in turn, find use as a raw material for making products or as a renewable fuel itself.

"The industry will adapt technology, which right now doesn't exist. So that's our challenge," said Jack Groppo, CAER's principal research engineer for environmental and coal technologies. "The nice thing about algae is that it actually does capture and sequester the carbon dioxide."

Instead of acres of ponds, CAER's strategy is based on a closed system of photobioreactors to grow algae. CAER's system, made of plastic tubes and off-the-shelf PVC pipes, is built by UK students and staff and glued together on-site. Expanding the system simply means adding more tubes. The closed system is more efficient, even in winter when sunlight is minimal. It is less prone to contamination, and evaporation is much less of a problem than with ponds.

For more visit:

<http://phys.org/news/2013-10-algae-greenhouse-gas.html>

## **Carbon's new champion: Carbyne, a simple chain of carbon atoms: Strongest material of all?**

**9<sup>th</sup> October 2013, unattributed, Science Daily**

Carbyne will be the strongest of a new class of microscopic materials if and when anyone can make it in bulk. If they do, they'll find carbyne nanorods or nanoropes have a host of remarkable and useful properties, as described in a new paper by Rice University theoretical physicist Boris Yakobson and his group. The paper appears this week in the American Chemical Society journal *ACS Nano*.

Carbyne is a chain of carbon atoms held together by either double or alternating single and triple atomic bonds. That makes it a true one-dimensional material, unlike atom-thin sheets of graphene that have a top and a bottom or hollow nanotubes that have an inside and outside.

According to the portrait drawn from calculations by Yakobson and his group:

- \* Carbyne's tensile strength -- the ability to withstand stretching -- surpasses "that of any other known material" and is double that of graphene. (Scientists had already calculated it would take an elephant on a pencil to break through a sheet of graphene.)
- \* It has twice the tensile stiffness of graphene and carbon nanotubes and nearly three times that of diamond.
- \* Stretching carbyne as little as 10 percent alters its electronic band gap significantly.
- \* If outfitted with molecular handles at the ends, it can also be twisted to alter its band gap. With a 90-degree end-to-end rotation, it becomes a magnetic semiconductor.
- \* Carbyne chains can take on side molecules that may make the chains suitable for energy storage.
- \* The material is stable at room temperature, largely resisting crosslinks with nearby chains.

That's a remarkable set of qualities for a simple string of carbon atoms, Yakobson said. "You could look at it as an ultimately thin graphene ribbon, reduced to just one atom, or an ultimately thin nanotube," he said. It could be useful for nanomechanical systems, in spintronic devices, as sensors, as strong and light materials for mechanical applications or for energy storage. "Regardless of the applications," he said, "academically, it's very exciting to know the strongest possible assembly of atoms."

Based on the calculations, he said carbyne might be the highest energy state for stable carbon. "People usually look for what is called the 'ground state,' the lowest possible energy configuration for atoms," Yakobson said. "For carbon, that would be graphite, followed by diamond, then nanotubes, then fullerenes. But nobody asks about the highest energy configuration. We think this may be it, a stable structure at the highest energy possible."

For more see:

[http://www.sciencedaily.com/releases/2013/10/131009162732.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/10/131009162732.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

## **Underground coal gasification holds significant opportunity for South Africa**

**10<sup>th</sup> October 2013, Leandi Kolver, Mining Weekly**

State-owned power utility Eskom would start work on a larger-scale underground coal gasification (UCG) plant at its Majuba power station, in Mpumalanga, as soon as environmental approvals were received, Eskom group executive for sustainability Dr **Steve Lennon** said on Thursday.

He stated that the power utility had run a small-scale pilot successfully for two years, co-firing the Majuba power station with gas and coal, adding that the next step of the project would make use of a larger gasifier to feed larger amounts of gas into Majuba.

During this second phase of the pilot study, the gas supplied to Majuba would still be co-fired with coal, with the third phase planned to only use gas that would be put into a gas turbine. "This has been a successful project to date and UCG presents a big opportunity for South Africa as it opens up the possibility for us to exploit coal reserves that were previously unexploitable," Lennon told *Mining Weekly Online*. He added that the Majuba coal seams had previously seemed virtually unmineable.

"With UCG, we can use the coal at Majuba, as well as many other deposits that may be too fragmented, too deep, or simply not economical to mine using traditional methods, which could increase South Africa's coal reserves significantly," he explained. Lennon added that, at the right depth, Eskom also expected UCG to be an extremely efficient and clean coal technology. "Naturally, UCG would have to compete with other forms of gas and coal but we do believe that it has the potential to be a very competitive technology for power generation," he said.

While Eskom was constantly reviewing the technology through the pilot plant process, at this time, it was found to be commercially viable. "All our plans are to take this technology forward," Lennon stated.

<http://www.miningweekly.com/article/underground-coal-gasification-holds-significant-opportunity-for-sa-lennon-2013-10-10>

## **Scientists wary of shale oil and gas as U.S. energy salvation**

**28<sup>th</sup> October 2013, unattributed, Science Daily**

After 10 years of production, shale gas in the United States cannot be considered commercially viable, according to several scientists presenting at the Geological Society of America meeting in Denver on Monday. They argue that while the use of hydraulic fracturing and horizontal drilling for "tight oil" is an important contributor to U.S. energy supply, it is not going to result in long-term sustainable production or allow the U.S. to become a net oil exporter.

Charles A.S. Hall, professor emeritus at the College of Environmental Science and Forestry, State University of New York, Syracuse, is an expert on how much energy it takes to extract energy, and therefore which natural resources offer the best energy return on investment (EROI). He will describe two studies: one of the global patterns of fossil-fuel production in the past decade, and the other of oil production patterns from the Bakken Field (the giant expanse of oil-bearing shale rock underneath North Dakota and Montana that is being produced using hydraulic fracturing).

Both studies show that despite a tripling of prices and of expenditures for oil exploration and development, the production of nearly all countries has been stagnant at best and more commonly is declining -- and that prices do not allow for any growth in most economies.

"The many trends of declining EROIs suggest that depletion and increased exploitation rates are trumping new technological developments," Hall said. For more visit:

[http://www.sciencedaily.com/releases/2013/10/131028141516.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/10/131028141516.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

## **Report suggests slowdown in CO2 emissions rise**

**31<sup>st</sup> October 2013, Matt McGrath, BBC News**

Global emissions of carbon dioxide may be showing the first signs of a "permanent slowdown" in the rate of increase. According to a [new report](http://www.pbl.nl/en/publications/trends-in-global-co2-emissions-2013-report) , (http://www.pbl.nl/en/publications/trends-in-global-co2-emissions-2013-report), emissions in 2012 increased at less than half the average over the past decade. Key factors included the shift to shale gas for energy in the US while China increased its use of hydropower by 23%. However the use of cheap coal continues to be an issue, with UK consumption up by almost a quarter. The report on trends in global emissions has been produced annually by the Netherlands Environment Assessment Agency and the European Commission's Joint Research Centre. It finds that emissions of carbon

dioxide reached a new record in 2012 of 34.5bn tonnes. But the rate of increase in CO<sub>2</sub> was 1.4%, despite the global economy growing by 3.5%. For more visit:

<http://www.bbc.co.uk/news/science-environment-24742770>

### **Three-dimensional carbon goes metallic**

**6<sup>th</sup> November 2013, unattributed, Science Daily**

A theoretical, three-dimensional (3D) form of carbon that is metallic under ambient temperature and pressure has been discovered by an international research team. The findings, which may significantly advance carbon science, are published online this week in the Early Edition of the *Proceedings of the National Academy of Sciences*.

Carbon science is a field of intense research. Not only does carbon form the chemical basis of life, but it has rich chemistry and physics, making it a target of interest to material scientists. From graphite to diamond to Buckminster fullerenes, nanotubes and graphene, carbon can display in a range of structures.

But the search for a stable three-dimensional form of carbon that is metallic under ambient conditions, including temperature and pressure, has remained an ongoing challenge for scientists in the field. For more visit:

[http://www.sciencedaily.com/releases/2013/11/131106114125.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/11/131106114125.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

### **Fossil fuel subsidies 'reckless use of public funds'**

**7<sup>th</sup> November 2013, Matt McGrath, BBC News**

The world is spending half a trillion dollars on fossil fuel subsidies every year, according to a new report. The Overseas Development Institute (ODI) says rich countries are spending seven times more supporting coal, oil and gas than they are on helping poorer nations fight climate change. Some countries including Egypt, Morocco and Pakistan, have subsidies bigger than the national fiscal deficit.

The **new report** calls on the G20 to phase out the payments by 2020. While there is no globally agreed definition of what a fossil fuel subsidy actually is, the report draws on a range of sources from the International Monetary Fund to the International Energy Agency. It details the range of financial help given to oil, coal and gas producers and consumers from national governments and through international development. What emerges is a complicated web of different types of payments in different countries. For more visit:

<http://www.bbc.co.uk/news/science-environment-24833153>

### **Graphene: Wonder material for electronics, computers and beyond...**

**7<sup>th</sup> November 2013, unattributed, Science Daily**

You might think that such a new 'wonder material' would lie outside your everyday experience, but graphene is the exception. When you write or draw with a pencil, the graphite (the 'lead' of the pencil) slides off in thin layers to leave a trail -- the line on the paper. Carbon's ability to form a thin layer of molecules is what makes graphene special -- and scientists are starting to explore the possibilities for electronics and computing of carbon grids that are just one molecule thick.

The semiconductor industry is the basis of today's high-tech economy, directly supporting over 100,000 jobs in Europe, and indirectly even more. This has been achieved through continued miniaturisation in 'Complementary metal-oxide-semiconductor' (CMOS) technology, based on silicon. But this model will only last for 10 or 15 more years.

The major challenge for the ICT industry is to find alternatives for information processing and storage beyond the limits of existing CMOS. There are good indications that graphene is a

prime candidate for "Beyond CMOS" components, and is, despite its revolutionary nature, complementary to conventional CMOS technologies.

Graphene has been the subject of a scientific explosion since the ground-breaking experiments on this novel material less than 10 years ago, recognised by the Nobel Prize in Physics in 2010 awarded to Professor Andre Geim and Professor Kostya Novoselov, at the University of Manchester. The remarkable electrical properties of graphene may overcome the physical limits silicon faces as transistors shrink to ever-smaller sizes -- providing solutions for the "Beyond CMOS" era, needed to meet the challenges of global competition. For more visit:

[http://www.sciencedaily.com/releases/2013/11/131107122934.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/11/131107122934.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

or

[http://cordis.europa.eu/result/brief/rcn/12056\\_en.html](http://cordis.europa.eu/result/brief/rcn/12056_en.html)

## **US DoE to fund 18 research projects to drive down costs of carbon capture**

**7<sup>th</sup> November 2013, Sonal Patel, Power**

Eighteen carbon capture projects across the U.S. have been chosen to receive \$84 million in federal funding to help improve the efficiency and drive down costs of carbon capture processes for new and existing coal power plants.

The Department of Energy (DOE), which announced selection of the projects today, said funded research will focus on post-combustion carbon capture processes and gasification processes, which are expected to "improve the efficiency and cost-effectiveness of pre-combustion carbon capture," it said.

The largest funding award, about \$15 million, will go to Boulder-based ION Engineering, which will test an advanced carbon dioxide (CO<sub>2</sub>) capture solvent under realistic slipstream conditions during continuous long-term operation to further the goal of smaller, more efficient CO<sub>2</sub> capture processes. About \$10.5 million will go to SRI International's project to test a CO<sub>2</sub> sorbent capture process and conduct pilot-scale testing of the sorbent under realistic conditions to validate affordability and opportunities for CO<sub>2</sub> use in commercial applications. Three pre-combustion technologies were picked, including Colorado-based TDA Research's project to pilot test a new sorbent-based capture technology for integrated gasification combined cycle (IGCC) power plants.

The projects were selected as part of President Obama's Climate Action Plan, said Energy Secretary Ernest Moniz. "In the past four years we've more than doubled renewable energy generation from wind and solar power. However, coal and other fossil fuels still provide 80 percent of our energy, 70 percent of our electricity, and will be a major part of our energy future for decades," he said.

<http://www.powermag.com/doe-to-fund-18-research-projects-to-drive-down-costs-of-carbon-capture/>

## **CSLF endorses five new carbon capture projects**

**7<sup>th</sup> November, unattributed, Coal International**

The Carbon Sequestration Leadership Forum (CSLF) has added five new carbon capture and storage (CCS) projects to its existing research and development portfolio in an ongoing effort to bring together developed and developing nations in a collaborative quest to curtail anthropogenic emissions of the greenhouse gas carbon dioxide (CO<sub>2</sub>).

The new projects were approved at the CSLF's Fifth Ministerial Meeting in Washington, DC, US and bring the total number of recognized projects over the past 10 years to nearly 40. Twelve of these projects have been successfully completed.

These projects provide the basis for international information sharing on some of the most important projects throughout the world covering all aspects of CCS. All are aimed at gathering the knowledge and experience required to initiate widespread carbon capture and to conduct safe, secure geologic storage on the order of thousands of years.

Currently the CSLF portfolio includes pioneering activities to identify potential storage capacities and projects dedicated to matters such as cutting the costs of CO<sub>2</sub> capture technology and developing new methods of combustion; identifying storage capacity and widening the understanding of geologic reservoirs; predicting the behaviour of stored carbon in various kinds of reservoirs; and developing technologies for successful, reliable and long-term monitoring, measurement and verification of stored carbon.

Most projects serve several purposes and a number capitalize on the concept of using CO<sub>2</sub> storage to augment energy production as with enhanced oil recovery (EOR) and methane recovery from un-mineable coal seams.

The projects in the portfolio report progress regularly to the CSLF and results are available to all members, stakeholders and others through the CSLF website. In return, the projects receive global visibility. For project details visit:

<http://mqworld.com/article.php?id=15129> and <http://www.cslforum.org>

### **Scots workers joy as open-cast mine is set to reopen in Fife**

**8<sup>th</sup> November 2013, James Moncur, Daily Record**

Scottish industry got a bit of good news yesterday with the announcement that an open-cast mine is to reopen. Work at St Ninians, in Fife – which fell victim to Scottish Coal's collapse – is due to restart after one of Europe's leading mining firms stepped in to run it. Hargreaves Services reached an agreement with Fife Council and other regulatory bodies to start operations, restore the area and create 25 jobs. The site, near the M90 on the outskirts of Kelty, is one of five opencast sites that Durham company Hargreaves bought into and it is believed there is still 65,000 tons of coal there to be mined. The scheme will also include a land art restoration project featuring a landscape park that should be completed by next autumn.

For more visit:

<http://www.dailyrecord.co.uk/news/scottish-news/scots-workers-joy-open-cast-mine-2688392>

### **Look what's slowing down global warming**

**10<sup>th</sup> November 2013, Tim McDonnell, Mother Jones**

Climate deniers like to point to the so-called global warming "[hiatus](#)" as evidence that humans aren't changing the climate. But according to a [new study](#), exactly the opposite is true: The recent slowdown in global temperature increases is partially the *result* of one of the few successful international crackdowns on greenhouse gases.

Back in 1988, more than 40 countries, including the US, signed the Montreal Protocol, an agreement to phase out the use of ozone-depleting gases like chlorofluorocarbons, (today the Protocol has nearly [200 signatories](#)). According to the EPA, CFC emissions are [down 90 percent](#) since the Protocol, a drop that the agency calls "one of the largest reductions to date in global greenhouse gas emissions." That's a blessing for the ozone layer, but also for the climate. CFCs are a [potent heat-trapping gas](#), and a new analysis published today in *Nature Geoscience* finds that slashing them has been a major driver of the much-discussed slowdown in global warming.

Without the Protocol, environmental economist Francisco Estrada of the Universidad Nacional Autónoma de México reports, global temperatures today would be about a tenth of a degree Celsius higher than they are. That's roughly an eighth of the total warming documented since 1880.

Estrada and his co-authors compared global temperature and greenhouse gas emissions records over the last century and found that breaks in the steady upward march of both coincided closely. At times when emissions levelled off or dropped, like during the Great Depression, the trend was mirrored in temperatures; likewise for when emissions climbed.

"With these breaks, what's interesting is that when they're common that's pretty indicative of causation," said Pierre Perron, a Boston University economist who developed the custom-built statistical tests used in the study.

The findings put a new spin on investigation into the cause of the recent "hiatus." Scientists have suggested that several temporary natural phenomena, including the deep ocean sucking up more heat, are responsible for this slowdown. Estrada says his findings show that a recent reduction in heat-trapping CFCs as a result of the Montreal Protocol has also played an important role.

"Paradoxically, the recent decrease in warming, presented by global warming sceptics as proof that humankind cannot affect the climate system, is shown to have a direct human origin," Estrada writes in the study. For more see:

<http://www.motherjones.com/blue-marble/2013/11/cutting-emissions-really-does-slow-global-warming-study-finds>

## **Coal continues to dominate global carbon emissions**

**18<sup>th</sup> November 2013, unattributed, Science Daily**

Despite explosive growth in renewable energy consumption, continued strong growth in coal consumption has further consolidated coal as the dominate source of carbon dioxide emissions. In its annual analysis of global carbon emissions production published online Tuesday 19 November, the Global Carbon Project (GCP) found that global emissions from fossil fuel combustion and cement production reached a record high of 35 billion tonnes CO<sub>2</sub> in 2012, 58 per cent above the level of 1990.

In 2012 global carbon dioxide emissions were 2.2 per cent higher<sup>1</sup> than in 2011, and based on estimates of economic activity in 2013, emissions are set to rise 2.1 per cent in 2013 to reach 36 billion tonnes CO<sub>2</sub>. These growth rates are slightly lower than the average growth of 2.7 per cent per year in the last 10 years.

In 2012 many countries increased dependence on coal. German emissions increased 1.8 per cent in 2012, with coal growing at 4.2 per cent. Japanese emissions increased 6.9 per cent in 2012, with coal growing at 5.6 per cent. EU28 emissions decreased 1.3 per cent, but emissions from coal grew 3.0 per cent. Indian emissions increased 7.7 per cent, with coal growing at 10.2 per cent.

Poland, host of the 19th Conference of the Parties to the UNFCCC, recorded a 3.1 per cent decrease in emissions in 2012, but it is still one of Europe's most coal-reliant economies.

For more visit:

[http://www.sciencedaily.com/releases/2013/11/131118193131.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy%2Ffossil\\_fuels+%28ScienceDaily%3A+Matter+%26+Energy+News+--+Fossil+Fuels%29](http://www.sciencedaily.com/releases/2013/11/131118193131.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy%2Ffossil_fuels+%28ScienceDaily%3A+Matter+%26+Energy+News+--+Fossil+Fuels%29)

## **Coal science award for Professor Terry Wall**

**18<sup>th</sup> November 2013, Matt Carr, Newcastle Herald**

A University of Newcastle professor has received a prestigious award for his lifetime contribution to coal science. Emeritus Professor Terry Wall received the Baragwanath Award, one of the highest honours in Australian coal science from the Australian Institute of Energy, in recognition for his work on coal combustion.

Professor Wall's research has increased efficiency and environmental controls in coal-fired power stations around the world during his 40 years in the industry. "It's a never-ending quest but I think you can say that technology that uses coal has really improved drastically," Professor Wall said. "Newcastle has been an Australian centre of this activity and it will continue to be as well."

Professor Wall is still working in the industry, researching carbon capture and other potential environmental fixes to coal pollution. He said the award was an honour. "It's basically the recognition of a lot of people who have worked with me over the years at the university," he said. "I've just been the one who has gone on with it." The award was presented at the Australian Coal Science Conference in Brisbane on Monday night.

<http://www.theherald.com.au/story/1916647/coal-science-award-for-professor-terry-wall/?cs=2373>

## **Carbon capture and storage: An inside look at a Metal-Organic Framework (MOF) in action**

**22<sup>nd</sup> November 2013, unattributed, Science Daily**

A unique inside look at the electronic structure of a highly touted metal-organic framework (MOF) as it is adsorbing carbon dioxide gas should help in the design of new and improved MOFs for carbon capture and storage. Researchers with the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab) have recorded the first *in situ* electronic structure observations of the adsorption of carbon dioxide inside Mg-MOF-74, an open metal site MOF that has emerged as one of the most promising strategies for capturing and storing greenhouse gases. For more visit:

[http://www.sciencedaily.com/releases/2013/11/131122132453.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/11/131122132453.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

## **Tracking fracking pollution**

**3<sup>rd</sup> December 2013, unattributed, Science Daily**

As a result of the fracking revolution, North America has overtaken Saudi Arabia as the world's largest producer of oil and gas. This is despite endless protests from environmentalists. But does drilling for natural gas really cause pollution levels to skyrocket? A team of geochemistry researchers affiliated with Concordia University, l'Université du Québec à Montréal, l'Institut national de la recherche scientifique, and the GEOTOP research group has just completed the first detailed study to examine the natural quality of groundwater prior to fracking.

The resulting report, commissioned by the Strategic Environmental Assessment Committee on Shale Gas, provides a benchmark for naturally occurring levels of pollution. This will help scientists prove definitively whether fracking causes groundwater pollution by establishing the concentrations of methane, ethane, propane, helium and radon found in the groundwater in a location where fracking has yet to occur -- the low-lying areas surrounding the St. Lawrence River, between Montréal and Québec.

For more visit:

[http://www.sciencedaily.com/releases/2013/12/131203112219.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/12/131203112219.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

## **Ocean crust could store many centuries of industrial carbon dioxide**

**4<sup>th</sup> December 2013, unattributed, Science Daily**

Researchers from the University of Southampton have identified regions beneath the oceans where the igneous rocks of the upper ocean crust could safely store very large volumes of carbon dioxide.

PhD student Chiara Marieni, who is based at the National Oceanography Centre, Southampton, investigated the physical properties of CO<sub>2</sub> to develop global maps of the ocean floor to estimate where CO<sub>2</sub> can be safely stored.

Postgraduate researcher Chiara says: "We have found regions that have the potential to store decades to hundreds of years of industrial carbon dioxide emissions although the largest regions are far off shore. However, further work is needed in these regions to accurately measure local sediment conditions and sample the basalt beneath before this potential can be confirmed."

For more visit:

[http://www.sciencedaily.com/releases/2013/12/131204091142.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/12/131204091142.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

## **UK solar energy potential under study**

**6th December 2013, unattributed, The Engineer**

Academics and industry partners are embarking on a research project into the potential costs and benefits of solar energy in the UK. Prof Ralph Gottschalg, Dr Paul Rowley and Dr Tom Betts at Loughborough University's Centre for Renewable Energy Systems Technology (CREST), alongside academics from Imperial College London, will collaborate with aerial mapping company Bluesky on the £1m 'PV2025' project.

The project aims to answer a number of questions relating to the production of energy through solar panel electricity systems and how geography, legislation and social factors might impact on the costs and benefits to the country. The project is funded by the EPSRC and led by CREST. Other project partners include E.ON and SMA Solar UK.

In a statement, Loughborough University's Dr Paul Rowley, senior lecturer in Renewable Energy Systems, said: 'Working with Bluesky will be critical as they bring a wealth of experience and expertise to this project having launched the first maps of solar potential back in 2010.' James Eddy, technical director of Bluesky International said: 'Over an eighteen month period we assessed the solar potential of more than half a million properties working with energy companies, local authorities, housing associations as well as property owners and solar panel installers.

'We developed a unique method of generating solar potential maps using photogrammetric techniques to accurately measure and record factors that may contribute to the suitability for solar power.'

The PV2025 project will consider photovoltaic (PV) energy production in the national context, looking at how PV systems of different sizes or regional differences in environmental conditions affect factors such as energy generation and the infrastructure required to effectively distribute this energy.

The PV2025 project will be split into four work packages including analysis of impacts on the electricity network and detailed mapping of issues such as reductions in fuel poverty arising from PV. Tools developed during the project will be made available for general use.

<http://www.theengineer.co.uk/energy-and-environment/news/uk-solar-energy-potential-under-study/1017640.article>

## **Scientists probe abandoned mine for clues about permanent carbon dioxide sequestration**

**8<sup>th</sup> December 2013, unattributed, Science Daily**

An abandoned mineral mine near Stanford University is providing geoscientists new insights on how to permanently entomb greenhouse gas emissions in the Earth. For two years, a team of Stanford researchers has been trying to unravel a geological mystery at the Red Mountain mine

about 70 miles east of the campus. The abandoned mine contains some of the world's largest veins of pure magnesium carbonate, or magnesite -- a chalky mineral made of carbon dioxide (CO<sub>2</sub>) and magnesium. How the magnesite veins formed millions of years ago has long been a puzzle.

Now the Stanford team has proposed a solution. Their findings could lead to a novel technique for converting CO<sub>2</sub>, a potent greenhouse gas, into solid magnesite. The results will be presented at the 2013 fall meeting of the American Geophysical Union (AGU) in San Francisco. "Conventional geological storage involves capturing CO<sub>2</sub> from industrial smokestacks and injecting it as a fluid into the subsurface," said Kate Maher, an assistant professor of geological and environmental sciences at Stanford. "But there is concern that the carbon dioxide would eventually leak back into the atmosphere. Our idea is to permanently lock up the CO<sub>2</sub> by converting it into a stable mineral."

Power plants and other industries are responsible for more than 60 percent of global CO<sub>2</sub> emissions, according to the International Energy Agency. Sequestering the CO<sub>2</sub> in magnesite deposits would prevent the gas from entering the atmosphere and warming the planet, Maher explained.

[http://www.sciencedaily.com/releases/2013/12/131208090629.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/12/131208090629.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

## **New long-lived greenhouse gas discovered**

**9<sup>th</sup> December 2013, unattributed, Science Daily**

Scientists from U of Toronto's Department of Chemistry have discovered a novel chemical lurking in the atmosphere that appears to be a long-lived greenhouse gas (LLGHG). The chemical -- perfluorotributylamine (PFTBA) -- is the most radiatively efficient chemical found to date, breaking all other chemical records for its potential to impact climate.

Radiative efficiency describes how effectively a molecule can affect climate. This value is then multiplied by its atmospheric concentration to determine the total climate impact. PFTBA has been in use since the mid-20th century for various applications in electrical equipment and is currently used in thermally and chemically stable liquids marketed for use in electronic testing and as heat transfer agents. It does not occur naturally, that is, it is produced by humans. There are no known processes that would destroy or remove PFTBA in the lower atmosphere so it has a very long lifetime, possibly hundreds of years, and is destroyed in the upper atmosphere.

"Global warming potential is a metric used to compare the cumulative effects of different greenhouse gases on climate over a specified time period," said Cora Young who was part of the University of Toronto team, along with Angela Hong and their supervisor, Scott Mabury. Time is incorporated in the global warming potential metric as different compounds stay in the atmosphere for different lengths of time, which determines how long-lasting the climate impacts are.

Carbon dioxide (CO<sub>2</sub>) is used as the baseline for comparison since it is the most important greenhouse gas responsible for human-induced climate change. "PFTBA is extremely long-lived in the atmosphere and it has a very high radiative efficiency; the result of this is a very high global warming potential. Calculated over a 100-year timeframe, a single molecule of PFTBA has the equivalent climate impact as 7,100 molecules of CO<sub>2</sub>," said Hong.

[http://www.sciencedaily.com/releases/2013/12/131209124101.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29](http://www.sciencedaily.com/releases/2013/12/131209124101.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy+%28ScienceDaily%3A+Matter+%26+Energy+News%29)

## **Carbon capture technology could be vital for climate targets**

**11<sup>th</sup> December 2013, unattributed, IIASA**

The future availability of carbon capture and storage (CCS) will be pivotal in reaching ambitious climate targets, according to a new comprehensive study of future energy technologies from IIASA, the Potsdam Institute for Climate Change, the Stanford Energy Modelling Forum, and researchers worldwide.

The study, published in a special issue of the journal [Climatic Change](#), provides an overview of the results of EMF27, a major research project combining 18 different global energy-economy models from research teams around the world. It examines the role of technology in future climate mitigation, asking which technologies will be needed and when in order to reach different climate targets.

In 2010, coal, oil, and gas supplied more than 80% of the world's total primary energy supply—and the demand for energy is projected to increase by 2 to 3 times by 2100. The EMF27 study shows that without policies to cut greenhouse gas emissions, fossil fuels will remain the major energy source in 2100, with resulting increases in greenhouse gas emissions. But where should policymakers focus their carbon mitigation efforts? Which technologies hold the most promise? For more visit:

<http://www.iiasa.ac.at/web/home/about/news/20131211-EMFCarbon.en.html>

## **The shifting economics of coal-fired generation**

**11<sup>th</sup> December 2013, Barbara Vergetis Lundin, Fierce Energy**

Just months after the U.S. Environmental Protection Agency (EPA) announced carbon emission standards for new power plants and proposed standards for existing power plants are expected next year, updated research is showing a shift in the economics of coal-fired generation. Market factors are making an increasing number of the nation's coal-fired power plants less viable, economically, especially in Michigan, Alabama, Georgia, Indiana and Texas, according to researchers at the Union of Concerned Scientists (UCS).

"Coal-fired generation is getting increasingly expensive compared with cleaner power sources," said Jeff Deyette, assistant director of energy research at UCS and co-author of the study. "This shift in economics is a historic opportunity to modernize our electric sector and gain the economic, health and climate benefits that come with it."

In addition to the 18 GW of coal units that were retired between 2011 and 2013 and the 28 GW that have been announced for retirement by 2025, another 59 GW, or about 329 generators, are no longer economically competitive and should be considered for closure, the report says. Once the costs of installing modern pollution controls are included, these generators produce electricity that is more expensive than that of an average existing natural gas plant. For more:

<http://www.fierceenergy.com/story/shifting-economics-coal-fired-generation/2013-12-11>

## **Coal in the global energy landscape**

**11<sup>th</sup> December 2013, Nicholas Loris, The Heritage Foundation**

An abundant, affordable energy resource, coal provides 30 percent of the world's energy, 41 percent of the world's electricity generation and factors into 70 percent of the world's steel production.<sup>[1]</sup> While coal is by no means the only source of energy developed across the globe, it is a critical resource to driving economic growth all over the world and will continue to be so well into the future.

As the U.S. federal government is promulgating and applying regulations to significantly reduce the use of coal, the rest of the world's use could propel coal to the planet's number one energy source by 2017, surpassing oil.<sup>[2]</sup> The purpose of this paper is not to promote one source of energy over another—markets should drive energy production and consumption. Instead, this paper reviews coal use in other parts of the world to highlight how vital it is to current and future economic growth and improved standards of living. For more see:

<http://www.heritage.org/research/reports/2013/12/coal-in-the-global-energy-landscape>

## **Can we turn unwanted carbon dioxide into electricity?**

**13<sup>th</sup> December 2013, unattributed, e! Science News**

Researchers are developing a new kind of geothermal power plant that will lock away unwanted carbon dioxide (CO<sub>2</sub>) underground -- and use it as a tool to boost electric power generation by at least 10 times compared to existing geothermal energy approaches. The technology to implement this design already exists in different industries, so the researchers are optimistic that their new approach could expand the use of geothermal energy in the U.S. far beyond the handful of states that can take advantage of it now.

At the American Geophysical Union meeting on Friday, Dec. 13, the research team debuted an expanded version of the design, along with a computer animated movie that merges advances in science with design and cognitive learning techniques to explain the role that energy technologies can have in addressing climate change.

The new power plant design resembles a cross between a typical geothermal power plant and the Large Hadron Collider: It features a series of concentric rings of horizontal wells deep underground. Inside those rings, CO<sub>2</sub>, nitrogen and water circulate separately to draw heat from below ground up to the surface, where the heat can be used to turn turbines and generate electricity.

The design contrasts with conventional geothermal plants, explained study co-author Jeffrey Bielicki, assistant professor of energy policy in the Department of Civil, Environmental and Geodetic Engineering and the John Glenn School of Public Affairs at The Ohio State University. For more visit:

<http://esciencenews.com/articles/2013/12/13/can.we.turn.unwanted.carbon.dioxide.electricity>

## **Coal is here to stay**

**17<sup>th</sup> December 2013, Samuel Dodson, Palladian Publications Ltd.**

At the launch of the International Energy Agency (IEA)'s medium-term coal market report, Maria van der Hoeven, executive director of the IEA, said that while there was no denying the controversial reality of coal, it nonetheless would be here to stay for "a long time to come."

Van der Hoeven said that coal dominated power generation worldwide, yet no other fuel few the same "ire, particularly for its polluting qualities both locally and in terms of greenhouse gas emissions. And yet no fuel is as responsible for powering the economic growth that has pulled billions out of poverty in the past decades." She said it was clear that there would be a role for coal in the future energy mix, but that without mitigating the polluting effects of the fuel, pursuing business as usual would have "enormous and tragic consequences." For the full text visit:

<http://www.iea.org/newsroomandevents/speeches/131206MCMR2013LaunchRemarks.pdf>

## **Eggborough bio bites bullet**

**19<sup>th</sup> December 2013, unattributed, reNews.biz**

The planned coal to biomass conversion on Unit 2 at Eggborough Power Station in Yorkshire has been abandoned after the project failed to meet the UK government's "affordability" grade. The facility's management said operations at the unit will now cease in September 2014 and the shut-down will remove 500MW (or 1%) of capacity from the UK electricity grid. It added that without the biomass element, the existing 2000MW fossil fuel plant (*pictured*) "will no longer be supplying power to the grid beyond 2015". The blow is a result of [today's decision by Westminster](#) that the project is not "affordable" under the terms of the Final Investment Decision Enabling for Renewables process. The biomass conversion was described as "shovel ready to start on 6 January 2014, with investment and key engineering and construction contracts in place" but an initial £17m contract with supply partners due to be signed today has been suspended. Eggborough Power Station said it "remains open to working with the

government in order to quickly find a solution". Chief executive Neil O'Hara said: "Unless a viable solution is found, the most likely outcome now is that Eggborough will no longer be supplying electricity to the grid beyond 2015. "Impending EU regulation and the escalating impact of the carbon price floor mean this is unfortunately the rational economic conclusion based on the information we have available at this time."

<http://renews.biz/56730/eggborough-bio-bites-emr-bullet/>

### **Burn more low-quality coal, power plants urged 19<sup>th</sup> December 2013, unattributed, Eco-Business.com**

The country's power plants should burn more poor-quality coal, leaving better coal for smaller coal-burning enterprises that lack emission controls — a move that would reduce pollution, it has been suggested. This recommendation is in a newly released study co-authored by the China Electricity Council and the Environmental Defense Fund, an international environmental NGO based in New York City. "Power plants should be encouraged to use more brown coal and coal with high sulfur content, and to conduct highly efficient pollution control measures, in a bid to reduce the total emissions of society," said the study, which was released on Tuesday.

Wang Zhixuan, secretary-general of the China Electricity Council, said the nation's power plants used about half of the 4 billion metric tons of coal burned in 2012. But at least 1 billion tons of the rest was used by small coal-burners, such as residences and small enterprises, which seldom adopt pollution-reduction measures when burning coal, he said. Power plants, on the other hand, have the ability to control emissions to a certain level even if they use coal of poor quality, he said. "The more low-quality coal that power plants burn, the less will be used by small burners," he said.

Dai Bing, director of the coal industry information department at JYD Online Corp, a Beijing-based bulk commodity consultancy, agreed. "Usually, medium and large-scale power plants have high-end facilities and equipment for environmental protection," he said. "It can effectively reduce emissions and pollution if the government encourages these plants to use more brown coal as fuel."

<http://www.eco-business.com/news/burn-more-low-quality-coal-power-plants-urged/>

## New RFCS coal-related projects started in 2013

Project Number	Project category	Short title	Title	Duration (months)	Start date	Co-ordinator	Total Funding (EU Support) (€)
RFCR-CT-2013-00001	TGC 1	AMSSTED	Advancing mining support systems to enhance the control of highly stressed ground.	36	01.07.2013	Glowny Instytut Gornictwa, Poland.	4,294,628 (2,576,776)
RFCR-CT-2013-00002	TGC 1	COGAR	Underground coal gasification in operating mine and areas of high vulnerability.	36	01.07.2013	Glowny Instytut Gornictwa, Poland.	2,839,866 (1,703,920)
RFCR-CT-2013-00003	TGC 1	RTRO-Coal	Real-time reconciliation and optimization in large open pit coal mines.	48	01.10.2013	Technische Universiteit Delft, Netherlands.	1,447,283 (761,967)
RFCR-CT-2013-00004	TGC 1	M-SMARTGRID	Mining smart electrical grids.	36	01.07.2013	Asociacion Para La Invest. Y El Desar. Industrial De Los, Spain.	2,798,888 (1,679,334)
RFCR-CT-2013-00005	TGC 1	MANAGER	Management of mine water discharges to Mitigate environmental risks for post--mining period.	36	01.07.2013	Glowny Instytut Gornictwa, Poland.	2,845,595 (1,707,358)
RFCR-CT-2013-00006	TGC 2	COALPHENES	Coal liquid-based high crystalline carbons for the synthesis of graphene---based composites.	36	01.07.2013	Agencia Estatal Consejo Superior De Investigaciones Cie, Spain.	1,896,144 (1,137,686)
RFCR-CT-2013-00007	TGC 2	COWEST	Coal weathering study to predict oxidation, improve coke properties and protect coke oven operation.	42	01.07.2013	University of Nottingham, UK.	2,045,947 (1,227,568)
RFCR-CT-2013-00008	TGC 2	CO2freeSNG2.0	Advanced substitute natural gas from coal with internal sequestration of CO2.	36	01.07.2013	Friedrich-Alexander Universitat, Erlangen Nurnberg, Germany.	1,834,169 (1,100,502)
RFCP-CT-2013-00009	TGC 3	ASC2	Amine-impregnated alumina solid sorbent for CO2 capture.	36	01.07.2013	Fundacion Circe-Centro De Investigacion De Recursos Y, Spain.	3,093,285 (1,546,642)
RFCR-CT-2013-00010	TGC 3	BiOxySorb	Economic low carbon power production and emissions control for future and flexible biomass co-fired power stations.	36	01.07.2013	Universitaet Stuttgart, Germany.	2,105,362 (1,263,217)
RFCR-CT-2013-00011	TGC 3	CRAMUFAT24	Crack mechanism understanding and failure avoiding treatment of T24 tube material in advanced supercritical coal fired steam generators.	24	01.07.2013	Universitaet Stuttgart, Germany.	2,138,151 (1,282,891)
						TOTAL	<b>27,339,318 (15,987,861)</b>
						EU Support (average %)	<b>58.4</b>

Technical Group Coal (TGC) 1 projects:-

Coal mining operation, mine infrastructure and management and unconventional use of coal deposits

Technical Group Coal (TGC) 2 projects:-

Coal preparation, conversion and upgrading

Technical Group Coal (TGC) 3 projects:-

Coal combustion, clean and efficient coal technologies, CO2 capture

## CALENDAR OF COAL RESEARCH MEETINGS AND EVENTS

Date	Title	Location	Contact
18th to 19 <sup>th</sup> February 2014	Platts 8th Annual European Carbon Capture and Storage	Marriott Brussels, Belgium	Visit <a href="http://www.platts.com/conferencedetail/2014/p465/index">http://www.platts.com/conferencedetail/2014/p465/index</a> for details
<b>Wednesday 12<sup>th</sup> and Thursday 13<sup>th</sup> March 2014</b>	<b>"14th Annual APGTF Workshop : Title to be announced, Organised by the Advanced Power Generation Technologies Forum, (APGTF) in collaboration with the Coal Research Forum</b>	<b>The IVS Conference Centre, 1, Victoria Street, Westminster, London</b>	<b>Mr. Philip Sharman, Chairman of the APGTF, Tel : 07976-847305 E-mail : <a href="mailto:philip.sharman@evenlodeassociates.co.uk">philip.sharman@evenlodeassociates.co.uk</a></b>
<b>Tuesday 8<sup>th</sup> April 2014</b>	<b>"Combustion For Low Carbon Power Generation" CRF Annual Meeting and Combustion Divisional seminar</b>	<b>University of Warwick, Coventry</b>	<b>Dr. David J.A.McCaffrey Secretary of the Coal Research Forum Tel : 01242-236973 E-mail : <a href="mailto:mail@coalresearchforum.org">mail@coalresearchforum.org</a></b>
<b>Thursday 15<sup>th</sup> or 22<sup>nd</sup> May 2014 (provisional)</b>	<b>"The UK Energy Scene", (Provisional Title) Minerals Engineering 2014, organised by the Minerals Engineering Society, (MES), and co-sponsored by the Coal Research Forum, (CRF), the South Midlands Mining and Minerals Institute, (SMMMI) and the RSC Energy Sector.</b>	<b>Yew Lodge Hotel, Kegworth, East Midlands.</b>	<b>Mr. Andrew Howells, Secretary of the MES, Tel : 01909-591787 Mobile : 07510-256626. E-mail : <a href="mailto:hon.sec.mes@lineone.net">hon.sec.mes@lineone.net</a></b>
3 <sup>rd</sup> to 5 <sup>th</sup> June 2014	Power-Gen Europe	Cologne, Germany	<a href="http://www.powergeneurope.com/index.html#showcase_3">http://www.powergeneurope.com/index.html#showcase_3</a>
<b>Monday 15<sup>th</sup> to Wednesday 17<sup>th</sup> September 2014</b>	<b>Biennial Conference Organised by the Coal Research Forum 10<sup>th</sup> European Conference on Coal Research &amp; Its Applications, ECCRIA 10</b>	<b>The Business School, University of Hull, Kingston-upon- Hull</b>	<b>To receive further information on this Conference, please complete the "Interest in Registration" form via the Conference website <a href="http://www.constableandsmith.com/coalresearch">www.constableandsmith.com/coalresearch</a></b>
<b>Date to be announced</b>	<b>"The Control of Mercury and Trace Element Emissions" Coal Research Forum Environment Divisional seminar</b>	<b>Venue to be announced</b>	<b>Dr. Bill Nimmo Chairman of the CRF Environment Division Tel : 0113-343-2513 E-mail : <a href="mailto:w.nimmo@leeds.ac.uk">w.nimmo@leeds.ac.uk</a></b>
5 <sup>th</sup> to 9 <sup>th</sup> October 2014	12th International conference on greenhouse gas control technologies: GHGT-12	Austin, TX, USA	Sian Twinning, IEAGHG, Orchard Business Centre, Stoke Orchard, Cheltenham, Gloucestershire GL52 7RZ, UK Tel: +44 1242 680753 Fax: +44 1242 680758 Email: <a href="mailto:sian@ieaghg.org">sian@ieaghg.org</a> Internet: <a href="http://ghgt.info/index.php/Content-GHGT12/ghgt-12-overview.html">ghgt.info/index.php/Content-GHGT12/ghgt-12-overview.html</a>