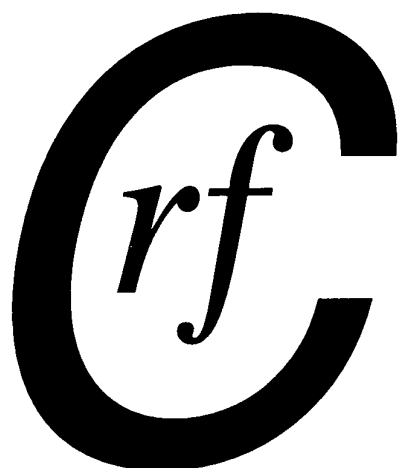


# NEWSLETTER



*of  
the  
Coal Research Forum*



## **EDITOR'S MUSINGS:**

A somewhat belated wish for a Happy New Year to you all from the Coal Research Forum!

One of the main topics of recent news, in addition to the flooding in the UK, was COP21. A suitably short and memorable acronym for an important conference but what will it actually achieve? Well, it certainly seemed to excite those who see it heralding the imminent demise of coal. From the investment companies who have removed coal from their portfolios to those who see an easy and cheap replacement of coal with some renewable power source, the life of coal is surely over. Needless to say it is not quite that simple. If it were then surely the changeover would be happening much faster. Whilst some coal fired stations have closed and others are planned for closure, several countries which were parties to the COP21 agreement are continuing to build coal fired power stations and clearly see a future for coal in their countries. And can we be sure that if fossil based carbon emissions were to cease right now that global temperatures would stabilise and if so how long would it take? Whilst I believe attempts should continue to be made to minimise carbon emissions I think such a complex scenario needs to consider all options in a pragmatic way including much more on adapting to climate change.

A more certain event is, however, ECCRIA 11 which is taking place on the 5<sup>th</sup> to 7<sup>th</sup> September 2016. Please make a note of it in your diary and remember that the closing date for abstracts is 29<sup>th</sup> January 2016 so get composing! Visit the following link for more information <http://www.maggichurchosevents.co.uk/crf/ECCRIA.htm>

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## Student Bursaries for 2016-2017

Travel and subsistence bursaries of up to £300 are on offer to bona-fide full-time students who wish to attend appropriate National and International coal-related conferences, (please see the Calendar of Coal Research Events for details of future conferences), and whose supervisor is a member of the Coal Research Forum. To apply, please send the abstract submitted to the conference with a brief supporting letter from your supervisor together with details of the expected expenditure and other sources of funding applied for, to :-

Prof. J.W. Patrick,  
Dept. of Chemical and Environmental Engineering,  
Faculty of Engineering,  
The University of Nottingham,  
Energy Technologies Building,  
Innovation Park, Triumph Road,  
Nottingham NG7 2TU

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, this report will provide some brief details of the beneficiary, their topic of study and the reasons for wishing to attend the conference. Potential applicants should see the template for these reports on the CRF website, [www.coalresearchforum.org](http://www.coalresearchforum.org), where such reports must comply with these requirements.

Please note that these bursaries are only for travel and subsistence to attend the conference, (i.e. not for conference or other fees). In addition, priority will be given to applicants who will be attending the whole of a conference rather than one day of a multi-day event and will be using the conference accommodation provided should this be required. It may not be possible to fund all applications for bursaries or meet the request in full as this will depend on the funds available at the time.

### Reports from Student Bursary Recipients

#### Mr Farooq Abubakar Atiku

This is the report of Mr Farooq Abubakar Atiku who was awarded a travel bursary by the Coal Research Forum, to attend the 1<sup>st</sup> Chemistry in Energy Conference held at the Heriot-Watt University in Edinburgh on 20<sup>th</sup> to 23<sup>rd</sup> July 2015.

The Conference was sponsored by EDF energy, HPC energy, Rolls-Royce, Veolia, Anton Paar, Metrohm, ThermoFisher Scientific, UKCCS, DNV.GL, BIAPWS, and RSC Energy Sector. Although it was the first conference in the world to focus on scientific problems of whole energy field such as material chemistry, corrosion, and water/steam chemistry which lead to discussions on the latest advances.

More than 100 participants from different countries worldwide, including scholars, experts and entrepreneurs from various energy sectors, attended the Conference. Exchanges and discussions were carried out in different sessions of the three-day Conference.

I am a 3rd year PhD student supervised by Professor Jenny M. Jones in the Energy Research Institute the School of Chemical and Process Engineering of the University of Leeds. I delivered an oral presentation entitled "Asphaltene Structure and its Effect on the Combustion of Heavy Fuel Oil".

My particular interest in attending this conference was the opportunity to hear similar presentations in session of oil combustion and oil energy matters, and to meet with other students, who are also working in combustion.

The three-day conference was divided into three sessions titled as follows: Nuclear, catalysis, Carbon Capture and Storage, and other Fossil Fuel Issues, Oil and Gas Exploration, Production and Conversion etc. A total of sixty-four oral presentations were given and over twenty posters were presented in the poster session.

The conference meeting had very interesting and engaging academic sessions, especially the combustion, nuclear and catalysis what I was most interacted in. This meeting has been very intellectual academically. Similarly, not only did I listen to amazing lectures but also I found that the meeting had significant importance in research as it involved meeting with different inter-disciplinary researchers within the combustion research area and sharing ideas and networking which was very productive and stimulating. This conference being the first Chemistry in Energy Conference gave research students the opportunity to present their work and develop presentation methods.

Finally, we had a marvellous and unforgettable conference dinner with most abiding of memories for all attendees.

### **Patrick Daley**

This is the report of Mr Patrick James Daley who was awarded a travel bursary by the Coal Research Forum, to attend the 17th International Conference on Coal Science and Technology held at the Melbourne Convention and Exhibition Centre in Melbourne, Australia on 27<sup>th</sup> of September to 1<sup>st</sup> of October 2015.

Brown Coal Innovation Australia (BCIA) was the conference partner, Global CCS Institute, Fluor, Ignite Energy Resources (IER), and Perkin Elmer were conference supporters, Elsevier was the exhibitor, and the dinner sponsor was MONASH University. The ICCST is one of the world's leading conferences in the field of coal research and focussed on scientific and technological problems of coal such as combustion, gasification, ash chemistry, coal structure, value-added products, biomass co-firing, coal bed methane, enhanced coal bed methane, and carbon dioxide capture and storage, which lead to discussions on the latest advances.

More than 900 participants from all over the world, including scholars, experts and entrepreneurs from various energy sectors, attended the Conference. Exchanges and discussions were carried out in different sessions of the 4-day Conference.

I am a 2<sup>nd</sup> year EngD student supervised by Professor Ed Lester in the Chemical and Environmental Engineering Department of the University of Nottingham. On the first day of the conference program I delivered an oral presentation entitled "Image Analysis Based Ash Fusion Testing". My research is based around the automation and improvement of the existing ash fusion test. The intention is to evolve the test from a rather mistrusted characterisation technique to become a more useful tool in the process of fuel selection to determine the slagging and fouling propensities of coal and biomass.

Of particular interest, at this conference, was the opportunity to hear similar presentations in Session Coal Structure and meet with other students, researchers and professionals who are also working in ash & coal characterisation.

The proceedings of the 4-day conference commenced with 1 or 2 plenary speakers at 8.30 each morning before the refreshments at 10:10. The day was then divided into 3 periods with 5 presentation rooms entitled as follows: Gasification, Carbon Capture Storage and Utilisation, Gas & Liquid Products, Low Rank Coal Upgrading, Coal Structure. The morning session lasted from 10:40 to 12:20 with an hour for lunch and the afternoon session lasting from 1:20 to 3:00. A

20 minute break preceded the evening session from 3:20 to 5:00. The breaks were housed in a large hall with a conference fair type set up with stalls around the edges and food platters (with an excellent standard and variety) in the centre of the room, these intermissions in the morning, lunch and evening coupled with the 1 hour poster session at the end of each day offered ample time to network and review the posters set up at the back.

The oral presentation breakdown across all 4 days included 70 on the Monday, 77 on the Tuesday, 60 on the Wednesday which included an honorary speaker (The Australian Minister for industry and science, Ian Macfarlane) from 10:45 to 11:00, and finally 26 on the Thursday which finished at lunch. In total, 236 presentations were given across the conference, and 113 posters were presented in the poster sessions.

A particular highlight from the presentations was the plenary presentation from Professor Thomas Maschmeyer on his patented catalytic process for producing a crude oil from biomass. There was a conference gala dinner on the Tuesday night at the Sea Life Melbourne Aquarium, the food was great and the after dinner speakers were interesting and concise as of course everyone was eagerly awaiting their food. The overwhelming highlight of the dinner for me was the live 12 foot crocodile in tank next to our table.

### **Xiangyi Long**

This is the report of Miss Xiangyi Long who was awarded a travel bursary by the Coal Research Forum, to attend the 17<sup>th</sup> International Conference on coal science and technology held in Melbourne, Australia on 27<sup>th</sup> September to 1<sup>st</sup> October 2015.

The conference was organised by Engineers Australia and Institute of Chemical Engineers (IChemE), and sponsored by Brown Coal Innovation Australia, Global CCS Institute, Fluor, Ignite Energy Resources, Perkin Elmer, Elsevier and Monash University. This conference is one of the world's leading conferences in the field of coal research. It is held every two years in different international settings. It covered many areas of coal interest, including combustion, gasification, ash chemistry, coal structure, value-added products, biomass co-firing, coal bed methane, enhanced coal bed methane, and carbon dioxide capture and storage. More than 200 scholars and entrepreneurs of coal science and technology from many countries, including the UK, Australia, China, Japan, US, Germany and Poland, attended this conference. Exchanges and discussions were carried out in different sessions of the five-day conference.

I am a 3rd year PhD student supervised by Doctor Marcos Millan in the Chemical Engineering Department of Imperial College London, and I delivered an oral presentation entitled "Syngas Production by Pressurised Fluidised Bed Gasification of Lignite in a Steam/Carbon Dioxide Atmosphere". Through the presentation, I had a chance to show my research results to the participants from both academia and industry.

My particular interest in attending this conference was the opportunity to listen to presentations that related to my research area in Session of Gasification and meet with other researchers I was also much benefited through discussing our research with the very best experts in our international community. This could nurture new research ideas and potential international collaboration in the future, and open the opportunity to establish collaborations with people in similar area but in different institutions worldwide.

The five-day conference was divided in 20 sessions which cover the topics of gasification, low rank coal upgrading, coal structure, etc. In particular, the session on gasification attracted many attendees, which reflects the current interest on this technology. A total of 241 oral presentations were given and 107 posters were presented, which offered me a chance to know the research of different areas. For example, I very enjoyed the plenary talk given by Kouichi Miura from Kyoto University (Japan) about clean and efficient use of low rank coal, and the presentation of Ashleigh Cousins from CSIRO (Australia) on the topic of low cost combined capture of SO<sub>2</sub> and CO<sub>2</sub>.

The conference dinner was at Sea Life Melbourne Aquarium where I enjoyed fantastic food in a room with an amazing 360 degree Fish Bowl. More importantly, the conference dinner gave me an opportunity to build network with excellent researchers and practitioners from different universities and companies worldwide.

**Report of the  
1<sup>st</sup> Chemistry in Energy Conference (1<sup>st</sup> CEC)  
Heriot-Watt University  
20<sup>th</sup> to 22<sup>nd</sup> July 2015**

The '1<sup>st</sup> Chemistry in Energy' conference, organised by the RSC Energy Sector, was held at Heriot-Watt University on 20<sup>th</sup> to 22<sup>nd</sup> July 2015, where the main purpose of this event was to bring together scientists and technologists from academe and from industry with interests in the applications of chemistry in the energy industry. It was the first event of more than one day organised by the Energy Sector and the first RSC Conference covering all aspects of chemistry in energy.

The scope of this conference was broad and included, but was not be limited to fossil fuels including oil, gas and coal, nuclear, renewables, energy storage, energy distribution and energy conversion. Research students were strongly encouraged to submit papers, attend and give presentations and there was a very significantly reduced and subsidised conference fee for students, made possible with an ESED Grant, generous sponsorship from several industrial organisation, (please see the conference website, [www.chemistryinenergy.org](http://www.chemistryinenergy.org)), as well as a donation from BIAWPS, which provided 12 student Conference fee bursaries and an RSC travel grant, which provided travel expenses to 15 RSC Member students.

This conference covered all aspects of Chemistry in Energy currently being carried out in the UK and had participants from most of the major UK organisations carrying energy R&D. The Conference began with a strong message in the Opening Plenary Address, which was given by Fergus Ewing MSP, Minister for Business, Energy and Tourism of the Scottish Parliament. As the first conference of its kind in the UK, it was considered a significant technical success and was attended by just over 125 participants, including 43 students where 29 of the participants were from overseas representing 15 countries. The conference had 68 oral presentations, which were presented in two parallel sessions, 3 plenary addresses and 1 keynote address, as well as almost 40 poster presentations. The Plenary Speakers were invited to give presentations on specific themes, policy, nuclear, and fossil fuel issues, to cover present and future developments in these fields. A highlight of the Conference dinner was the inspirational after-dinner speech, which was presented by Prof Lesley Yellowlees, Professor of Inorganic Electrochemistry, University of Edinburgh, and a former President of the Royal Society of Chemistry.

In addition to the benefits to RSC Members derived from attending and taking part in this technical conference as described above, there were five other positive and tangible benefits to the RSC.

- 1) RSC Student Members were able to attend this Conference at a considerably reduced Conference Fee as a direct result of the ESED Grant and the other donations.
- 2) The Conference was able to accommodate a session for the presentation of the award and the oral presentation of the 2015 RSC Sustainable Energy Award to Prof. John Irvine, University of St Andrews, "Low carbon energy generation and the development of electrode materials for solid oxide fuel cells".
- 3) The Conference was able to provide an exhibition stand for publicity for RSC publications and the complimentary attendance of a Member of staff of the RSC.

4) The Conference will generate a number of papers for the RSC Journal "Environmental Science: Processes & Impacts".

5) During the conference registration process, at least 5 new RSC Members were recruited that were known of and possibly more that are not known of, as a direct result of the lower conference fees for RSC Members.

This first conference attracted a mainly UK audience, however, this event was publicised worldwide to overseas Chemical Societies with the help of the RSC. On the basis that this first conference was successful, the Energy Sector will consider making this conference a biennial or triennial event.

For those Energy Sector Members not able to attend this event, the abstracts for both the oral and poster presentations are on the conference website, [www.chemistryinenergy.org](http://www.chemistryinenergy.org), as are a selection of the presentations.

Report prepared by Dr D.J.A. McCaffrey, 1<sup>st</sup> CEC Conference Chairman

### **Report on the Biomass and Fossil Fuel Research Alliance (BF2RA) Energy Science Event 6<sup>th</sup> October 2015**

BF2RA held its first combined energy science lecture and research event at the Institute of Chartered Accountants in England & Wales in London on 6th October. The event comprised an afternoon start with an introduction to BF2RA by chairman Greg Kelsall followed by five presentations of on-going research projects funded by BF2RA. This was followed by the Energy Science Lecture, this year given by Professor Rachel Thomson of Loughborough University and was entitled "Challenges for Flexible Operation of Conventional Power Plant: Materials Solutions".

Greg Kelsall (Chairman BF2RA) opened the event by giving an overview of the alliance. BF2RA was formed in late 2009 and is a not-for-profit company that is limited by guarantee. Membership is open to both the private and public sector and members currently include those from the electricity supply industry, equipment manufacture, fuel user and research sectors. The objectives of BF2RA are to promote research into issues related to biomass and fossil fuels. BF2RA also organises the annual Energy Science Lecture.

The annual membership subscription may be varied in subsequent years subject to the agreement of the Membership of BF2RA but for 2015 the fees are tier 1 (Fuel / major equipment suppliers/ power generators) = £25,000; tier 2 (Users, consultants) = £12,500 and tier 3 (R&D/ government organisations) = £18,000.

The funding model and call process typically results in the award of up to £40k per successful project with the balance funding coming from academic institutions, other third parties and/or the UK Research Council. The PhD projects are typically funded for 3 to 4 years but can be of shorter duration and in some cases RA projects are funded in well justified cases. For 2016, there will not be a 'wide' Open Call as in previous years. Instead, bids will be invited against 1-2 specific topics to widen the project portfolio which will be communicated via the BF2RA website and email.

BF2RA's project portfolio contains 20 projects of which 5 have been completed. Information on these projects can also be obtained from the May editions of the CRF newsletter which contains updates.

The new research projects selected for 2015 starts are as follows:-

21. Additives to mitigate against slagging and fouling in biomass combustion: addition of coal pfa-University of Leeds.

22. Rapid fuel evaluation to detect blending, contamination, and predict ash bridging, NO<sub>x</sub>, SO<sub>x</sub> and ESP performance–University of Nottingham.
23. Investigating the potential of co-milling biomass PFA with coal to reduce NO<sub>x</sub> emissions-University of Leeds.
24. The Performance of High Chromium Creep Strength Enhanced Ferritic Steels-University of Loughborough.
25. Advanced Flame Monitoring and Emission Prediction through Digital Imaging and Spectrometry-University of Kent.

Greg summarised BF2RA by indicating that it was a world class research portfolio with good funding leverage. It has around £3m equivalent programme (at full economic cost) and provides Industrial Supervisors for all BF2RA projects. BF2RA also defines the scope of the open call and detail of invited projects. Additionally organises the annual Energy Science Lecture which is funded with BCURA grant/CRF sponsorships/BF2RA.

The afternoon technical session was introduced by Greg Kelsall and the first presentation was given by Professor Meihong Wang from the University of Hull. It was entitled “Modelling and Operational Analysis of Supercritical Coal-fired Power Plant (SCPP) Integrated with Post-Combustion CO<sub>2</sub> Capture Under UK Grid Code Requirement” - a rather lengthy title for what proved to be an information-packed series of overheads!

As background to the talk Meihong explained the need for power plant efficiency improvement, a reduction in greenhouse gas emissions and higher generating capacity to mitigate the effect of increasing energy demand. This can be achieved using supercritical power plant with CO<sub>2</sub> capture. Supercritical coal-fired power plant (SCPP) generally has higher thermal efficiency than its sub-critical counterpart. It is necessary to model accurately SCPP for better process analysis and controller design. The dynamic model of SCPP can also be used to study integration between SCPP and CO<sub>2</sub> capture plant. The dynamics of the SCPP is largely influenced by the dynamics of the once-through boiler. During the presentation Meihong described different mathematical models developed to compare the different approaches and to validate the model predictions with an existing plant data.

One of the successes of this work was the creation of a steady-state model of the SCPP integrated with PCC. Conventional and advanced exergetic analysis of the SCPP-PCC of the processes and dynamic modelling and operation of a 600MWe SCPP integrated with PCC under UK grid code requirement was performed.

Analyses of the strategies for operating the SCPP under the UK grid requirement as regards to primary frequency response were also carried out. The results showed that using a turbine throttling approach, extraction stop or condensate stop individually was not sufficient to meet the grid requirement. However, a combination of turbine throttling, extraction stop and/or condensate stop can achieve a 10% increase in generating capacity (MCR) of a SCPP within 10s to 30s of a primary frequency change within 65% to 100% MCR as required by the UK grid.

The dynamic model of SCPP was integrated with a scaled-up dynamic model of PCC.

The stripper stop mechanism was found to be insufficient for the 10% MCR required for the primary response. However, a combination of the stripper stop mechanism with SCPP steam extraction stop mechanism shows promising results which meet the UK grid requirement at above 75% MCR operation of the SCPP.

Recommendations for future work involved the investigation of different variants of the “stripper stop” mechanisms with downstream compression and transport system. For example:- i.e. CO<sub>2</sub> compressor trip (if compression is added to the CCS chain); Stripper pressure reduction and CO<sub>2</sub> venting and lean and rich amine solvent storage.

In addition it was recommended that detailed model-based control studies of the SPP-PCC integration studies be considered. This would allow the analysis of the controller design strategies/challenges under primary frequency response considering the continuous influx of renewables into the grid system.

Orla Williams from the University of Nottingham then gave a talk about biomass milling for power generation. Orla began by explaining that biomass combustion either alone or in co-firing provides a significant proportion of bioenergy in Europe, however operational issues with storage, conveyance and milling have restricted the use of biomass in coal fired power stations. One of the main issues in selecting biomasses for power generation, which will be used in coal mills, is estimating their grindability and energy consumption in comparison to coal. Traditional gauges of coal grindability such as the Hardgrove Grindability Index have been shown to be ineffective in predicting the grindability of poor coals, coal blends and biomass.

The areas of interest in Orla's work included looking into how different woody, herbaceous, fruit and thermally treated densified biomasses comminute in different mills; how mills impact densified biomass particle shape factors; the suitability of standard coal grindability test for densified biomass; the differences between grindability tests and classification on mill product and an investigation of industrial operational issues associated with biomass, such as mill choking and olive caking.

Findings from the research into biomass characterisation showed that pre-milled biomass pellets are composed of similar particle size distributions, but show a large variance in particle shape. The standard coal abrasion index test does not work for biomass as it caused the apparatus to catch fire!

The Hardgrove Grindability Test (HGI) is a poor indicator of the grindability of biomass in a vertical spindle mill. Grindability tests results which aim to analyse the grindability of biomass to  $75\mu\text{m}$  have been shown to be inappropriate. An alternative method known as the Bond Work Index (BWI) has been developed to estimate the energy consumption of materials in full size horizontal tube and ball mills. The BWI can be used to replicate mill choking. It is recommended that biomass pellets should be composed of particles close to the required size.

Olive caking is a phenomenon associated with the pulp section of the material. The sugar and moisture content of the pulp section are such that when milled a glass transition step occurs which results in caking of the olive pulp. Olive cake fines below 1mm should be sieved out and sent directly to the burner and not comminuted.

In ring-roller mill testing a strong negative correlation was obtained between comminuted particle size and particle shape for a mill with a separator. Biomass mill classifiers should be set to the Stokes number requirements for coal rather than a blanket particle size for all biomasses.

The overall project findings showed that the critical particle size for comminution through compression is key to understanding milling behaviour in different mills. By knowing a materials critical particle size and the target size of the specific biomass based on the classifier settings for a mill, it will be possible to tell whether or not a biomass pellet will break down easily within the mill; if the biomass particles which compose the pellet will need extra comminution to reach its required particle size for combustion and if the biomass particles will struggle to reduce in size if comminution is required due to their critical particle size being larger than the target particle size for combustion. Milling had little impact on particle shape even when an order of magnitude difference was seen in the particle size. Particle shape is inherent to a pellet and is determined by the pre-densified comminution processes.

The third paper was given by Philip Jenkinson of the University of Nottingham entitled "A new classification system for biomass and waste material for use in combustion". Philip explained that the ageing UK coal-fired fleet of generators and the continuing reduction in emissions



limits, for such as SO<sub>x</sub>, NO<sub>x</sub> and particulates, together with increased legislative drivers for carbonisation has made the consideration of other biomass and waste materials as replacements essential.

The objectives of this work were to derive a new classification system which would be able to predict biomass volatile/char yields under PF combustion conditions and to be able to predict char reactivity and combustion performance.

A large variety of commercially available biomasses, covering herbaceous, softwoods and hardwoods, have been analysed. These included pellets of straw, corn stover, miscanthus, and eucalyptus, pine woodchips, mixed wood pellets and olive cake. The methodology was to torrefy at 240°C, 260°C, 280°C and also steam explosion treat the biomass samples. Steam explosion of biomass is a pre-treatment process that opens up the fibres, and makes the biomass polymers more accessible for subsequent processes, i.e. fermentation, hydrolysis or densification processes. Delignified and demineralised analogues of the above were also prepared.

The samples were subjected to slow (50°C/min using TGA) and entrained flow fast pyrolysis (in a drop tube furnace (DTF)). High ash samples were demineralised by HCl washing to remove alkali and alkaline earth metals. Standard 50 MHz CP <sup>13</sup>C NMR spectra were obtained to measure the fraction of aromatic carbon of the total carbon (and thus wt% aromatic carbon content). Note that <sup>13</sup>C NMR provides a quantitative indication of biomass structural composition allowing for more in depth investigation of component thermal decomposition – This approach has been utilised successfully to quantify aromatic carbon content of coals and is now being used for lignocellulosic biomasses. DTF testing was employed to generate char samples under simulated pulverised fuel pyrolysis/combustion conditions with rapid heating rates (~10<sup>6</sup>) and low residence times (15-600 ms). The test conditions ensured complete devolatilisation of the biomass particles.

The linearity of the relationship between fixed carbon (char) and aromatic carbon content of coals with varying rank is widely reported and the logical next question was “Could such a system be utilised in the case of biomass fuels which likewise contain both aromatic and non-aromatic carbon structures?” Philip showed some data from his work which seemed to indicate a relationship between Apparent 1<sup>st</sup> Order rate constant and biomass aromatic carbon content although the relationship showed some scatter.

In summary, the yield, form and oxidative reactivity of pulverised fuel biomass chars are largely dependent upon the aromatic carbon and alkali/alkaline earth mineral content of the fuels. Although char combustion rates for biomass are higher than standard bituminous coals in all cases deactivation of biomass chars at higher level of conversion does occur and will influence carbon levels in ash. A good appreciation of the overall combustion properties of varied biomass fuels can be obtained given an understanding of their aromaticity, mineral matter content and speciation; this includes a quantitative prediction of pyrolysis mass losses, surface area and morphology of char and subsequent combustive reactivity

John Clark of the University of Nottingham gave the fourth paper of the afternoon entitled “Investigating chemical and microstructural evolution at dissimilar weld metals”. This project addresses the Materials Development priority theme of the BF2RA call in that it is directly relevant to the performance in-service of fusion welded joints between dissimilar alloys (e.g. steels and nickel alloys or different steel grades). It will also be pertinent to the development of advanced plant components which require protective coatings by weld overlay or thermal spraying for the more aggressive operating environments of biomass combustion.

The scope of the work described included background on dissimilar metal welds (DMWs), experimental and computational methods, two case studies, one from a failed ex-service DMW and the other novel weld samples).

The aim for manufacturers is to use the least expensive material which will perform to a required standard. However, as service temperatures rise there are needs for higher quality materials of dissimilar composition and structure. Problem can arise when the joining together of such materials is needed. For example, with fusion welds atomic diffusion can occur across the weld interfaces at high temperatures and this can lead to weld failure at joints.

Computational models are needed to model the complex systems in the weld zone and surrounding areas. Use has been made of a software package known as DICTRA. It is used for accurate simulation of diffusion controlled reactions in multi-component alloy systems and is based on numerical solution of multi-component diffusion equations.

John described a range of experimental methods available to study weld failures. These included optical microscopy (OM) for quick and convenient characterisation, (resolution  $\sim 5\mu\text{m}$ ); scanning electron microscopy (SEM) for high resolution characterisation options, (resolution  $\sim 0.25\mu\text{m}$ ), transmission electron microscopy (TEM) for extremely fine-scale characterisation, (resolution  $< 50\text{nm}$ ) and energy dispersive x-ray (EDX) which allows local changes in chemical composition to be traced.

The two case studies were explained in great detail and convincing evidence for the mechanisms of failure was presented in both cases.

John rounded off his talk by summarising that weld failures have been observed in joints between P91 steel and nickel alloy 625 in service conditions. Precipitate evolution, resulting from diffusion, causes vulnerability in the steel. The P87 weld metal inhibits diffusion, which should minimise vulnerability. Further testing on P87 systems should be conducted.

Dominika Orlicka of Cranfield University gave the final talk of the event entitled "Development of novel coatings to resist fireside corrosion in biomass-fired power plants". The fundamental research challenge to be addressed in this PhD project, and its overall aim, is to use a novel, rapid coating development methodology to identify coating compositions that will resist the fireside corrosion environments found on superheater and reheater tubes in combustion plants firing a high proportion of biomass fuels.

One of the first objectives was to understand the stability of a range of sodium and potassium salts (KCl, NaCl,  $\text{K}_2\text{SO}_4$ , and  $\text{Na}_2\text{SO}_4$ ) at high temperatures and to choose a deposit for fireside corrosion testing. In terms of coating development a number of activities were identified which included the use of the combinatorial model alloy development methodology by using two-target magnetron sputtering; the study the influence of Cr, Al and Fe on the coatings properties and their role in chloride-based corrosion. Also investigated were the best coating compositions in the fireside corrosion tests and to develop an understanding of their behaviour in different environments. Finally, it was intended to evaluate the alternative methods of applying the best coating compositions on the boiler tubes.

A test facility was developed to measure the salt stability and to test the coatings. For salt stability testing the gas used was typically 0.035% HCl, 0.01%  $\text{SO}_2$  and the balance nitrogen, sometimes oxygen was included. Test durations were typically 50 hours and the temperature 550 or 600°C. Magnetron sputtering was used to successfully to produce a range of Fe-Cr-Al coatings.

*[Magnetron Sputtering is a Plasma Vapor Deposition (PVD) process in which a plasma is created and positively charged ions from the plasma are accelerated by an electrical field superimposed on the negatively charged electrode or "target". The positive ions are accelerated by potentials ranging from a few hundred to a few thousand electron volts and strike the negative electrode with sufficient force to dislodge and eject atoms from the target. These atoms will be ejected in a typical line-of-sight cosine distribution from the face of the target and will condense on surfaces that are placed in proximity to the magnetron sputtering cathode. The targets are fabricated from materials that one subsequently wishes to deposit on the surface of the component facing the*

*electrode. Conductive materials can be deposited using a direct current (DC) power supply and insulators can be deposited by using a radio frequency (RF) power supply. 13.56 MHz is one of the frequencies in the RF spectrum that has been allocated to "industrial applications" as is by far the most common frequency used in the sputtering application.]*

Coating tests were run at 550°C with a gas containing around 315ppm HCl in air for up to 450 hours. A wide range of analytical techniques were used to evaluate the coating and corrosion products.

The work is continuing and some selected results were provided. The highlights to date were that the presence of HCl in gas (without KCl) did not result in any significant changes compared to air alone but that KCl strongly accelerated the corrosion rate.

This was followed by the Energy Science Lecture. A blog of the lecture has been kindly provided by Toby Lockwood of IEA Clean Coal Centre and is reproduced below with his approval and with our thanks:-

Rechristened the Energy Science Lecture to reflect its broadening scope, the annual Coal Science Lecture was given this Tuesday by Professor Rachel Thomson of Loughborough University on 'challenges for flexible operation of power plants: materials solutions'. The talk provided some great insight into the impact being made in the power industry by relatively new techniques in materials science - now not only used to help predict the behaviour of existing metals, but also to design new, ideal materials with better performances.

As the capacity of intermittent renewables on the UK grid grows, fossil fuel power plants are increasingly required to ramp their output up and down to balance electricity demand, placing their metal components under stresses they were never intended to endure. Part of Professor Thomson's work has been to bring a sophisticated array of materials characterisation and modelling techniques to the challenge of better predicting the remaining lifetime of these metal parts, such as the martensitic steels used in steam pipes. The widely used metals derive their strength from microscopic particles of certain metal carbides and nitrides which attach to grain boundaries and prevent them from deforming under high temperature and stress. Using an imaging technique which bombards the metal surface with metal ions, the researchers were able to visualise these particles and even to distinguish beneficial particles from other kinds which have no strengthening properties. Certain parameters which were not strictly controlled previously, such as the aluminium content in the metal or the precise temperatures they experience during welding, were found to favour the formation of these detrimental particles and severely weaken the metals.

The efficiency of state-of-the-art fossil fuel power plants is limited by the steam temperatures which the metal components can withstand, so efforts to improve plant efficiency are centred around developing new, high-strength metals which allow higher steam temperatures of up to 700°C to be used. By modelling the behaviour of new martensitic steel compositions, the addition of boron was found to prevent the beneficial particles from growing in size over time and losing their effectiveness. This 'designer material' has now been made in a bulk quantity and is being tested under real power plant conditions.

A similar approach was also used to design new coatings for gas turbine blades which help protect them from high temperatures and corrosion they encounter, particularly when the fuel composition is varied. This task is rendered even more challenging by the complex interaction between the substrate metal and the coating, with can diffuse into each other and form new materials at the interface. Nevertheless, Professor Thomson's team have managed to develop a new, high-performance multi-layered coating based on their models, which is now also being tested in a real gas turbine.

The solutions offered by materials science and advanced manufacturing currently seem to be developing faster than the power industry can keep pace with, and future fossil fuel power

plants will surely draw on these new techniques more and more as they meet the growing demands for high efficiency and flexibility. This exciting field will be covered by a new IEA CCC workshop series on high efficiency, low emissions power plant or 'HELE2016', which will be held in Tokyo next May, <http://hele.coalconferences.org>.

**Carbon Capture and Storage:  
What role for R&D in delivering cost-competitive CCS projects in the UK  
in the 2020s?**

**Conference Room, Mary Sumner House, London. SW1P 3RB  
15th October 2015**

The APGTF, (Advanced Power Generation Technologies Forum), CCSA, (Carbon Capture and Storage Association), the KTN, (Knowledge Transfer Network) and the UK Carbon Capture and Storage Research Centre, (UKCCSRC), together with the Coal Research Forum, organised and funded a joint workshop on Thursday 15<sup>th</sup> October 2015 at Mary Sumner House in London to identify innovative research and development solutions to support the next generation of Carbon Capture and Storage, (CCS), projects in the UK. This event was well attended by over 100 participants representing virtually all of the stakeholders with interests in CCS in the UK, including power generation companies, energy intensive industrial organisations, technology providers, academics and associated supply chain companies and funders.

The aims of this collaborative meeting were to build on work done previously by the APGTF, CCSA Technical Working Group and UKCCSRC, where this event gave an opportunity for industry and academia to consider the lessons learnt from successful CCS projects and to work collaboratively to steer the future CCS R&D agenda in the UK. This event explored the challenges associated with second and third generation CCS projects and how research and development could help to solve these challenges, reduce costs and support the development of a sustainable supply chain. This conference brought together a wide range of participants to consider these key priority areas for CCS R&D spend in the UK.

As a background to this event, in the previous year, (November 2014), stakeholders from the UKCCSRC and CCSA came together to discuss the Government's approach to funding CCS R&D. The Government at the time had placed great emphasis on low carbon energy technologies competing on price as a means of securing best value for money for consumers. In practice this meant that all low carbon technologies would need to demonstrate rapid cost reductions in order to secure a future share of the UK market. For CCS the challenge was more apparent given the complete absence of operating commercial scale projects in the UK. This was despite clear evidence from the ETI and Committee on Climate Change demonstrating the value of CCS to the UK energy system.

Participants at the 2014 workshop agreed that there was a need for all in the CCS community to be focused on meeting the dual challenges of supporting efforts to deliver commercial-scale operational projects and to demonstrate a clear cost-reduction trajectory. This included a recognition that R&D activities could be prioritised in order to give greater emphasis to projects that could help support achieving these objectives in the short-medium term (e.g. next decade).

Following the November 2014 workshop, a draft list of priorities was developed in consultation with a wide range of stakeholders and circulated for comment by the CCSA, APGTF and UKCCSRC. This current conference was therefore designed to bring a wider group of stakeholders into the discussion, to test the validity and credibility of thinking to date and to improve upon the current list of priorities.

The themes covered by this event include:

- The role of R&D in delivering early cost-reductions for commercial-scale CCS projects
- R&D priorities for CO<sub>2</sub> capture
- R&D priorities for R&D priorities for CO<sub>2</sub> transport and storage
- Project selection criteria and metrics

- Future for CCS in the UK

The CRF was represented by Dr. Kris Milowski, Portfolio Manager-Energy of the University of Sheffield, who gave a presentation on the Coal Research Forum and CCS research needs. Nearly all of the presentations from this event can be found on the CRF website, [www.coalresearchforum.org](http://www.coalresearchforum.org) and a joint document, "UK R&D priorities for Carbon Capture and Storage (CCS)" will also be published on the CRF website.

### **Energy and Climate Change Committee Future of CCS in the UK – Hearing 20<sup>th</sup> January 2016**

In the wake of the November announcement of the cancellation of the CCS Competition, the House of Commons Energy and Climate Change Committee (ECCC) has instigated an inquiry into the future of CCS in the UK. The ECCC held the hearing on 20 January 2016 morning. Giving evidence were UKCCSRC Director Professor Jon Gibbins and Richard Simon-Lewis (Financing Director, Capture Power) Luke Warren (Chief Executive, CCS Association), Chris Littlecott (Programme Leader, Fossil Fuel Transitions and CCS Technology, E3G) and Neil Kenley (Director of Business Investment, Tees Valley Unlimited)

See the transcript at:-

<http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/energy-and-climate-change-committee/future-of-carbon-capture-and-storage-in-the-uk/oral/27178.html>

Also included is a letter which the ETI sent to the Committee Chair, prior to the hearing of 20 January 2016. See link below:-

<http://www.parliament.uk/documents/commons-committees/energy-and-climate-change/ETI-letter-to-Chair-on-Future-of-CCS.pdf>

### **A Welcome to the New Chairman of the Advanced Power Generation, (APG), Division of the CRF.**

The Coal Research Forum is pleased to welcome Dr. Robin Irons of Uniper Ltd., as the New Chairman of the CRF's Advanced Power Generation Division. A further article on this will appear in the next CRF Newsletter, where there are currently early plans for a joint seminar with the Advanced Power Generation Technologies Forum, (APGTF) in the Autumn. The CRF thanks the previous Chairman, Mr. Peter Sage, for his efforts over many years.

### **UKCCSRC Director moving to Sheffield**

From January 2016, the UK CCS Research Centre Director, Jon Gibbins, (also the Chairman of the CRF's Combustion Division), will be taking the position of Professor of Power Plant Engineering and Carbon Capture at the University of Sheffield. Going forwards the UKCCSRC will remain as a virtual centre with inclusive national coverage, with administration operationally the centre will be a dual located with staff at both the University of Edinburgh and the University of Sheffield. See [www.ukccsrc.ac.uk](http://www.ukccsrc.ac.uk) for more details on the UKCCSRC and its activities.

## General News Items

### **Drax to pull out of UK White Rose CCS project when ends**

25<sup>th</sup> September 2015

UK power producer Drax said on Friday it would not invest further in the White Rose carbon capture and storage (CCS) project when it is completed and will then withdraw as a partner in the developer Capture Power Ltd.

The project, aimed at proving CCS technology on a commercial scale, is due to end in six to 12 months. It is exploring the feasibility of capturing 90 percent of carbon emissions from a new coal-fired power station next to Drax's existing power plant in Yorkshire and storing them under the North Sea. When the project has ended, Drax will not invest further but will make the site, which it owns, and the power plant infrastructure available for the project to be built.

"This is for us a sad decision but ultimately investment is about choices and we are in a very different financial situation today than we were two years ago when we decided to invest in the project," Drax Chief Executive Dorothy Thompson told the BBC radio. "There have been changes to the government's renewable policy but there have also been dramatic movements in the commodity markets and that has greatly reduced our profitability," Thompson said. Other partners in Capture Power are energy technology firm Alstom and industrial gas supplier BOC, which is part of the Linde Group.

Capture Power said it was still committed to delivering the CCS project and a final investment decision will depend on the outcome of an engineering and design study. Britain, along with many other countries, will need CCS to help meet its emissions reduction targets if it is still running fossil fuel power generation plants.

The British government has committed 1 billion pounds (\$1.5 billion) for two CCS projects - one at a coal plant and one at a gas plant which is being developed by Shell and SSE and which could be operational by the end of the decade.

In general, CCS technology has so far failed to live up to early hopes of wide adoption. After many years of research, Saskatchewan Power opened the world's first coal-fired power plant retrofitted with CCS last year, but European utilities have struggled.

(Reporting by Nina Chestney; additional reporting by James Davey; editing by David Clarke)  
Source:-

<https://uk.news.yahoo.com/drax-pull-uk-white-rose-ccs-project-completed-061939120--finance.html>

### **IEA CCC criticises UK government energy plan**

**Jonathan Rowland, World Coal Association**

20<sup>th</sup> November 2015

With only a passing reference to carbon capture and storage (CCS) in UK Energy and Climate Change Secretary Amber Rudd's recent speech laying out the UK's energy development plan for the next decade, the UK's CCS industry risks falling into irrelevance, according to the IEA Clean Coal Centre (IEA CCC).

"At one time the UK was a leader in the development of CCS," said the centre in a press release. "We know the government has recently given its support for CCS projects, such as £4.2 million for research and feasibility work for a proposed 570 MW CCS coal-gasification power station in Grangemouth, Scotland, awarded in March this year. However, it will certainly be hard to promote and sell the technology abroad if there is no commercial deployment in the UK."

Instead, the IEA CCC argues that the construction of CCS demonstration plants should proceed promptly, pointing out that, when combined with ultra-supercritical technology, CCS-equipped coal-fired power plants have lower emissions than unabated gas-fired plants.

"Building unabated gas-fired power stations locks the UK in to substantial emissions from fossil fuels for possibly the next 40 yr," continued the IEA CCC. "The IEA CCC published a report this year comparing the greenhouse impact of coal and gas. It found that, if the rate of methane leakage is more than 3% during the upstream sourcing and processing of natural gas, then the climatic benefit of substituting gas for coal is negated.

As an example of the potential CCS could play in helping the UK meet its climate targets, the IEA CCC highlighted the White Rose CCS project in Yorkshire as having the potential to not only provide very-low CO<sub>2</sub> emitting coal-fired power but also acting as a CCS hub, allowing neighbouring industries to also capture a store their CO<sub>2</sub> via that White Rose pipeline.

The IEA CCC also noted the lack of any mention of biomass in the minister's speech. Biomass can have "a significant impact on CO<sub>2</sub> emissions when co-fired with coal," the IEA CCC said. "The conversions at Drax have cut emissions of CO<sub>2</sub> by 12 million t/yr for example. Biomass also has the advantage over other renewables in that it is not intermittent and can use the massive grid infrastructure that is already in place for coal-fired power plants."

### **COP21: What does the Paris climate agreement mean for me? 14<sup>th</sup> December 2015**

As the euphoria of delegates at the UN climate talks in Paris fades, it is time to get down to the business of saving the planet and ask what does it mean for me? Over the past two weeks, almost every nation on the planet has sent a team of negotiators to Paris to pore over page after page of nuanced jargon peppered with what seemed like a world record attempt for the most square brackets in a document. But these brackets did matter. In the tense talks at a conference centre in north Paris, semantics was king.

Negotiators inhabited a world where "shall" would result in something becoming legally binding and "should" actually meant voluntary, as BBC environment analyst Roger Harrabin explained here.

The fortnight kicked off with more than 150 world leaders, including Presidents Obama, Putin and Xi, descending on Paris to tell delegates that climate change was the most important issue facing us in the 21st Century. Whether that was welcome support or unnecessary pressures it meant negotiators got down to business, often working through the night. On Saturday evening - to claps, cheers and tears - a new landmark deal was born. It was agreed by 195 nations. They will attempt to cut greenhouse gas emissions to a level that will limit the global average temperature to a rise "well below" 2C (3.6F) compared to pre-industrial levels - a level of warming deemed to be the point when dangerous climate change could threaten life on Earth.

Mark Kinver, BBC News

Source:- <http://www.bbc.co.uk/news/science-environment-35092127>

### **COP 21 - What does it mean for the UK? 15<sup>th</sup> December 2015**

The UK entered COP21 negotiations on the back of an ambitious commitment to close all coal power stations by 2025, even if it was somewhat tainted by domestic policy confusion. Energy Secretary Amber Rudd, who led the UK delegation in Paris, has spent the last eight months repositioning the national debate away from decarbonisation to one of energy security and consumer value for money.

While she has consistently maintained that the UK is a global leader in championing the low-carbon economy and renewable energy, she has simultaneously cut a raft of low-carbon subsidies and energy efficiency schemes at the cost of dwindling investor confidence. In this sense the Paris deal, which calls on just under 200 countries to keep global temperature increase “well below” 2°C and to pursue efforts to limit it to 1.5°C, does not change the reality that investing in UK energy infrastructure is a risky undertaking. Perhaps the greatest illustration of this came in the 24 hours before the final agreement was published, when National Grid announced subsidy payments of £294 million will be made to polluting diesel generators and aging coal power stations from 2019.

As unsettling as this sounds, the UK’s adoption of the Climate Change Act in 2008 has committed successive governments to cutting national carbon emissions by 80% of 1990 levels by 2050, which is an obligation 33% more demanding than the pledge put forward at COP21 by the whole of the EU bloc. The announcement in November of the Fifth Carbon Budget reminds us that the Department for Energy & Climate Change is under pressure to ensure emissions are cut by 60% of 1990 levels by 2032, and will have to enshrine this in law no later than June 2016. The question is what the 1.5°C element of the Paris deal will have on UK carbon targets, something the Government’s advisory body, the Committee on Climate Change, has already been tasked with investigating. The likelihood is that Chancellor George Osborne will no longer be able roll back low-carbon projects on the premise they place the UK at an economic disadvantage.

Whether true in practice, the UK already operates one of the strictest emissions frameworks in the world. Binding EU targets, such as the obligation to generate at least 15% of energy from renewable sources by 2020, place further pressure on the Government to pursue ever greater commercial decarbonisation through low-carbon building standards, energy efficiency measures, and more robust renewable heat networks and transport fuels. Each of these areas will require significant private sector investment going forward.

However, the Government has also shown itself willing to make concessions to business in the name of competition with a tax relief and compensation package to help shield energy intensive industries, such as heavy manufacturing, from environmental levies. This will be achieved by offsetting the indirect costs of the carbon price floor, currently £18.08 per tonne of CO<sub>2</sub>, and the EU Emissions Trading Scheme (ETS). In his Paris speech, Prime Minister David Cameron sent a conciliatory message to investors by suggesting that the UK hasn’t “even really begun to generate the private finance that is possible to help in tackling climate change”. His words will likely be borne out through a series of Government schemes, such as the recent commitment to spend £500 million on innovation over the next five years to ensure that clean-tech and R&D remain viable business spaces.

Looking to 2016, the March Budget will be the first chance for the Government to make financial decisions deemed necessary in the light of the Paris agreement and investor unrest. These could include a post-2020 renewable energy subsidy framework and therefore new opportunities for investors, or, indeed, a decision on the future of long-term financial support for fossil fuels. Furthermore, if a referendum on the UK’s EU membership is to take place in the summer or autumn, even a so-called ‘Brexit’ would be no justification for the Government to renege on its existing emissions commitments.

Therefore, while COP21 may not have in the first instance placed any significant new demands on the UK Government, ministers will face heightened pressure to steady the ship for investors while also developing a coherent energy strategy that promotes decarbonisation and welcomes business with open arms.

Mike Jones, Edeleman

Source:- <http://www.edelman.co.uk/magazine/posts/cop21-what-does-it-mean-for-the-uk/>



## **Europe needs to backtrack on its big climate ambitions**

**(or what does COP21 means for the EU)**

**15<sup>th</sup> December 2015,**

**Brian Ricketts**

History was made at the U.N. climate talks in Paris last Saturday evening with a well-planned show. If emotional fervour could power the planet, then COP21 provided us with enough energy to keep the lights on for the next 100 years. But wait, there's a last-minute problem.

The U.S. has said "no" to any binding emission-reduction targets in the closing minutes of COP21, when "shall" became "should" in Article 4.4. Now there are no binding targets for developed or developing nations, except for the 28 member states of the European Union. The EU and the EU alone has agreed to emission reduction targets (Article 4.18). That wasn't how the show was supposed to end; the EU was supposed to lead the world on climate action. The reality is that we don't lead the world and must now get back to the business of wealth creation to rebuild our global standing.

The U.N. portrays fossil fuels as public enemy number one, and wants to see an end to the fuels that have enabled great progress over the last 250 years. It would do this by diktat, if allowed, but Paris shows us that other nations are not ready to accept any emission reduction targets. The U.N. believes that we can switch away from fossil fuels and thereby make deep cuts in greenhouse gas emissions: Renewables are the answer, they say, and the U.N. wants Africa to become the poster child of sustainable development, using renewable energy sources, all paid for by us in the developed countries.

According to former MEP Caroline Lucas, (Greens/EFA, U.K.), "Renewables are already massively coming down in price and within a very few years solar energy, for example, will be totally competitive with fossil fuels, indeed will probably be cheaper than fossil fuels."

This would be fantastic news, because free markets would then deliver what everyone wants. If this prophesy were true, the U.N. Framework Convention on Climate Change could be declared a spent force and the EU could abandon its climate targets. The coal industry would happily roll over and die, if overtaken by a cheaper and better alternative energy source. Right now, we don't see any such alternative.

The European Commission must now get back to basics. DG Climate Action staff can help build a modern Europe, based on a fair and competitive energy market — the greatest strength of our European Union. In their future work, they should consider only whether they are helping to create added value and jobs in Europe.

To begin with, the EU needs to backtrack on its ambitious "intended nationally determined contribution" with its 40 percent greenhouse gas reduction target for 2030, as submitted to the U.N. in March 2015. It must do this before April 22, 2016, when the agreement is ratified.

Last year, EURACOAL suggested that a lower, 30 percent target for 2030 would give more leverage with other nations: They would see how a balanced mix of energy sources could be used cleanly and efficiently to fuel growth.

However, if other nations see the EU flounder under the deadweight of worthless targets, then we will never be seen as a leader, only as a bit player. The Paris Agreement is thus an opportunity for the EU to rethink its mission. Saving the planet was perhaps too ambitious. Saving Europe is more important.

Brian Ricketts Secretary General EUROCOAL

<http://www.politico.eu/article/europe-needs-to-backtrack-on-big-climate-ambitions-cop21-deal-global-warming/>

## **IFRF relocation 14<sup>th</sup> December 2015**

A special meeting of the IFRF's Joint committee was held last week at the offices of IFRF Member Organisation Fives, in Paris. Two Business Plans supporting the relocation of IFRF from Livorno to either Sheffield (UK) or Essen (Germany) were presented by the two prospective candidates for the position of IFRF Director. Philip Sharman presented a Sheffield University Business plan, while Joerg Leicher presented a Business Plan on behalf of Gas-und Wärme Institut Essen (GWI). Both proposed locations and both proposed Directors met with universal approval of the IFRF Joint Committee, which brought together seven out of eight National Committee representatives, as well as the Officers and technical advisors (B Members). After a lively debate with JC Members speaking in favour of both Business Plans, a majority decision selected the University of Sheffield and its PACT laboratory as the preferred new location, with Philip Sharman as the incoming Director. At the same time, the GWI proposal offers people and facilities that would be a great asset to IFRF, and IFRF will be working with GWI and Sheffield University to create a strong package of Officers, personnel and facilities to take the IFRF forward. Outgoing Director, Neil Fricker, will present further progress with the handover as it occurs during the early part of 2016.

Source of article:-

<http://www.mnm.ifrf.net/mnm/article.html?aid=1488>

### **Newsletters from other organisations**

The IEA Clean Coal Centre Newsletter for October 2015 (issue No.88) is available below:-

<http://www.iea-coal.org.uk/site/2010/publications-section/newsletter>

EU Energy Focus Newsletter December 2014 is available below:-

<http://www.euenergyfocus.co.uk/newsletter>

EERA Bioenergy Newsletter Issue 5 December 2015 is available below:-

<http://eera-bioenergy.eu/resources/EERA%20Bioenergy%20News%20Issue%205%20v1.pdf>

Carbon Storage Newsletter for December 2015 is available below:-

<http://www.netl.doe.gov/File%20Library/Research/Coal/carbon-storage/Reference%20Shelf/news/2015/12-15.pdf>

The British Carbon Group Newsletter No. 48 December 2015 is available below:-

<http://www.britishcarbon.org/newsletters/CarbonNewsletterDec2015.pdf>

### **SUMMARIES 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.

#### **Researchers invent a wastewater tech that captures carbon and produces clean energy**

**19<sup>th</sup> August 2015, Stephen Lacey, Green Techmedia**

Cleaning up municipal and industrial wastewater can be dirty business, but engineers at the University of Colorado-Boulder have developed an innovative wastewater treatment process that not only mitigates carbon dioxide (CO<sub>2</sub>) emissions, but actively captures greenhouse gases as well. The treatment method, known as microbial electrolytic carbon

capture (MECC), purifies wastewater in an environmentally friendly fashion by using an electrochemical reaction that absorbs more CO<sub>2</sub> than it releases while creating renewable energy in the process.

<https://www.greentechmedia.com/articles/read/researchers-invent-a-wastewater-tech-that-captures-carbon-and-produces-clea>

### **'Diamonds from the sky' approach turns CO<sub>2</sub> into valuable products**

**19<sup>th</sup> August 2015, unattributed, Science Daily**

Finding a technology to shift carbon dioxide, the most abundant anthropogenic greenhouse gas, from a climate change problem to a valuable commodity has long been a dream. Now, a team of chemists says they have developed a technology to economically convert atmospheric CO<sub>2</sub> directly into highly valued carbon nanofibers for industrial and consumer products. For more visit:-

<http://www.sciencedaily.com/releases/2015/08/150819083117.htm>

### **China CO<sub>2</sub> emissions: 'Coal error' caused wrong calculations**

**19<sup>th</sup> August 2015, Matt McGrath, BBC News**

Confusion over the types of coal being burned in Chinese power stations has caused a significant overestimation of the country's carbon emissions. Researchers, published in the journal Nature, say existing CO<sub>2</sub> calculations had used a globally averaged formula. But when scientists tested the types of coal actually being burned in China, they found they produced 40% less carbon than had been assumed. The study says the error amounted to 10% of global emissions in 2013.

China's drive for economic growth over the past 15 years has seen the rapid expansion of coal burning for the production of energy. Indeed, the widely quoted statistic about the country building a new coal power station every week was actually exceeded in 2006, when one and a half such plants were constructed on average. That rate of expansion has fallen away but this reliance on coal means that China's emissions of carbon dioxide topped the rest of the world for the first time back in 2007, a position it has retained ever since. For more visit:-

<http://www.bbc.co.uk/news/science-environment-33972247>

### **Soaking up carbon dioxide and turning it into valuable products**

**27<sup>th</sup> August 2015, unattributed, Science Daily**

Researchers have incorporated molecules of porphyrin CO<sub>2</sub> catalysts into the sponge-like crystals of covalent organic frameworks (COFs) to create a molecular system that not only absorbs carbon dioxide, but also selectively reduces it to CO, a primary building block for a wide range of chemical products. For more visit:-

<http://www.sciencedaily.com/releases/2015/08/150827154411.htm>

### **Cost-effective catalyst converts CO<sub>2</sub> into natural gas**

**1<sup>st</sup> September 2015, unattributed, Science Daily**

A discovery made in Leiden helps not only to make natural gas from CO<sub>2</sub> but also to store renewable energy. Research by Professor Marc Koper and PhD student Jing Shen shows how this process can be implemented in a cost-effective and controllable way.

For more visit:-

<http://www.sciencedaily.com/releases/2015/09/150901140855.htm>

### **Newcastle and Durham University fracking study looks at history of UK earthquakes**

**9<sup>th</sup> September 2015, Tony Henderson, Chronicle Live**

A study of past UK earthquakes has been carried out by North East experts ahead of any future decisions around fracking operations. The work reveals that since 1999, an average of at least three onshore earthquakes a year with local magnitude greater than or equal to 1.5 - the minimum detectable threshold - were as a result of human activity.

The research was carried out by Researching Fracking in Europe, an independent research consortium focusing on the issue of shale gas and oil exploitation using fracking methods. Newcastle and Durham universities were involved in the project. Research lead Professor Richard Davies, of Newcastle University, said: "Earthquakes triggered or induced by humans are not a new concept in the UK, but earthquakes related to fracking are.

"Understanding what the current situation is and setting a national baseline is imperative, otherwise how can we say with any confidence in the future what the impact of fracking has been nationwide? "What this research shows is that in recent years, an average of at least three earthquakes a year, with local magnitudes greater than or equal to 1.5, are as a result of human activity. "If widespread exploitation of the UK's shale reservoirs is granted and numbers consistently rise then, in conjunction with local monitoring data, we should be able to confidently demonstrate a causal link." The first human-induced earthquake in the UK probably occurred in 1755 due to the collapse of lead mines in Derbyshire. For more visit:- <http://www.chroniclelive.co.uk/news/north-east-news/newcastle-durham-university-fracking-study-10016729>

### **Study finds CO2 storage 'can be boosted' in North Sea**

**10<sup>th</sup> September 2015, unattributed ,BBC News**

A new technique for securing and storing carbon dioxide could help to unlock the North Sea's "vast" CO2 storage potential, researchers claim. Experts around the world have been looking to develop techniques for Carbon Capture and Storage (CCS). This involves storing CO2 greenhouse gas emissions captured from power plants and industrial facilities in geological formations under the sea. Researchers said their new technique could store greater volumes of CO2. Project partners behind the CO2MultiStore study include Scottish Carbon Capture and Storage (SCCS), the Scottish government, the Crown Estate, Shell, Scottish Enterprise and Vattenfall. For more visit:-

<http://www.bbc.co.uk/news/uk-scotland-scotland-business-34199773>

### **RWE secures German consent for commissioning 1.6GW Dutch coal-fired Eemshaven power plant**

**10<sup>th</sup> September 2015, unattributed, Power technology**

German energy major RWE has gained environmental consent for developing a 1.6GW coal-fired power plant at Eemshaven in the Netherlands. The approval, issued by a Dutch court, clears the way for commissioning the power plant, which involves an investment of €3bn (\$3.36bn), reports Reuters. Once operational, the thermal power facility is expected to generate enough electricity for two million German and Dutch homes.

"Once operational, the thermal power facility is expected to generate enough electricity for two million German and Dutch homes." Delivering an efficiency of more than 46%, the facility is claimed to be one of the world's most modern power stations. Construction of the facility, which was scheduled to be operational in 2014, was started in 2008. Commissioning of the facility was delayed over environmental concerns about its development near nature reserves, including mud flats and islands off the Dutch and German North Sea coast.

Greenpeace and other environmental groups filed objections over the issues in a Dutch court for the development across a 50ha at the Eemshaven port. Carbon dioxide emissions from the coal-fired facility were also an issue Greenpeace opposed. Both German and Dutch governments are in support of the thermal power project, since Germany intends to end nuclear power production by 2020, and the Netherlands will struggle owing to a decline in natural gas resources. According to RWE's Dutch subsidiary Essent, coal is a relatively cheaper fuel for power generation and can be derived in large quantities from politically stable countries.

Source:- <http://www.power-technology.com/features/feature-largest-nuclear-power-plants-world/>

## **Southern Ocean sucks up 1.2bn tonnes of carbon in 2011 and buries it deep**

**11<sup>th</sup> September 2015, Oliver Milman, The Guardian**

The Southern Ocean has started to absorb more greenhouse gases after a period when the vast ocean's uptake had slumped by about a half, a study has found. The ocean's role as a crucial carbon "sink" appeared to be waning throughout the 1990s, but after 2002 it began to rebound to its previous level, absorbing 1.2bn tonnes of carbon in 2011.

This enormous uptake, double that of its lowest point in the 1990s, is roughly equivalent to the European Union's annual carbon output. The huge Southern Ocean, which encircles Antarctica, accounts for 40% of all the carbon soaked up by the world's oceans. In turn, all the oceans suck up a quarter of all the carbon emitted through human activity, including burning fuels such as coal, gas and oil. Research by scientists based in Switzerland, France, the US and Australia, published in Science, found the Southern Ocean had "regained its expected strength". Changes in winds and temperatures were given as a reason. Its gargantuan carbon intake is due to its pattern of seawater circulation, which effectively takes carbon from the surface and buries it deep underwater. For more visit:-

<http://www.theguardian.com/environment/2015/sep/11/southern-ocean-sucks-up-12bn-tonnes-of-carbon-in-2011-and-buries-it-deep>

## **Chinese coal data cast doubt on historic stalling of world CO2**

**15<sup>th</sup> September 2015, Alistair Doyle and David Stanway, Yahoo News**

When the International Energy Agency reported in March that global carbon emissions had stayed flat in 2014, even as the world economy grew, the news was hailed as a turning point in the struggle to curb climate change. But more recent data about Chinese coal consumption, seen by Reuters, raise doubts about whether that historic decoupling of economic growth and carbon emissions from energy use actually occurred.

One of the keys to keeping carbon emissions flat in 2014 was significantly lower coal consumption in China, the world's top greenhouse gas emitter: a 2.9 per cent drop, reported in preliminary Chinese data in February. It was the first fall in coal use by China this century. And it was good news for the U.N. climate conference meeting in Paris in December with the aim of stopping temperatures rising more than 2 degrees Celsius (3.6 Fahrenheit) above pre-industrial levels: the limit beyond which scientists say the world will suffer ever-worsening floods, droughts, storms and rising seas. But in May, China's National Bureau of Statistics (NBS) released a China Statistical Abstract, not available online but only on paper, showing that coal consumption edged up by 0.06 percent from 2013. Just that difference between two sets of NBS data would in turn lift global emissions growth in 2014 from a flat line to about 0.5 per cent, in line with an estimate by oil company BP in a report in June.

That global growth rate is still low, but would undermine the arguments of many, from environmental groups to governments, who have cited the IEA data to support the idea that cuts in carbon use need not necessarily hamper economic growth. When the IEA report first came out, the agency issued a statement trumpeting that carbon emissions from energy had stalled in 2014, marking "the first time in 40 years in which there was a halt or reduction in emissions of the greenhouse gas that was not tied to an economic downturn."

For more visit:- <http://news.yahoo.com/exclusive-chinese-coal-data-cast-doubt-historic-stalling-141026238.html>

## **Carbon capture 'essential' for climate-friendly fracking in UK, says industry-backed report**

**16<sup>th</sup> September 2015, Simno Evands, Carbon Brief**

While CCS need not be a prerequisite for exploratory drilling, it will be “essential” if fracking develops at scale, says the report on the impact of shale gas on climate change. It also recommends that fracking tax revenues be used to fund renewables research and development. This is the third report from the industry-funded Task Force on Shale Gas. Carbon Brief measures its approach on fracking and climate change against previous reports.

The report's 32 pages don't directly answer the question of whether there is space for UK shale gas to be exploited within the UK's legally binding carbon budgets. They also pay scant regard to the global context of the internationally agreed 2C limit for avoiding dangerous warming. Instead, the report poses a series of rhetorical questions that lead the reader towards its conclusion: that UK shale gas can be part of a transition to a low-carbon future, as long as CCS is developed and fracking revenue is used to boost low-carbon energy research.

For instance, the report asks whether renewables can meet the UK's entire energy demand in the short term. It says they can't, yet this conclusion is uncontroversial and most analysts would agree. Rather than the size of the UK's carbon budgets, the starting point for the report is to consider the role of gas in the UK energy mix — including in future scenarios based around reducing emissions.

Gas currently supplies around a third of the UK's energy, it says, pointing to data from the Department for Energy and Climate Change (DECC). Home heating and cooking take the largest share, with electricity generation accounting for a minority of total UK gas use. The report then goes on to consider how much gas will be needed in future. It looks at a range of international scenarios and UK projections from National Grid, the Energy Technologies Institute and the UK Energy Research Centre (UKERC), only some of which comply with carbon budgets.

The report says they show a need for gas for “several decades”, with “all scenarios expecting gas to play a significant role, globally and in the UK, between now and 2050”. What does “significant” mean? The 2013 UKERC report says unabated gas without CCS can only act as backup generation after 2030, if the UK is to stay within its carbon budgets. It adds that homes will use “almost no natural gas” by 2050. For more visit:-

<http://www.carbonbrief.org/carbon-capture-essential-for-climate-friendly-fracking-in-uk-says-industry-backed-report>

## **Puffed wood pellets hold promise for coal power plant conversions**

**16<sup>th</sup> September 2015, Bill Esler, Woodworking Network**

A Michigan firm says it will bring to market a biomass conversion process that transforms wood waste and other vegetation into material that burns well with coal. Developed by Biomass Energy Enhancements, the new process overcomes limitations of standard pelletising wood and thermal drying, which can leave polluting toxic salts and energy-dampening moisture in the biomass.

Munro & Associates says it has been working with Biomass Energy Enhancements and UK-based and AIM-listed Active Energy Group Plc to bring to market what it terms the first sustainable biomass fuel. Since it can be used in traditional coal-fired plants as a co-mixed fuel or independently without changing the infrastructure of the plant, it eliminates hundreds of millions of dollars in conversion costs. Current coal-fired plants can reduce pollution emissions by transitioning to the new fuel, Munro says.

Other processes that have been used in the past, such as simple compaction and thermal drying, either leave a high level of toxic salts in the biomass creating pollution and frequent maintenance issues or leave too much intercellular moisture reducing the effective energy

release from the fuels. BEE's process "explodes" the fibers like popcorn and exposes the intra-fiber moisture and soluble salts which can then be easily removed. This new process allows biofuels to be generated from materials that would not have been suitable or viable before, such as reclaimed waste wood, and diseased and invasive crops or trees.

A further benefit is that the final product is also hydrophobic, which not only prevents possible reabsorption of moisture that would degrade the fuel, but it subsequently reduces distribution, transportation and storage costs. For more visit:-

<http://www.woodworkingnetwork.com/news/woodworking-industry-news/popcorn-biomass-holds-promise-coal-power-plant-conversions>

## **Israeli firm in final talks for CO<sub>2</sub>-to-fuel test at coal power plant**

**17<sup>th</sup> September 2015, Tsvetomira Tsanova,**

Israeli clean energy firm NewCO<sub>2</sub>Fuels Ltd (NCF) is in final discussions to install and test its technology for the conversion of carbon dioxide emissions into fuel at a large industrial coal-fired power plant. Australian firm Greenerth Energy Ltd (ASX:GER), which holds a minority stake in the Israeli company, said in an update on Thursday that NCF is in talks with a large corporation for the project, without disclosing the name or location.

The NCF engineering team has progressed the design and development of its first large-scale pilot plant. It will have two commercial reaction units able to turn around 160 tonnes carbon dioxide (CO<sub>2</sub>) annually into fuel and oxygen. It will have a CO<sub>2</sub> processing capacity equal to the CO<sub>2</sub> absorption capacity of roughly 6,000 mature trees, according to Greenerth Energy's statement.

<http://renewables.seenews.com/news/israeli-firm-in-final-talks-for-co2-to-fuel-test-at-coal-power-plant-493327#>

## **Closer look reveals true cost of coal**

**17<sup>th</sup> September 2015, unattributed, Science Daily**

The cost of coal use is greater than it seems and policies geared toward subsidizing its use must be reformed quickly, before countries invest in coal-fired plants, Ottmar Edenhofer argues in this Perspective. The costs of generating electricity from wind and solar power have declined substantially in recent years, but coal still remains the cheaper option.

Some major emitters such as China and the US have pledged to reduce their dependence on fossil fuels over the next few decades to mitigate climate change -- yet this will only cause world market coal prices drop, making coal more appealing to developing countries that are only now beginning to invest in long-term energy infrastructure. Yet this will only make world market coal prices drop, making coal more appealing to developing countries that are only now beginning to invest in long-term energy infrastructure. But what is the true cost of coal?

As Edenhofer points out, governments around the world heavily subsidize fossil fuels, and in 2013 pre-tax subsidies amounted to about \$550 billion US worldwide. These substantial subsidies not only drain funds that could be used for other purposes, such as sanitation and poverty reduction, but discourage investments in low-carbon alternatives.

Furthermore, a recent report by the International Monetary Fund quantifies substantial additional costs of burning fossil fuels, such as local air pollution and other adverse side effects of vehicle use. Thus, the cost of coal usage can be deceptively low, and understanding the true costs -- before long-term energy infrastructure is built -- is essential, Edenhofer concludes. For more visit:-

[http://www.sciencedaily.com/releases/2015/09/150917160048.htm?utm\\_source=feedburner&utm\\_medium=email&utm\\_campaign=Feed%3A+sciencedaily%2Fmatter\\_energy%2Ffossil\\_fuels+%28Fossil+Fuels+News+---+ScienceDaily%29](http://www.sciencedaily.com/releases/2015/09/150917160048.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy%2Ffossil_fuels+%28Fossil+Fuels+News+---+ScienceDaily%29)

## **Will the UK phase out coal in a decade?**

**18<sup>th</sup> September 2015, Karl Mathiesen, The Guardian**

The government is wrong to assume its existing policies will be enough to phase out coal power in the UK, analysts have told the Guardian. Minister for energy and climate change Andrea Leadsom said this week that her department expected unabated (meaning without carbon capture) coal would make up just 1% of the country's electricity generation by 2025. Referring to a Department of Energy and Climate Change (Decc) report from September last year, Leadsom said the decline would occur "as a result of deployment of low carbon alternatives, the cost of generation and the investment needed to meet new pollution abatement standards".

But this prediction is not reinforced by a mandatory end date for electricity generation from coal. Despite rhetoric from the prime minister and his ministers that coal needs to go, the government has been reluctant to set a timeline for the phase-out of the most carbon intensive fossil fuel. Robert Gross, director of Imperial College's Centre for Energy Policy and Technology, said relying on existing policies and the market for cleaner technologies left the door open for coal generation to continue beyond 2030. "There's a considerable range of uncertainty about how much coal will be retained on the system. And if it's at the upper end of the range of possibilities then its going to absolutely blow the carbon budget," he said.

A 2014 report prepared by Gross found that the range of coal generation expected to remain on the system was dependent on the price of carbon set by the government in future. With a low carbon price, coal would continue to provide 19% of electricity in 2025, down from roughly a third in 2013. A high carbon price would reduce coal generation to 3%.

For more:-

<http://www.theguardian.com/environment/2015/sep/18/will-uk-phase-out-coal-in-decade>

## **Underground coal gasification worth £13bn to UK**

**21<sup>st</sup> September 2015, unattributed, Proactive Investors**

Cluff Natural Resources' underground coal gasification (UCG) plans have been boosted by an independent economic consultant, which highlighted potential long term economic benefits for the UK. The report, produced by Biggar Economics, claimed some £12.8bn could be added to the UK economy over the long term.

The nascent industry could create 7,500 new jobs on average, the report says, with a peak of about 11,900 jobs. UCG, which converts in-situ coal deposits into gas, could fuel a new generation of gas-fired power stations, according to the report. And the report added that, if the gas is used as a feedstock, it could safeguard jobs in the UK's chemical industry.

Focusing specifically on CLNR's Kincardine licence, Biggar Economics stated that the project could generate a 'total benefit' of around £600m and could support more than 350 jobs. "The findings of this report highlight the huge potential for the development of a UCG industry in the UK," said chief executive Algy Cluff. "UCG has a vital role to play in the diversification of the UK's energy mix and its long term security and this report demonstrates how the development of UCG would create significant benefits for the UK economy." Broker Panmure reckons today's report further highlights the potential benefits from the development of UCG in the UK and the firm's leading role in that process. "However, the company indicated at the 1H15 results stage that it needs more support from the Scottish government before committing fully to the expense of an environmental impact study for a pilot project at Kincardine," said analyst Colin Smith.

<http://www.proactiveinvestors.co.uk/companies/news/110950/underground-coal-gasification-worth-13bn-to-uk-report-says-110950.html>



## **UK-China research centre to address energy challenges**

**15<sup>th</sup> October 2015, Beckie Smith, The PIE News**

The University of Nottingham and the Shanghai Advanced Research Institute have launched a new research centre to find low-carbon solutions to some of the world's most pressing energy and environmental challenges. The new £1m Joint Centre on Low Carbon Research will aim to create a bridge between China and the Midlands county of England, where the UK government's £60m Energy Research Accelerator – a research institute formed of six UK universities including Nottingham and the British Geological Survey – will be based.

<http://thepienews.com/news/uk-china-research-centre-to-address-energy-challenges/>

## **New crystal captures carbon from the air, even in the presence of water**

**15<sup>th</sup> October 2015, unattributed, Science Daily**

A new material with micropores might be a way to fight climate change. Scientists have created crystals that capture carbon dioxide much more efficiently than previously known materials, even in the presence of water. The research was recently published in a report in the scientific journal *Science*. For more visit:-

<http://www.sciencedaily.com/releases/2015/10/151015144806.htm>

## **IEA report on benefits of coal is 'deeply misleading'**

**23<sup>rd</sup> October 2015, Damian Carrington, The Guardian**

A coal industry report due to be published by the International Energy Agency (IEA) on the benefits of new coal-burning technology has been heavily criticised by experts. The report, seen by the Guardian, is "deeply confused and deeply misleading" and a "litany of errors and false assumptions, clearly written ultimately as a disinformation tool", according to two financial experts. They said the legitimacy conferred by the respected IEA on the report raised serious questions. For more visit:-

<http://www.theguardian.com/environment/2015/oct/23/iea-report-on-benefits-of-coal-is-deeply-misleading>

## **Deep-sea bacteria could neutralise greenhouse gas, researchers reveal**

**26<sup>th</sup> October 2015, Karla Tecson, International Business Times**

A type of bacteria found at the bottom of the ocean could neutralise large amounts of industrial carbon dioxide in the atmosphere, a U.S. study has found. Researchers from the University of Florida (UF) said that the bacterium called *Thiomicrospira crunogena* produces carbonic anhydrase, an enzyme that helps remove carbon dioxide in organisms. Their findings were detailed in the journals *Acta Crystallographica D: Biological Crystallography* and *Chemical Engineering Science*. The majority of greenhouse gases emitted in the atmosphere are carbon dioxide, which can be captured and neutralised in a process known as sequestration. To convert the carbon dioxide into a harmless compound, a durable, heat-tolerant enzyme is required. That's where the deep-sea bacterium comes into play, according to the researchers. For more:-

<http://www.ibtimes.com.au/deep-sea-bacteria-could-neutralise-greenhouse-gas-researchers-reveal-1477698>

## **China underreporting coal consumption by up to 17%, data suggests**

**4<sup>th</sup> November 2015, Tom Phillips, The Guardian**

China, the world's largest carbon emitter, has been dramatically underreporting the amount of coal it consumes each year, it has been claimed ahead of key climate talks in Paris. Official Chinese data, reported by the New York Times on Wednesday after being quietly released earlier this year, suggests China has been burning up to 17% more coal each year than previously disclosed by the government. For more visit:-

<http://www.theguardian.com/world/2015/nov/04/china-underreporting-coal-consumption-by-up-to-17-data-suggests>

## **Developing proprietary solvent for CO2 capture technology**

**9<sup>th</sup> November 2015, Harleigh Hobbs, World Coal Association**

The Norwegian national program for research, development and demonstration of technology for CO<sub>2</sub> capture, transport and storage technologies for power generation and other industrial sources, CLIMIT-Demo, has approved funding for a project collaboration between a leading carbon capture technology company, ION Engineering, and the Trondheim, Norway based research organisation SINTEF (The Foundation for Scientific and Industrial Research). ION Engineering and SINTEF have joined to collaborate on a project that will focus on the design, construction and demonstration of real-time online analysis of ION's solvent used in carbon dioxide capture. For more visit:-

<http://www.worldcoal.com/power/09112015/Research-collaboration-to-develop-proprietary-solvent-for-CO2-capture-technology-3127/>

## **Coal plants without CCS can meet EPA standards, EPRI study says**

**11<sup>th</sup> November 2015, Thomas Overton, Power**

Certain types of coal-fired power plants are capable of meeting the 636 kg CO<sub>2</sub>/MWh emissions limit in the Environmental Protection Agency's (EPA's) new source performance standards for new plants without relying on carbon capture and storage (CCS), but doing so will require leveraging cutting-edge technologies to improve efficiency, according to a new study from the Electric Power Research Institute (EPRI).

The general assumption underlying the EPA's Clean Power Plan is that coal plants will need to deploy CCS to meet the standards. But CCS development has been both slow and fraught with setbacks. In the study, *Can Future Coal Power Plants Meet CO<sub>2</sub> Emission Standards Without Carbon Capture & Storage?*, the EPRI looked at whether other technologies exist or are in development that could lower CO<sub>2</sub> emissions enough to allow coal plants without CCS to meet the standards. "[T]he answer," says the study, "is a qualified 'yes.'" For more visit:-

<http://www.powermag.com/coal-plants-without-ccs-can-meet-epa-standards-epri-study-says/>

## **First 'porous liquid' invented**

**11<sup>th</sup> November 2015, unattributed, Science Daily**

Scientists at Queen's University Belfast have made a major breakthrough by making a porous liquid -- with the potential for a massive range of new technologies including 'carbon capture'. Researchers in the School of Chemistry and Chemical Engineering at Queen's, along with colleagues at the University of Liverpool and other, international partners, have invented the new liquid and found that it can dissolve unusually large amounts of gas, which are absorbed into the 'holes' in the liquid. The results of their research are published in the journal *Nature*. The three-year research project could pave the way for many more efficient and greener chemical processes, including ultimately the procedure known as carbon capture -- trapping carbon dioxide from major sources, for example a fossil-fuel power plant, and storing it to prevent its entry into the atmosphere. For more:-

<http://www.sciencedaily.com/releases/2015/11/151111143221.htm>

## **UK scientists to lead EU fracking research**

**13<sup>th</sup> November 2015, Priyanka Sreshtha, Energy Live News**

Scientists at the University of Edinburgh are to lead a new EU study on the risks of fracking. The research aims to improve the understanding of geological, mechanical and chemical processes involved in shale gas exploration as part of a three-year project. Fracking, also known as hydraulic fracturing, is a technique of extracting gas or oil from rock formations and involves drilling deep into the ground. The international team of researchers will make recommendations to Member States to develop legislation that mitigates the likely impacts of shale gas exploration and recovery. "Research will be based on collecting data, carrying out experiments and creating computer models of how natural materials respond to fracking stresses. Models will be validated by comparing them with data from fracking sites in the US and proxies in Europe," the university stated. For more visit:-

<http://www.energylivenews.com/2015/11/13/uk-scientists-to-lead-eu-fracking-research/>

## **UK to shut down all coal power plants by 2025, but will remain fossil fuel dependent**

**19<sup>th</sup> November 2015, Lauren McCauley, EcoWatch**

The world's wealthiest nations appear to be slowly acknowledging the destruction that decades of coal burning has wrought on the environment, though campaigners are warning that pledges to curb subsidies and close power plants still fall substantially short of the "radical shift" necessary to keep global warming beneath the stated goal of 2°C. UK Energy Secretary Amber Rudd on Wednesday announced that her country would close all coal-fired power plants by 2025, making it first major global economy to commit to such a plan. For more details visit:-

<http://ecowatch.com/2015/11/19/uk-shut-down-coal-plants/>

## **Future supplies of coal ash are secure**

**21<sup>st</sup> November 2015, unattributed, Agg Net**

UKQAA seeks to reassure construction products industry over security of future supplies. In response to the Government's recent announcement of plans to close all coal-fired power stations by 2025, the UK Quality Ash Association (UKQAA) has issued a statement on ash availability and supply to help reassure the construction products industry. The statements confirms that: ash supplies for the construction industry are plentiful and varied; coal-fired power stations are already producing up to 5 million tonnes annually; annual supply continues to outstrip consumption; and ash recovery programmes offer additional sources of ash.

Dr Robert Carroll, technical director at the UKQAA, said: 'While the planned closures of coal-fired power stations in the UK will have a significant impact on the UK's future energy mix, the UKQAA is confident about the supply of coal ashes (fly ash and furnace bottom ash) for construction products both now and in the foreseeable future. 'The UK's coal-fired power stations produce an average of 5 million tonnes of fly ash a year and annual supply continues to outstrip consumption. Additionally, around 50 million tonnes of stockpiled ash has been amassed over the years. This mostly untapped resource could become a valuable complementary raw material if correctly processed. 'Ultimately, the UKQAA aims to maximize the beneficial use of coal fly ashes over the next decade and support recovery of raw material from ash stockpiles.'

Source:- <http://www.agg-net.com/news/future-supplies-of-coal-ash-are-secure>

## **Coal plant gets green light to burn American wood pellets**

**1<sup>st</sup> December 2015, Emily Gosden, The Telegraph**

One of Britain's dozen remaining coal-fired power plants is to be converted to burn wood pellets shipped in from North America, after the European Commission approved a £1bn subsidy contract for the project. RWE's Lynemouth power station in Northumberland is due to close by the end of this year under environmental rules, but will now be resurrected as a biomass plant following EU state aid approval for the consumer-funded subsidies.

The 420 megawatt plant, which produces enough electricity to power 450,000 homes, could be up and running again within 18 months, subject to a final investment decision early next year, RWE said. The decision also boosted Drax, the Yorkshire coal plant that is awaiting state aid approval of a similar subsidy contract for the conversion of one of its units to burn biomass. For more visit:-

<http://www.telegraph.co.uk/news/earth/energy/coal/12027606/Coal-plant-gets-green-light-to-burn-American-wood-pellets.html>

## **If we care about the climate, why are we planning so many coal-fired power plants?**

**3<sup>rd</sup> December 2015, Cassie Werber, Quartz**

The world is preparing to build 2,440 coal-fired power stations, which may seem odd given that world leaders recently launched high-profile talks in Paris to come up with a global agreement to limit global warming. According to Climate Action Tracker, an environmental NGO, the pollution from that many coal plants—which have either been announced, are in pre-permit phase, are permitted, or are under construction—would ruin any chance for limiting global warming to less than 2°C, a commonly held goal. In fact, the coal plants alone would mean overshooting emissions goals by 400%. For more visit:-

<http://qz.com/563593/if-we-care-about-the-climate-why-are-we-planning-so-many-coal-fired-power-plants/>

## **Power plant spinoff sees E.ON say farewell to coal plants**

**31<sup>st</sup> December 2015, unattributed, CTRM Center**

Germany's EON SE will officially part with its fossil fuel past tomorrow, when a new company called Uniper is created. Here's what you should know about the spinoff. What will be spun off? The new entity based in Dusseldorf, Germany, will take on EON's commodity trading and fossil fuel power generation divisions along with a quarter of its employees. The trading business, which buys and sells commodities including power and coal, is grappling with a global slump in prices. EON moves to Essen to focus on renewables, its power grid and selling energy to customers. For more visit:-

<https://www.ctrmcenter.com/news/industry-related/power-plant-spinoff-sees-eon-say-farewell-coal-plants-qa/>

## New RFCS coal-related projects started in 2015

Note: There are only six new coal-related projects which are starting in 2015 and there does not appear to be any projects funded in category TGC 3. It is noted, however, that there are 29 new steel-related projects in eight different categories. Fuller details of all 2015 RFCS projects can be seen at :\_

[http://ec.europa.eu/research/industrial\\_technologies/pdf/rfcs/synopsis\\_projects\\_2015.pdf](http://ec.europa.eu/research/industrial_technologies/pdf/rfcs/synopsis_projects_2015.pdf)

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

Project Number	Project category and reference number	Short title	Title	Duration (months)	Start date	Co-ordinator	Total Funding (EU Support) (€)
RFCR-CT-2015-00001	TGC1.01/15	SLOPES	Smarter Lignite Open Pit Engineering Solutions	36	1/07/2015	University of Nottingham	3,309,995 (1,985,998)
RFCR-CT-2015-00002	TGC1.02/15	STAMS	Long-term STability Assessment and Monitoring of flooded Shafts	36	01/07/2015	INERIS (Institut National De L'environnement Industriel Et Des Risques)	3,153,076 (1,891,845)
RFCR-CT-2015-00003	TGC1.03/15	BEWEXMI N	Bucket wheel excavators operating under difficult mining conditions including unmineable inclusions and geological structures with excessive mining resistance.	36	01/09/2015	Poltegor Instytut - Instytut Gornictwa Odkrywkowego	2,817,117 (1,690,271)
RFCR-CT-2015-00005	TGC1.05/15	MapROC	Monitoring, Assessment, Prevention and Mitigation of Rock Burst and Gas Outburst Hazards in Coal Mines	42	01/07/2015	I.C. London	4,122,079 (2,473,246)
RFCR-CT-2015-00006	TGC2.01/15	SUPERCOAL	Coal-liquid based upgraded carbon materials for energy storage	36	01/07/2015	CSIC (Agencia Estatal Consejo Superior De Investigaciones Cientificas)	2,075,609 (1,245,365)
RFCR-CT-2015-00007	TGC2.02/15	BINGO	Bulk density and Internal Gas pressure in coke Ovens	42	01/07/2015	Arcelormittal Maizieres Research S.A.	1,897,471 (1,138,483)
						<b>TOTAL</b>	<b>17,375,347 (10,425,208)</b>
						<b>EU Support (average %)</b>	<b>60</b>

## CALENDAR OF COAL RESEARCH MEETINGS AND EVENTS

Date	Title	Location	Contact
20 <sup>th</sup> April 2016	The Control of Mercury and Trace Element Emissions and The Analysis and Characterisation of Coal and Biomass for Utilisation	Imperial College London	CRF Annual Meeting and Joint Seminar of the Coal Research Forum Environment and Coal Characterisation Divisions. Contacts:- 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> 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> Prof. Ed Lester Chairman of the CRF Coal Characterisation Division Tel : 0115-951-4974 E-mail : <a href="mailto:edward.lester@nottingham.ac.uk">edward.lester@nottingham.ac.uk</a>
18 <sup>th</sup> to 20 <sup>th</sup> May 2016	International Conference and Exhibition On Emissions Monitoring, CEM 2016	Lisbon, Portugal	For information visit:- <a href="http://www.cem.uk.com">www.cem.uk.com</a>
23rd to 25 <sup>th</sup> May 2016	HELE, High Efficiency, Low Emissions Coal-fired Plant	Tokyo, Japan	For more information please contact: <a href="mailto:Toby.Lockwood@iea-coal.org">Toby.Lockwood@iea-coal.org</a> Abstracts must be submitted through the <a href="#">event website</a> by 5 Feb 2016.
12 <sup>th</sup> to 16 <sup>th</sup> June 2016	8th International Freiberg Conference on IGCC & XtL Technologies	Cologne, Germany	For information visit:- <a href="http://www.gasification-freiberg.com/en/">http://www.gasification-freiberg.com/en/</a>
5 <sup>th</sup> to 7 <sup>th</sup> September 2016	11 <sup>th</sup> European Conference on Coal Research and Its Applications (11 <sup>th</sup> ECCRIA)	The Edge, University of Sheffield, UK	For further information on this Conference, please see the Conference website, <a href="http://www.maggichurchousevents.co.uk/crf">www.maggichurchousevents.co.uk/crf</a>