

Newsletter of the Energy Sector



FROM THE CHAIR

Dear Members of the RSC Energy Sector,

Another year comes to an end, so it is time to finish wrapping our presents, rush to the Post Office, and more importantly, time to reflect. 2013 has indeed been a very busy year for the RSC Energy Sector, where we have continued an active programme of events, and also launched new activities for our members. Please, read this newsletter to find more details.

Following the success last year from the first RSC Energy Sector Early Careers Event, this year we held this event at the headquarters of UKERC in London. The event was so well received with our early careers chemists that we have to close registration prior to the event. We had over 50 attendees and 23 oral and poster presentations. The invited speakers, Prof James Watson, Prof James Durrant, Mr Richard Wain and Laura Woodward, were indeed inspirational and clearly showed us the breadth of opportunities of careers in chemistry. You can find more details about our 2013 event on the article by Anna Weston.

I want to highlight here the launch of our RSC Energy Sector PhD Thesis Award with a £500 cash prize for best PhD thesis awarded in 2013 in the field of Chemistry for the Energy Sector. The application process is very simple, but please keep in mind that deadline is 31st December 2013. Full details and application form can be found at: www.rsc.org/energysector

I hope you have enjoyed being involved with the RSC Energy Sector in 2013. We have several seminars and events planned for 2014, and please, do get in touch with me if you want to be involved with the Committee or propose an event.

With my best wishes for the Christmas Season and for the New Year!

Mercedes Maroto-Valer



FROM THE EDITOR

Dear Readers,

This is the last issue of 2013 and I would like to wish you all the very best for a New “energetic” Year 2014.

The RSC Energy Sector has been involved in the organization and sponsorship of some important events such as the RSC CRF meeting at Cranfield where the current and new directives for emissions controls were critically analyzed, and both the prestigious Coal Science Lecture and the CRF-BF2RA seminar focused on fossil fuels and biomass issues.

Dr. Donna Palmer, network manager, gave an interesting update on the activity of the Energy CTD Network.

The last update to the Energy Outlook 2013 defines how the world’s energy consumption is changing and also how the energy-related CO₂ emission is affecting the environment.

There is good news from the White Rose CCS project which has been awarded government funding for a Front End Engineering and Design (FEED) study aimed at defining a detailed engineering planning and financial assessment in the next two years.

A DECC funding scheme will support the development of CCS and Heat networks in the Tees Valley area. Solar PV is growing in the UK and it is likely that it will be cost-competitive with combined cycle gas turbine generation by 2025.

Many interesting meetings and conference will take place in the first months of 2014, have a look at our upcoming events session for finding something you like to attend.

I hope you enjoy this issue.

Giorgio Caramanna

**RSC ENERGY SECTOR AND CRF ENVIRONMENTAL
DIVISION MEETING HELD AT CRANFIELD
UNIVERSITY ON WEDNESDAY 2 10TH APRIL 2013**

by Alan Thompson, CRF Newsletter Editor

The joint meeting of the CRF Environmental Division and the RSC Energy Sector incorporating the AGM of the CRF was opened by John Oakey, Professor of Energy Technology at Cranfield University.

Prof. Oakey highlighted the unique nature of the university in that it caters only for the post-graduate study of science, technology engineering and management, which is unlike any other establishment in the United Kingdom. Cranfield's energy research capabilities include the combustion of solid fuels; bioenergy and energy-from-waste; CO₂ capture and transport; chemical and calcium looping; gas turbine engineering; surface science and engineering; sub-sea energy systems; offshore structural integrity and renewable energy; solar energy and a Masters courses which is offered in energy technology.

The seminar session was opened by the theme "The emissions control of NO_x, SO_x and particulates". The newly-appointed chairman of the Environmental Division, Dr Bill Nimmo of the University of Leeds chaired the session. The keynote talk was by Dr Nigel Burdett of Drax Power Ltd. and was entitled "Environmental Control Issues in Industry". Dr. Burdett gave an introduction on the Drax Power coal-fired power plant which is to expand its biomass firing capability. The talk went through the main legislative changes in the NO_x, SO_x and particulate limits from the 1990's. During the period 2000 to 2009 there were three separate unlinked directives in place in the UK: the International Pollution Prevention & Control (IPCC) directive, which developed sectoral and other BREFs (Best Available Technology Reference Notes); the National Emissions Ceilings Directive (NECD) which imposed national ceilings on SO₂ and NO_x and the LCPD which imposed site specific limits for dust, SO₂ and NO_x. The NECD run out in 2010 and is largely irrelevant in UK as there is no legislation and no active monitoring. The LCPD sets out fairly relaxed limits for plant, intended by EC as a 'backstop' rather than the norm. It was fixed using 1990's performance and there are several derogations. IPCCD was slow to be implemented. Many countries ignore BREF notes and regard them as guidance rather than being mandatory. EC started the revision process in 2003, 'proved' that IPCCD was

not being implemented correctly and initiated several new initiatives. The EC is trying to identify where the permit does not reflect EU BAT. The new EC proposals are two-fold. The first is a revamp of NECD with proposals for 2020. This is aimed as an adjunct to CO₂ reduction and as a means of implementing Kyoto 2 by closing fossil-fired plant. It is highly controversial since it relies on projections of each countries' energy mix in 2020 combined with tough ELV and is currently stalled. The UK coal-fired power sector 2020 limits are anticipated to be 20-45kt for NO_x and 15-35kt for SO₂ (Note: Drax NERP limits 2008-2016 are 41.9 and 33.5kt respectively). Gas plant will contribute as significantly to UK NO_x as coal plant, also biomass. The second is one in which IED merges seven sectoral Directives (LCPD,WID). It keeps most of the LCPD ELV but originally removed derogations and introduced ELV update mechanism and it ties BAT with ELV.IED effectively forces all EU plant to use limits in any new BREF. It allows EC to further change limits and introduce other issues during BREF production. Compliance with any new BREF is to be implemented in permits within 4 years (max).

From a plant operator point of view uncertainty and potential constraints to SO₂ or NO_x exist beyond 2019 but felt to be technically manageable through available equipment (SCR/SNCR), fuel choice, burner management and FGD enhancement. Fitting SCR requires £3-4/MWh for 10years in payback. The UK carbon price floor effectively limits coal operations. Existing plants are vital to provide sufficient capacity and flexibility but will experience output reductions and then closure as new low carbon capacity is completed.

The final address of this very detailed keynote presentation is that the BREF process is driving standards and the associated investments forward. Biomass conversion is new to the BREF process and CCS is judged to be an 'emerging technique' with no formal standards as yet. Low carbon requirements are dictating a new generation of plant which in turn raises a different set of environmental concerns which include biomass and CO₂.

Other technical presentation followed during this very intense day.

Further details on the event can be found on the CRF Newsletter 67:

<http://www.coalresearchforum.org/documents.html>

BF2RA COAL SCIENCE LECTURE HELD AT THE INSTITUTE OF PHYSICS LONDON ON MONDAY 7TH OCTOBER 2013

Alan Thompson, CRF Newsletter Editor

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

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

Professor Colin Snape from the University of Nottingham was the keynote speaker of the Annual Coal Science Lecture with the title: "How the advanced structural characterisation of coal has benefited coal utilisation". Prof. Snape's lecture described the variety of techniques he used during his scientific research aimed to identify the characteristics and behaviour of coal and other fossil fuels. His conclusions on the future of coal included a great deal of encouragement for novel coal utilisation techniques, and also the importance of training young engineers.

This event was also the occasion to meet other colleagues from UK coal research and industry enjoying an excellent venue and very pleasant environment.

INTERNATIONAL ENERGY OUTLOOK 2013

The U. S. Energy Information Administration has released the *International Energy Outlook 2013*. The report gives detailed projections for energy consumption and production up to 2040 and it is based on a series of scenarios built on estimates of current trends. In addition to the Reference (business as usual) case "High Economic Growth" and "Low Economic Growth" cases are developed together with "High Oil Price" and "Low Oil Price" scenarios. Through nine chapters the energy demand and production is analyzed for different fuels, and usage; moreover the energy-related CO₂ emissions are also considered in the final chapter.

The report estimates an increase of 20% by 2020 and 56% by 2040 in world energy consumption. The types of energy sources that will be sustainable are still to

be fully assessed. For example the return of Japan to nuclear-power energy after the Fukushima accident is uncertain. China and India will have to identify reliable sources able to support their fast-paced economic development. These countries will account for 34% of the total energy usage by 2040 and China alone is forecasted to consume more than twice as much energy as the U.S. in 2040.

Even if fossil-fuels will likely play a dominant role in the future of world's energy a shift in their consumption is foreseen with a general reduction in liquid fuels and an increase in gas, which is also linked to the growing discovery and extraction of shale-gas deposits despite the controversial potential environmental impact.

Coal will also be largely used both for energy and for steel and cement production; world coal use will increase of 1.3%/year from 2010 to 2040 with China, India and some other Asiatic Countries as the main consumers.

The overall renewable electricity is forecasted to grow up to 25% of the total production by 2040.

The full document can be downloaded at:
<http://www.eia.gov/forecasts/ieo/world.cfm>

WHITE ROSE TO GO AHEAD

The planned 426-megawatt power plant at the Drax site in Selby, Yorkshire has been awarded a first stage of the funding from the UK Government for the development of the White Rose CCS project aimed at capturing about 90% of the produced CO₂. About 2 Mt CO₂/year will be stored under the seabed of the North Sea.

The power plant will use oxyfuel combustion to burn coal and biomass, also acting as commercial-scale CCS demonstration project. An average of 1,000 new jobs will be generated locally during the construction phase and 60 permanent positions will be secured to operate the new plant. Other jobs will be associated with the the pipeline transportation network and maintenance activities.

A Front End Engineering and Design (FEED) study will develop for two years before the final full-funding of the project.

For more information:
<http://www.whiteroseccs.co.uk/>

THE ENERGY CDT NETWORK

Donna Palmer, Energy CDT Network Manager

It has been a busy two years for students and staff involved in the Network of Energy Centres for Doctoral Training. The network, which started in 2011, brings together the EPSRC funded energy doctoral training centres. There are currently 13 CDTs in the network and with the recent announcement of new CDTs to be funded by EPSRC there will be more joining in 2014.

The Energy CDT Network aims to provide an environment for energy CDTs to share knowledge, expertise and stimulate collaboration. The network also aims to raise the profile of CDTs and the research and training taking place. Over the past two years the network has supported energy CDTs in a variety of public engagement events. Last year they partnered with The British Library to hold TalkScience@BL 'Sustainable energy for the 21st century: Can we ensure a bright future?'. The panel discussion was sold-out but the podcast can still be downloaded from The British Library website

(<http://www.bl.uk/reshelp/expertshelp/science/talkscience/previousevents/ts18/index.html>).

More recently students have taken part in a range of activities; from being part of Einstein's Garden at the Green Man Music Festival in Wales to running a 'Dragons Den' at the British Science Association Festival. A number of students even managed to appear on Blue Peter (and received green Blue Peter badges) as they took part in BBC's Energy Day at Media City.

As well as public engagement activity the network has held two annual conferences and earlier in 2013, 50 students from across the UK took part in the first Energy Young Entrepreneurs Scheme (Energy YES). The innovative competition is the first of its kind specifically designed to enhance business skills of postgraduates in the energy community. It was developed by the Network of Energy Centres for Doctoral Training and University of Nottingham Haydn Green Institute for Innovation and Entrepreneurship.

Over a busy four days, 10 teams of researchers were tasked to developing a business plan for their own energy-related idea. To support them complete the task the teams received one-to-one mentoring and attended workshops given by leading companies in areas such as IP and patenting, finance, commercialisation and marketing strategies. The teams also heard from individuals that have taken research ideas to commercialisation. On the final day each team presented their idea 'Dragons Den-style' to a panel of would-be investors and industry experts. On the judging panel was Douglas Drysdale from Harrison Goddard Foote; "I was very impressed by the high standard of the presentations. The pitches

showed a remarkable level of applied innovation and, more importantly, demonstrated that the teams had come to grips with many of the drivers for creating a successful company and securing investment."



The delegates at the Energy YES (Photo credit: D. Palmer)

After the first round of judging ten teams were whittled down to two; the York-led Fusion Doctorial Training Network team, with their idea based on liquid earth alkaline batteries, and the team from the Midlands Energy Graduate School (MEGS), with their idea of an eco-friendly refrigerator cooling units. After completing a head-to-head final, in which both teams presented again and received further questioning from the judges, the overall winners were announced to be team MEGS. The team consisting of 5 postgraduate researchers from The University of Birmingham, Loughborough University and The University of Nottingham, won £1,000 prize fund. Mei Chew, a PhD student in her 3rd year of research into Nuclear Waste Management at Loughborough University and one fifth of winning team MEGS: "Energy YES has been so worthwhile. Winning aside, we've learnt a lot about commercialisation of science and it has been really useful to talk to mentors such as patent attorneys that we wouldn't usually have access to. The speakers were excellent and it's especially encouraging to hear from people who have been in our shoes as researchers and gone on to successfully commercialise their idea."



If you are a PhD student and interested in taking part in Energy YES 2014 or work in industry and want to find out how you can support we would love to hear from you. Please get in touch with Donna Palmer (donna.palmer@nottingham.ac.uk), Energy CDT Network Manager or visit <http://bit.ly/EYES1>.

CRF AND BF2RA SEMINAR

This event was hosted by the University of Nottingham Tuesday 15th October 2013.

A series of high-quality lectures explored the history of BF2RA and its activity including the sponsorship of research in the biomass and fossil fuels fields.

The first session was focused on cross-cutting research and the point of view of industry was presented by the keynote talk of Dr. David Waldrom, Alstom Power. Dr. Waldrom highlighted the needs for the future of energy in the next years up to 2050. CCS will be needed to achieve the required reduction of the CO₂ footprint of energy production.

Other technical lectures covered different topics of energy production ranging from innovative models for optimize coal-fired power plant with CCS to design implementation of intelligent burners, development of new alloys able to operate in the demanding high pressure and temperature conditions of the new burners

Mr. Ralph Chamberlain, E.ON Energy presented the latest R&D on Biomass from the E.ON perspective during his keynote speech for the second session of the seminar focused on biomass research.

Technical presentations covered a new classification system for biomass to be used in combustion and assessing the risk of self-ignition of stored biomass.

The day was concluded by a panel discussion over priority topics and future research projects in five thematic areas: fossil fuels and biomass, plant operation and control, material development, advanced cycles for fossil fuel/biomass, control of emissions and products from fossil fuel and biomass utilisation.

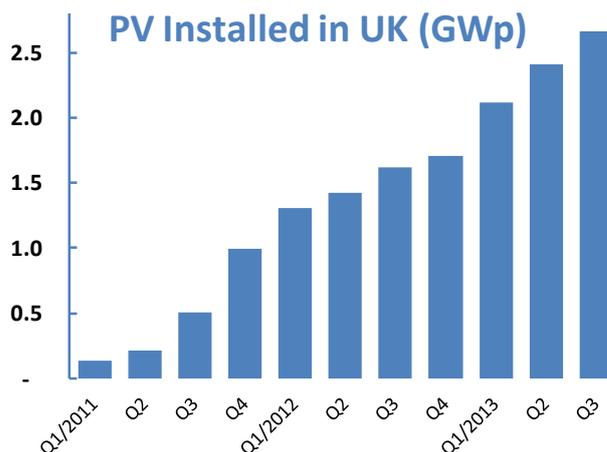
A final discussion covered the best timescale for different projects and what steps are needed to fill the gaps in knowledge based on the results obtained to date.

The presentations are available for download on the BF2RA (www.bf2ra.org) and CRF (www.coalresearchforum.org) websites.

SOLAR PV UPDATE

Dr. Nigel B Mason, PV Consulting Ltd

Despite dramatic reductions in feed-in tariff since April 2012, the latest published statistics from the Department of Energy and Climate change (DECC) continue to show steady increase in the deployment of PV in the UK with a cumulative 2.67 GWp installed to the end of 3rd quarter 2013. In October 2013 DECC published the *UK Solar PV Strategy Part 1: Roadmap to a Brighter Future* in which their central forecast expected 10 GWp to be deployed by 2020 but have aspirations to see 20 GWp by this time. 20 GWp of installed PV would generate annually around 19 TWh of electricity or close to 6% of UK annual (2012) consumption. On the basis of continued cost reduction in Solar PV, the DECC expectation is that PV electricity will be competitive (in levelised cost terms) with combined cycle gas turbine generation by 2025.



TEES VALLEY CITY DEAL FOR HEAT AND CCS NETWORKS

Dr. Sarah Mackintosh, DECC

City deals are a Cabinet Office led policy, aiming to devolve powers and funding to local cities and surrounding economic areas to boost growth.

A City Deal has been agreed with local authorities and Tees Valley Unlimited, the Local Enterprise Partnership, and will boost the process industries on Teesside, supporting the creation of 3,500 jobs and unlocking £28 million of private sector investment. The Tees Valley Deal covers several strands including funding for Heat Networks, and a more flexible planning process.

It also includes funding to complete a “pre-FEED” study for an industrial CCS network to identify “the best option for the onshore network, explore investment mechanisms and develop the business case for investment in industrial CCS”. The estimated cost is £1.25m, including £1m contribution from DECC. This funding is separate, and additional to, the £1bn CCS Commercialisation Programme funding.

RSC ENERGY SECTOR EARLY CAREER CHEMISTS SYMPOSIUM 2013 – UKERC, THURSDAY 21ST NOVEMBER 2013

*Dr. Anna Weston
Environmental Sustainability KTN
University of Oxford*

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

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

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

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

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



Energy Sector committee members with the RSC Energy Sector Early Career Symposium prize winners 2013 (Photo credit: A. Weston)

CO₂ – CAPTURING CURTAIN

Micropore, a well known supplier of CO₂ scrubbers for military and civil application, developed an innovative chemical absorber based on its patented ExtendAir© technology. This system is based on an extremely fine powder bound in a solid sheet composed by more than 95% of pure absorbent. The current application is to create “curtains” carried onboard submarines as emergency CO₂ control devices. The advantage is that

no power is required to operate the scrubbers. This could find application in post-capture technology for CCS reducing the associated energy cost.

For more information:

www.extendair.com

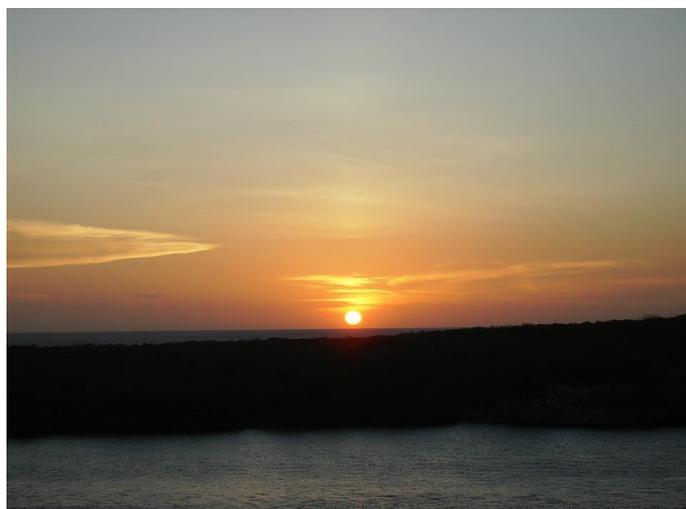
BEAM ME DOWN!

NASA is giving some seed funding to *Artemis Innovation Management Solutions* to develop the project for a satellite which could collect solar energy and beam it back to Earth. The idea, proposed by former NASA engineer John Makins, is to design an array of small mirrors disposed as the petals of a flower focusing the light over solar cells. The mirrors are made from a thin film which can be shaped in the flower-like structure. The energy would then be converted to microwaves beamed to a receiving station on Earth. The components of the system will be small and lightweight allowing cost reduction and the use of conventional carriers considering that the Space Shuttle program with its larger transport potential is terminated. If the feasibility project will convince NASA then further funding will be issued for a first small-scale prototype.

Should the project be successful it could open a totally new way of producing energy from the sun at a very large scale.

For more information:

www.nasa.gov/offices/oct/early_stage_innovation/niac/mankins_sps_alpha.html



A new dawn for solar energy? (Photo credit: G. Caramanna)

UPCOMING EVENTS

2nd International Conference on Clean Energy Science 13-16 April 2014, Qingdao, China

The conference topics will cover the main issues for developing clean energy sources including: biofuels and biomass, clean coal, CCS, Hydrogen production and storage, Photocatalysis, solar energy.

For more information: <http://www.icces.cn/>

Solid-state chemistry and renewable energy 14-16 April 2014, Kavli Royal Society International Centre, Chicheley.

This meeting, reserved to RSC members, will cover the materials involved in energy generation, storage and conversion with specific talks on materials modelling, photocatalysis, photovoltaics, batteries and fuel cells.

For more information:

<http://ssg-eastermeeting.moonfruit.com/>

Next generation materials for solar photovoltaics 15 January 2014, RSC Burlington House, London

This Energy Sector organised symposium will cover recent advances in Solar Photovoltaics with a focus on materials for organic, inorganic and hybrid thin films. The day will comprise six guest speakers, six contributing speakers and 30 poster presentations.

Guest Speakers are:

Prof Sir Richard Friend (Cambridge)
Dr Karsten Walzer (Heliatek GmbH)
Prof Iain McCulloch (Imperial College)
Prof Ayodhya Tiwari (EMPA, Switzerland)
Dr Henry Snaith (Oxford)
Prof Stuart Irvine (Glyndŵr)

For more information:

<http://www.rsc.org/ConferencesAndEvents/conference/alldetails.cfm?evid=114140>

Register at <https://events.rsc.org/rsc/220/home>

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The next Energy Sector Newsletter will be published in May 2014. All newsletters are in electronic format sent to your email address. Please note that if you have opted out of receiving RSC emails then you will not be able to receive our electronic newsletter and therefore will need to contact the RSC to change your preferences. If you would like to continue receiving a hard copy of the Energy Sector Newsletter, please contact the Newsletter Editor confirming your postal address.

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