

# NEWSLETTER



*of  
the  
Coal Research Forum*

## **EDITOR'S MUSINGS:**

Welcome to the third and incidentally last newsletter for 2015 which I hope you find will be of some interest. Well, I certainly got the hung parliament bit wrong in my last ramblings but at least I was not alone in thinking that exit polls might be right!

Whilst reviewing the technical press for coal articles I could not help but notice that whilst a number of developed countries are making noises, if not moves, to close their coal-fired generation plant there still remain a number of lesser developed countries who are proposing large scale new build coal power stations. One can only speculate what effect, if any, this will have on coal usage, the take-up of CCS technology and, I guess ultimately, the atmospheric CO<sub>2</sub> concentration.

This issue contains a report on the joint CRF meeting held with the Mineral Engineering Society entitled "Mineral Engineering 2015" and a list of new EPSRC projects in the Combustion & Conventional generation, CCS and Bioenergy topics.

We are also pleased to be able to report that membership fees and conference fees can now be paid using credit or debit cards. We have an agreement with Maggi Churchouse Events who manage our biennial conference to administer this facility. There is a small surcharge for this but we are absorbing some of the cost within the CRF.

Our next conference ECCRIA 11 is scheduled to take place from the 5<sup>th</sup> to 7<sup>th</sup> September 2016 so start to prepare your abstracts now!

Visit the following link for more information <http://www.maggichurchouseevents.co.uk/crf/ECCRIA.htm>

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## **Student Bursaries for 2015-2016**

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.

### **Report of "Minerals Engineering 2015" Meeting Minerals Engineering Society, co-sponsored by CRF and SMMMI 14<sup>th</sup> May 2015 Yew Lodge Hotel, Kegworth**

The regular joint annual meeting of the MES, the CRF and the SMMMI (South Midlands Mining and Minerals Institute) was once again held at the popular venue of the Yew Lodge Hotel in Kegworth. David Baillie, the MES president, welcomed the attendees and opened the symposium, the theme of which this year was "Minerals Engineering 2015".

The morning session of four papers was chaired by Rod Stace and the first presentation was given by Toby White of the Coalfield Community Investment Society Ltd. (CCIS). It was entitled "A new coal mine in the UK? New Crofton Mine". Toby has spent over 30 years associated with the minerals industry firstly with opencast coal and then with aggregates. He currently works four days a week for the Geology Department at Leicester University as Course Director for their postgraduate blended-learning quarry management programmes. Toby's other roles include being a Director of CCIS and he is a founding member of New Crofton Co-op Colliery Ltd, (NCCC).

CCIS was registered in 2014 as a Community Benefits Society with the aim of supporting the economic and social regeneration of coal mining communities through a number of initiatives. These include the use of share capital to invest in co-operatively owned enterprises in UK coalfields, with a specific focus on those connected with the coal mining industry; to facilitate the creation of new, high quality sustainable jobs in coalfield areas and to encourage the development of other co-operatively owned businesses in coalfield areas by the future careful investment of profits generated by co-operative coal mining.

CCIS's first project has been to partner with NCCC to develop a new drift mine to extract, process, stock and sell 4.9 million tonnes of coal over a 22 year period. NCCC has already been granted planning permission and is now raising the finance to start operations.

The proposed underground extraction area for which planning permission has been granted is surrounded by extensive underground and opencast workings. The four Sharlston seams will be worked at three levels; Top (~1.2m), Muck and Low together (~1.2m and ~1.42m respectively) and Yard (~0.82m). The plan area of surface and underground development is 174 hectares and the depth of working, limited by mine regulations, will be a minimum of 45m and a maximum depth of ~150m below the surface.

Access to the seams will be via two drifts, 5.5m wide by 2.2m high driven at a grade of 25% from the surface. Extraction of coal will be by room and pillar method, 6m wide room with a 10m square pillar. This will mean that around 55% of the coal will be recoverable. A continuous miner will be used to extract the coal with three coal scoops transporting the coal to an underground feeder-breaker, which will feed a run-of-mine conveyor taking the coal to the surface at less than 150mm. Mine stability will be ensured using a twin-arm roof bolter.

Over 85% of the coal will be sent to power stations by rail with up to 15% being screened at various sizes as lump coal for use in heritage steam and domestic markets. The Top, Low and Yard seams are generally clean (moisture ~13%, ash 6 to 11%, sulphur 1.5 to 2%, chlorine <0.05% and net CV 24.3 to 26.4 MJ/kg) and can be mined to produce a saleable product without washing. The lump coal will be separated on an inclined screen and then further sorted using a trommel screen. The Muck seam (moisture ~13%, ash ~20%, sulphur ~2.6%, chlorine <0.05% and net CV ~21MJ/kg), will be crushed to less than 30mm and then processed in a barrel washer to separate coal from waste. The waste will then be sent underground by hydraulic stowing.

The funding requirement for this project was said to be £11.5 million of which more than 80% had already been secured. The following funding streams were mentioned:- Social investors such as Social & Sustainable Capital, Big Issue Invest, FSE and KeyFund; Equipment manufacturer financing; Hargreaves (pre-payment for coal, driving the drifts and supplying redundant equipment from Maltby Colliery) and the CCIS who would be raising community finance to then loan to the NCCC.

The CCIS is a Community Benefit Society and the first Community Share Issue is for NCCC (others to follow). It is a withdrawable share which allows one member one vote and requires a minimum investment of £500 for five years. Shares can only be sold back to the Society and will not go up in value but may go down. No dividend is paid on the shares. So why invest? The Society pays interest on the shares and aims to pay out the Base rate + 5.5%. The main focus of the share issue is to provide funding for community benefit although a reasonable financial gain is allowed by the FCA. The offer was due to close on 30<sup>th</sup> June 2015 and at the time of the symposium around £120k had been raised with possible matching funding from Resonance Ltd. Toby concluded his talk by posing the question 'Welcomed by the community?' To which the answer certainly seemed at this stage to be yes. There had been a full and open consultation and engagement with the local community and £10 million is going into a Community Trust Fund. 51% of any profits would be going into this and other co-operative investment funds and 49% of any profits would be going to members i.e. workers as a dividend. In terms of feasibility Toby believes so and is it repeatable? Let's wait and see how this one goes!

The second presentation was by Arthur Gill who is a Contracts Manager with Nomenca Ltd. and was entitled "Hemerdon Tungsten Mine" Arthur is currently working for an Australian consultancy firm G.R. Engineering Services involved in the construction phase of the Hemerdon project

The discovery of tungsten at Hemerdon dates back to 1867 and such is the scale of the deposit that the site is now recognised by the British Geological Survey as the fourth largest tungsten resource in the world. The first significant workings of Hemerdon took place around the time of

the First and Second World Wars, when mine plants were built and went into production, although by today's standards the operations were relatively small in scale. On the second occasion operations ceased in 1944 due to the resumption of shipments of tungsten from overseas. Attempts during the 1960s and early 1970s to reopen the mine failed to bear fruit but in the late 1970s American mining company AMAX became involved in the mine and a significant programme of exploratory drilling got under way in 1977. In 1981, a planning application was submitted by AMAX to mine tungsten and tin. After a Public Inquiry in 1982 the Secretary of State indicated that improvements to the visual aspects of the processing plant and waste disposal area would be regarded more favourably in a new submission.

A revised plan was submitted in 1985 which was passed by Devon County Council in 1986, subject to stringent conditions governing the development and operation of the mine. The planning permissions to mine tungsten at Hemerdon until 2021 are still in place today and were recently updated by Wolf Minerals in 2011 with the approval of Devon County Council and the Secretary of State for Communities and Local Government.

Tungsten is in great demand at the present time and has grown in importance over the last century. At the moment the UK is almost totally dependent on supplies of the valuable metal from abroad. The site at Hemerdon has sufficient tungsten supplies to meet the demand of the UK for many years. The project to reopen the mine and create the infrastructure will be a significant boost to the South Devon economy. When fully operational, the mine will generate about 230 direct jobs and many more indirect jobs, pumping millions of pounds into the local economy every year. The Hemerdon and Lee Moor areas already have a great mining heritage and the industry remains a key driver of the economy. Large scale china clay and aggregates operations continue in the area, which has been extensively mined since the mid-nineteenth century. Beyond its hugely positive impact on the local economy, the project is an extremely important asset to the UK and has received the strong support of UK Trade and Industry (UKTI) due to the significant contribution it will make to the export market.

The first major infrastructure work on the Hemerdon project was completed in 2012 when a 600m link road was built and opened between Lee Moor Road and West Park Hill in Plympton. Work to commission the mine, its processing plant and other infrastructure began in 2013. The initial phase of this operation involved the detailed design of the processing plant and off-site fabrication. The first significant activity on site to begin building the mine and its infrastructure were scheduled for late 2013/early 2014, with the mine expected to be fully commissioned and in full production in 2015.

The mine itself will be state of the art - constructed and operated to the latest international regulations and best practice. Most of the valuable tungsten and tin at Hemerdon can be found within the large deposits of granite. The granite contains veins of tungsten and tin which has been identified by diamond drilling. The extraction of tungsten will take place through open pit mining, with the pit measuring about 850m long by 450m wide and extending to a depth of 200 metres. The sides of the pit will be cut in benches to allow for safe working as the mine gets deeper. When mining the open pit the overburden (or waste rock known as killas) will be loaded by excavators on to dump trucks and driven via internal haul roads direct to the mine waste facility on Crownhill Down. Granite removed from the pit will be taken first to the processing plant where it will be crushed and ground to remove the minerals from the rock and then separated by using various gravity and water methods. Once the mine is in full production an estimated 7 million tonnes of waste rock and 3 million tonnes of granite will be mined annually.

Arthur drew his talk to a close by describing the amount of valuable products resulting from the mining operation. It was expected that 5,000 tonnes of tungsten concentrate and 500 tonnes of tin will be produced each year – the equivalent of one truck a day leaving the mine for export to specialist off-takers in Europe and the USA.

Simon Moyle from Auegan plc presented the third paper of the day entitled "Removal of contaminated waste". Auegan is a company which claims to be the sector leader in modernising hazardous waste management practice. It is able to provide sustainable compliance-led waste management solutions for the UK's more difficult to handle wastes. The company employs a number of different techniques including soil washing, bio-remediation, physico-chemical stabilisation and thermal treatment (either high temperature incineration or indirect thermal desorption). Simon is based at Auegan's East Northants RMF (Resource Management Facility) at Kings Cliffe, near Peterborough.

The Kings Cliffe site operates as a hazardous landfill and is permitted to accept hazardous waste as well as Low Level Waste, (LLW), which typically arise in the UK from the decommissioning of nuclear power stations, science and research facilities, hospitals and manufacturing. The site also operates a stabilisation plant capable of treating Air Pollution Control Residues (APCR) from the incineration of household wastes.

The facility also treats a broad range of contaminated soils from the brown field remediation markets utilising a number of proven technologies. Contaminated soils are cleansed to remove a wide range of contaminants through the use of the most advanced treatment technologies which include physico-chemical and bioremediation techniques. Clean material is recovered and recycled and pollutants analysed and disposed of safely. To clean contaminated soil it is washed with water and chemical polymers to remove the contaminants and sand, gravel and soil-forming materials are obtained as usable products.

If the contaminant cannot be removed another technique, cement stabilisation may be used. This involves mixing the wastes with cement, fly ash and water which, following a chemical reaction, will bring, for example, heavy metals contaminants into a non-leachable and thereby safer state. This material may then be disposed of as landfill.

In the case of organic contaminants these may be removed by a technique known as bio-remediation. This involves composting the contaminated soil with bacteria which can destroy certain organic hydrocarbons. The degradation of petroleum type materials is promoted through the circulation of air and by controlling the levels of moisture

Simon concluded his talk by giving us an insight into the future for hazardous waste treatment as he saw it. He believes there will be a toughening of the environmental regulations and stricter limits on what may be sent to landfill. This is designed to reduce the amount of material which can be landfilled. There is likely to be an additional increase in the extent of thermal treatment of wastes and the need to further develop the treatment and recycling of APCR.

The last paper before lunch, "Global Coal Preparation and Materials Handling Overview/Technology Development", was given by David Woodruff, Vice President and Global Key Industry Director – Coal with F.L.Smidth. As his paper title indicated, David provided us with a wide ranging review of the current state of coal preparation and material handing worldwide.

David began by describing the market scenario for the coal industry. Global production in 2013 was 8 billion tonnes of saleable coal. An estimated additional discard and overburden of 22 billion tonnes had to be removed making a total extracted tonnage of ~30 billion tonnes per annum. Despite environmental concerns, coal output continues to increase, driven by the emerging economies power requirements. Coal output is now expected to peak at ~10 billion tpa in 2020 but beyond then the future is uncertain. Declining output is dependant on the development of other methods of large scale electrical power generation, or the development of carbon capture and sequestration technology.

Based on this scenario David provided us with his observations and the issues he sees as important. The coal industry is not going to go away anytime soon. Output will continue to decline in the western world, but this decline will be compensated by developing world increased production and consumption. There are still more than 1 billion people in the world

without access to electrical power, (600M in India alone!). These are the 1 billion that are the worlds poorest. There will be another 1 billion people on the planet by 2020. As coal technologists, David believes that it is our job is to produce more efficient ways of mining, processing and burning coal to minimise environmental effects, whilst keeping the lights on. As an example, export of high quality low ash steam coal from South Africa or Australia to India, to blend with extremely poor local coal, can see major reductions in CO<sub>2</sub> emissions per KWh, by improving combustion efficiency.

By far the most important recent development in materials handling in coal mines is the use of 'In-pit crushing and conveying', (IPCC), systems. This is the substitution of trucks with mobile and semi-mobile ROM/overburden reception and primary crushing systems. As a large opencast mine develops, the number of trucks required to transport and maintain a fixed output of overburden and coal increases because the distance to be travelled increases as the mine grows. Beyond a certain distance it is more economical to install mobile, or semi – mobile reception and primary crushing systems, which move towards the mining process. The output from the IPCC station is connected to the permanent static handling system, via extendable mobile conveying systems.

With regard to general trends in global coal preparation David explained that there are many minor variations in flow-sheet design in all major coal-producing countries, however a general trend has developed in most places, with the possible exception of China. Large capacity single unit equipment is preferred to simplify plant design and reduce the number of moving parts, and to avoid distribution error. The Dense Medium Process (DMP) is generally used in preference to jig technology on + 1.0 mm feed. Most new plants are now removing the 1 or 2 mm raw feed before the dense medium process. An interim process step using either spirals or upward current separators is used to process the 1 or 2 mm x 0.25mm - 0.15mm fraction. Froth flotation feed is now generally 0.25mm or 0.15mm x 0, or to 0.045mm, rather than the original 0.5mm x 0 seen in plants pre 1990.

David then described the current regional variations in coal processing and included his experiences in Australia, South and southern Africa, USA and Canada, India, China, Europe and Russia.

For fine coal separation technology most new plants now process the 1mm or 2mm x 0.25 or 0.15mm fraction using a number of gravity-based technologies. If a steam coal is the product and a high S.G. of separation is acceptable, spiral separators are the usual choice. If a higher quality, low ash product is required, the spiral has a problem in that it's SG of separation is fairly rigid around 1.70 to 1.85. This means that if you wish to include the spiral concentrate in a low ash product an even lower ash DMC product is required to compensate for the high SG, and ash spiral floats. This can lead to significant loss of yield of low ash high value product. There are two methods to process the intermediate fraction at lower SG cut points, to maximise yield. These are fine coal dense medium cyclones or the reflux classifier.

The fine coal dense medium cyclone (DMC) is a technology originally introduced in 1957 by DSM. A resurgence occurred in the 1980s to produce export coking coal in South Africa and there is now new interest here and in Australia for low gravity separations to increase yield of low ash products. In China the 3 Product DM cyclone plants, which do not include a de-sliming step, use a fine Coal DM Cyclone to recover fine coal from the medium circulation system. This system, although widely used in China, is inflexible and has a high magnetite consumption.

David then described the proprietary F.L. Smidth device known as the Reflux Classifier. This novel piece of equipment, which has great potential for cost savings, is an industrial machine that separates fine particles on the basis of either density or size, improving the efficiency of the process with its unique tilted design. It is a combination of a lamella separator, an autogenous dense medium separator and a fluidised bed. The operation draws together the best elements of these different systems. A powerful density based separation develops within the inclined channels. This forces low density particles to overflow, but retains high density particles. Fine

high density particles form an autogenous dense medium (above the fluidised bed). This zone then sends larger low density particles towards the inclined channels, and then to overflow.

This concept, along with advancements in channel spacing and width mean that Reflux Classifiers are more efficient and more compact than competing fine coal and mineral processing equipment. F.L. Smidth has commercial units from RC850 up to the RC3000 unit. Actual unit capacities are related to the feed material and the feed material sizing.

Fine clean coal dewatering (1 mm x 0) is most commonly carried out using horizontal belt vacuum filters and screen bowl centrifuges. For extreme cases, such as in Siberia, where temperatures can be – 50C, more extensive methods such as hyperbaric disc filters, or recessed plate filter presses are used, to avoid the fines product freezing in the transport rail wagons. Thermal dryers are being closed because of costs of operation and environmental concerns. New methods including microwave drying techniques are being considered

There are six methods which are most commonly used to treat and dispose of tailings. These are:- disposal to a lagoon; disposal to a reduced size lagoon with advanced flocculent technology; dewatering by recessed plate filter press; dewatering by belt filter press; dewatering by solid bowl centrifuge and dewatering by deep cone thickener and blending/co-disposal with coarser solids, (crushed).

At this point David drew his whistle-stop world tour of current coal and mineral processing to a halt.

Following the customary excellent lunch provided by the Yew Lodge the presentations resumed with Professor John Patrick chairing the afternoon session of four papers.

Professor Sam Kingman, who is currently Associate Dean in the Faculty of Engineering at the University of Nottingham kicked off the session with his talk entitled “Riding the Innovation Roller Coaster: Developing Microwave applications for Mineral Processing”.

Sam began by providing data which showed just how vitally important innovation was to the future. These so-called ‘mega-trends’ include population growth, urbanisation, energy demand and globalisation. 40% more primary energy will be needed in 2030 – How can we contribute to climate protection and energy supply? 8 billion people will live on earth by 2030 – How can we ensure food and water supply for everyone? 60% of the world population will live in cities by 2030 - Which materials are needed to make energy consumption more efficient? - 2 billion cars will drive on earth by 2030 – How can we reduce emissions and fuel consumption? Technology may be the answer as it can enable something to be done that was not previously possible; it can lead to new products or services; it may be adopted by existing or result in new industries and it may be able to deliver the necessary step change that will be needed to address the mega-trends.

Sam then moved on to explain the difference between heating by conventional means and that using microwaves. In conventional heating the entire furnace is hot and the sample surface gets heated initially whereas with microwaves only the sample is heated and it is heated evenly throughout. Conventional heating is based on a materials thermal conductivity but microwave heating results from the dielectric properties of the substance.

Sam then posed the question: - “Why use microwaves?” Although there is a qualifier that microwaves are not a panacea they nevertheless can offer a cost reduction and an improvement in energy efficiency. Microwave technology enables the meeting of new sustainability and legislation drivers and can show an increased capacity for the same plant footprint. It may offer an improved product quality and less waste but to be successful it must have the ability to do something that no other technologies can. As an example of the latter factor, coal dewatering studies were mentioned. Whilst quite clearly successful in its ability to dewater coal, the energy

requirements of microwave techniques were no better than conventional techniques. As a result very few commercially viable processes have been developed.

According to the Technology Strategy Board (TSB) the barriers to commercialisation include difficulty in finding the best route to market for disruptive ideas; poor support for early stage proof of concept work which limits demonstration and development; alignment of Government support in that investment is not targeted on the technology with the greatest potential and a lack of specialised skills which needs to be addressed and which may change during the commercialisation process.

Sam then identified the barriers to commercialisation as seen by the National Institute for Microwave Processing (NCIMP). These were the need for a stronger fundamental “science”; the lack of a multi-disciplinary approach and the need for an industry/academe partnership to “Define the Route to market”. In addition there is a poorly defined and understood value proposition and a lack of demonstration at the appropriate scale. Such demonstrators include a technology demonstrator (prototype–lab conditions), an application demonstrator (commercial scale – non lab conditions) and a commercial demonstrator (determination of the value proposition). Finally, there is a need for a trained workforce to support the technology.

Sam then moved on to describe a specific application on which his team had spent time developing, the microwave processing of vermiculite. Vermiculite is the geological name given to a group of hydrated laminar minerals which are aluminium-iron-magnesium silicates resembling mica in appearance. This naturally-occurring silicate mineral is composed of shiny flakes which when heated to a high temperature expand as much as 8 to 30 times their original size.

Sam outlined the extent of the market for vermiculite with products ranging in size from large (6% market share), medium (19%), fine (31%), superfine (35%) and micron sized (19%). The larger particles have a relatively low surface to volume ratio, need a low power density and take time to expand. However, the superfine and micron sized vermiculite have a high surface area to volume ratio, require a high power density and very rapid heating of the interlayer water and expand almost instantly.

For the finer grades of vermiculite the current state of the art indicates a highly energy intensive process with a gas furnace operating at 1,000°C. Different furnaces are necessary for different grades. Production rates are 0.6-1MWh/t (~1.5kg CO<sub>2</sub> per kWh) with a product yield ~85%. Significant additional energy and investment is necessary in associated plant, i.e. 400 to 500 kWh/t for dust handling systems. Cooling is required before product bagging and the process has poor flexibility – peaks and troughs in demand cannot be met. Scale of production precludes wide spread use. There are clear drivers for innovation in which microwave technology can play a significant role. These include reductions in energy and space, and improvements in product quality and production control.

Sam and his team have been able to develop a microwave-based system for the expansion of fine vermiculite which is now operating commercially. Although technical difficulties had to be overcome during the development stage the benefits to the customer are significant. There is a substantial energy saving (~500-700kWh/t), a 65% reduction in carbon foot print, significantly improved working conditions for staff and reduced dust and noise. Only compact dust handling system is required and the system operates within a closed containment with its inherent increase in safety. There is a significantly reduced requirement for cooling and storage space. Other benefits include a smaller plant footprint, reduced maintenance costs, instant start-up/shutdown time – rapid grade change. All of these lead to a uniform and consistent product to highly controllable specifications.

Sam closed his talk by identifying the key messages that he wished his audience to take away with them. These were that safety operation and design of systems is paramount; microwave

heating offers the ability to deliver real competitive advantage to users and a multi-disciplinary team and clear project focus are required. There is a need for a detailed understanding of the process for successful scale up, specifically interaction of microwave energy with materials, mechanistic understanding, and a staged demonstration at the appropriate Technology Readiness Level (TRL). Finally, there must be strong customer interaction at the earliest stage and crucially microwaves must offer a process advantage that no other technology can - that is they are not a panacea.

Second up in the afternoon was Dr Pablo Brita-Parada, Research Fellow at the Royal School of Mines in Imperial College London who presented a talk entitled "Froth Flotation Innovation and Research." Pablo began by describing the Froth and Foam Research Group (FFRG) of which he is a part. It is a group which is a world leader in research into flotation froth physics and is based in the Department of Earth Science and Engineering, Imperial College London. Its aims are the development of fundamentally based models and measurement techniques to characterise the structure and behaviour of 2- and 3-phase foams and to understand the physical processes in froth flotation which may lead to improvements in operating conditions that can be successfully implemented on an industrial scale.

After describing the basic process of froth flotation Pablo made a few observations about the technique. Even when it works really badly, it still works pretty well! It's relatively cheap and so there is a low incentive for big, risky changes to any process. Nonetheless, froth flotation uses huge amounts of energy to grind up the rocks, quite a lot of the valuable mineral is lost and quite a lot of the gangue minerals are collected. So what's the problem with flotation?

So how can froth flotation be improved? Much very good work has gone into improving the understanding and manipulation of the surface chemistry. Equipment manufacturers have reduced cost and increased energy efficiency mostly through size. The FFRG's approach is to focus on the physics of the froth, where the physical separation happens; to break down the process into its smallest components, build models, do experiments and identify new approaches to improvement.

Pablo explained the components of a froth model which is used to help understanding of the flotation process. It comprises froth motion, liquid flow in the froth and solids motion. In froth motion the model must predict the flowing patterns of froth and the velocity parameter is obtained by using the Laplace's Equation. The boundary conditions are the shape of the tank and the amount of air entering the froth that overflows and does not burst, known as air recovery (%).

The investigation needed to look into the location of the liquid within the froth flotation process and experiments involving the structure and physics of the froth were devised, using mathematical modelling and other techniques. Experiments were also carried out to examine foam flow and coalescence using narrow columns, flowing foams and accurate automated image analysis. Phenomena such as froth flow, coalescence and bubble bursting were observed. A model to predict size distribution and bursting was created and validated using experimental data.

Pablo posed the question "How do the solid particles move?" The attached valuable particles move with the froth and then detach due to coalescence. The unattached particles (valuable and gangue) follow the liquid, settle and then overflow into the concentrate. Complex experiments were then described to show the effect of the attached particles on the behaviour of the bubbles. A technique to track the trajectory of the particles known as Positron Emission Particle Tracking (PEPT) was used and was able to validate the models. PEPT measures the trajectory of a particle that has been labelled with a radionuclide which decays by positron emission. The range of particle sizes which can be measured is from ~100 microns to several millimetres. This technique allows the visualisation of the path line of the particle measured with a Positron Emission Tomography (PET) camera.

All very interesting but how does it help industrial optimisation of froth flotation plant? Pablo explained that it is linked to air recovery. There is a rate of air recovery known as PAR, (Peak Air Rate) which is an optimum balance between froth stability and mobility which leads to high recovery and grade. Below PAR, bubbles are stable and loaded but their mobility is low; above PAR the bubbles are under-loaded and unstable and so burst quickly. It was also found that the air rate that gives the highest air recovery also gives the highest mineral recovery.

Pablo drew his talk to a close by stating that the work on the physics of froth, an area largely previously neglected, has resulted in improved understanding of the process. The importance of air recovery was highlighted in this work and it is now an industrial control variable.

"Automated/Sensor-based Sorting Research at Camborne School of Mines" was the next presentation which was given by Dr Rob Fitzpatrick of the University of Exeter. Sorting is one of the oldest and most innate technologies imaginable e.g. hand sorting or by visual inspection, sensor-based sorters automate this technique. Sensor-based sorting exploits measurable differences in the physical properties of particles, either natural or induced, to produce a distinct response to an applied force.

Rob then described the sorting equipment used in this work. It is manufactured by a Norwegian company called Tomra. The sensor-based sorter comprises an inclined feed conveyor, optical and conductive sensors controlled by a CPU and an air ejection system. The process involves preparation of the feed material, particle examination by the sensors and an ejection system to produce the separated streams.

One of the advantages of sensor-based sorting is the removal of coarse waste which reduces unnecessary comminution and tailings disposal costs. It also allows the rejection of low-grade material before transportation to the concentrator (in-pit, underground). Consequently, a higher mill feed grade generally results in higher recoveries with increased production of concentrate. It can handle material over a wide size range - from 2 to 300 mm in diameter. However, there are disadvantages to these techniques. For example, it works best with closely sized feed (top/bottom size ratio of 2:1 - 3:1) coatings (slimes, dust etc.) have an adverse effect on surface based measurement and the expense of the main consumable, compressed air. Furthermore, it is necessary to distinguish the particle from any reference surface such as a belt or chute so that colour choice is important. Single surface sensors only see one side of a particle so there is potential for misplaced material and there is the issue of noise from air ejectors.

Performance/separation efficiency is a function of a sorting machine's ability to generate sensor data which is representative of physical properties, to correctly classify particles based on this sensor data and to accurately and reliably achieve the separation of particles. Applications include sorting of uranium ore, coal, quartz/feldspar/gypsum, diamonds, rubies and sapphires, gold, carbonates and talc.

Rob then described the Near Infra Red (NIR) sorting of copper ores. NIR sorting uses a region of the electromagnetic spectrum in the wavelength range of 780–2500 nm. Two processes are responsible for the absorption of radiation of molecules in the NIR region, electronic processes and vibrational processes. Research is focused on studying the vibrational processes of the NIR, where a limited number of functional groups (e.g. H<sub>2</sub>O, OH<sup>-</sup> and CO<sub>3</sub><sup>2-</sup>) dominate.

Within the NIR range, minerals can be grouped into three categories based on the absorption properties; NIR-active minerals displaying absorption features; NIR-active minerals not displaying absorption features and Non NIR-active minerals. The visibility of absorption features of individual minerals in a spectrum depends on any or the combination of these mineralogical factors: NIR-active mineralogical composition, relative proportion/concentration and relative mineral accessibility or sensitivity to NIR radiation.

The approach to current research is to identify and discriminate copper-bearing minerals (chrysocolla and malachite) from their associated gangue materials.

This method is being evaluated using physical testing on a prototype NIR sensor. It uses individual NIR-active minerals which were crushed and ground to  $-45\ \mu\text{m}$  particle grain size fraction. The mixtures were prepared at ratios of 1:9, 2:8, 3:7, 4:6, 5:5, 6:4, 7:3, 8:2 and 9:1 of mineral for two minerals mixture. Mixtures of three or more minerals were prepared at equal ratios of mass. The results from the copper ore NIR sorting tests showed that in a concentration-dependent mixture, the mineral with the higher concentration dominates the spectrum (e.g. chrysocolla and muscovite). In mineral accessibility-dependent mixture, even at lower concentration, the dominant mineral dominates spectra (e.g. malachite in chlorite). Minerals behaved differently in different mixtures. A weak mineral in one mixture may be strong when mixed with another mineral. For example, chlorite and chrysocolla show features together appearing mixed. Chrysocolla dominates malachite mixtures, while chlorite features are almost completely captured by malachite. Also, though malachite is weak in chrysocolla, it is stronger in hematite than chrysocolla.

The outcomes from this research are that chrysocolla is only visible in hematite at 90% concentration. Only freely-occurring calcite can be targeted for discrimination. Where hematite and chrysocolla occurs associated together, calcite, kaolinite and muscovite can be targeted for removal. Malachite is relatively more NIR-active than hematite. At higher calcite ratios both malachite and calcite show features side-by-side, but those of calcite appear displaced while malachite dominates when in higher concentration.

In order to scope an application, a good understanding of the constituent minerals, minerals associations and the diagnostic features locations of the NIR-active minerals in the ore is essential. Hence, strategies outlined depend upon the copper ore type and character, and may need to be calibrated or modified for specific copper-bearing-mineral type to achieve optimal results.

A project was undertaken to study separation efficiency and the rationale for doing this was that a sensor-based sorting has been applied with good success in certain mining applications. For the development of future applications it is important that the performance of sorters can be accurately predicted. The development of a model which can be used to predict the effect of particle loading on the separation efficiency of a sensor-based sorter would therefore be beneficial.

In modelling separation efficiency certain factors need to be considered such as the particle distribution in the flow to the sensor. This is affected by throughput, feed mechanism and the shape and size of the particles. Increased throughput also has the effect of masking physical properties and can also result in co-deflection ( $R_c$ ) of particles. The approach used in the current research project was to investigate the feasibility of using the distribution of particles to predict the fraction of co-deflected particles ( $R_c$ ) and hence the separation efficiency of a sensor-based sorter; to undertake physical testing on a Tomra Mining Solutions optical sorter to establish separation efficiency under varying test conditions and to use computer models to predict the distribution of particles for the sorter and use these models to predict the separation efficiency.

The test material was granite from Carnsew Quarry, Penryn, UK which was split into fractions based on size and shape and a portion of material was painted to ensure identification of particles is 100% accurate. Physical testing took place with three different throughput rates for three different particle sizes and three different rates of 'reject' additions. The model produced good agreement between the predicted and measured  $R_c$  values.

Rob also described the CFD DEM modelling of air ejection. The approach was to use computational techniques to investigate the underlying physics of the separation; to model air jets using CFD validated against physical measurements; to combine CFD data with DEM in a two-way coupling to model ejection process and to undertake physical testing on Tomra sorter to establish physical properties of air-jets and ejection process. Detailed results are not available at this time due to the need for confidentiality ahead of publication.

Rob ended his talk by outlining future mineral processing interests at Camborne. These included:- OPTIMORE project to optimise the crushing, milling and separation ore processing technologies for tungsten and tantalum mineral processing ([www.optim-ore.eu](http://www.optim-ore.eu)); gravity separation modelling and optimisation; bio-hydrometallurgy applications for sulphide mineral extraction and further CFD-DEM modelling of sensor-based sorters and NIR Sensor development and automated training methods

Dr Tom Skuse of the University of Birmingham who gave the last paper of the day has just completed his PhD which was entitled "The use of advanced flow diagnostics to optimise vertically stirred mills". Using the expertise he had acquired during his study Tom talked to us about the production of ultrafine CaCO<sub>3</sub> in vertically stirred media mills. Particulate materials in vertically stirred mills are fractured as grinding media particles collide and apply sufficient stress to break the trapped feed particles. The grinding process is determined by the frequency with which the feed particles are stressed, that is the number of stress events, and the stress exerted, or stress intensity, at each stress event. However, in reality the feed particles and their resulting fragments are not stressed equally with the same intensity and therefore the stress number and intensity can only be determined by distributions which, to date, cannot be determined using numerical or experimental techniques.

The aim of the work presented by Tom was to develop an experimental methodology using Positron Emission Particle Tracking (PEPT) to measure the stress intensity and stress number within a vertically stirred media mill.

*[Optional Tutorial!]*

*Positron emission particle tracking or PEPT is a technique for studying the flow of particulate systems such as tumbling mills in the minerals industry. Initially developed for the medical imaging industry, positron emission tomography has been adapted for engineering applications at the University of Birmingham. The particular value of PEPT is the ability to look deep within the particulate system for extended periods of time thereby elucidating the in-situ kinematics and dynamics of the flow. The basic principle of PEPT is based on positron annihilation. A single ("tracer") particle is labelled with a radionuclide that decays via beta-plus decay, resulting in two gamma rays, each of energy 511 keV travelling in exactly opposite directions. Simultaneous detection of the two gamma rays in an array of detectors (a PET "camera") defines a line along which the annihilation occurred. Detection of a few such events in a very short time interval allows the position of the tracer particle to be triangulated in three dimensions. Location in space of the tracer particle may be achieved at a frequency up to 250 Hz with an accuracy which depends on the speed and activity of the tracer particle.]*

The one day event was summarised by Professor Patrick who said he found the day to have been a particularly interesting and varied one. He thanked the presenters and the attendees and wished all a safe journey home.

## **Hopley Lecture 2015 - "Fracking: Energy Security or a White Elephant"**

The Coal Research Forum has been fortunate to be given permission to reproduce the report of the 41<sup>st</sup> Hopley Lecture of the Minerals Engineering Society (MES) which appeared in their Spring 2015 newsletter. Our thanks go to the presenter of the lecture William Gagie MRICS, a partner in the Minerals Division of Fisher German LLP, and MES personnel Andrew Howells and Doug Jenkinson.

The title of the lecture was "Fracking: Energy Security or a White Elephant" and the presenter, William Gagie, has a wide background in minerals and was well qualified to advise the audience on the current situation and future expectations of fracking in the UK.

William started by explaining “the science behind the controversy”, describing what hydraulic fracturing involved technically and how the operators and advocates for the technology had allowed the protestors against it to establish strong initial opposition. This opposition has proven very hard for the energy companies to counteract, perhaps due to an ingrained British suspicion of big companies. The name “fracking” is now synonymous with water aquifer contamination and earthquakes due to misinformation, with much of the evidence on which this was based having now been discredited; slides showing a typical drilling operation demonstrated how little impact such sites could have on the surrounding landscapes once they are operational. The main environmental impacts would likely be road transport of water sand and the few additives required for viscosity/friction control of the high pressure pumping operations involved. Noise from the initial drilling rigs would also be a factor to consider so there would have to be strict environmental legislation applied to any commercial operation.

A possible weak link in fracking was identified as the strength of the well casings closest to the surface, not the effect of drilling vertical and horizontally to a depth of ~10,000 feet. Failure of such multi-layer concrete casings could contaminate surface aquifers. Accordingly, safety standards must protect against this. It is expected that each drill hole would have a 200m diameter “fracking effect” underground so a commercial site will carry out numerous “fracks” from each well and will probably sink several wells at each site to maximise production and minimise the number of planning applications.

William proceeded to look at various sources for UK gas including shale gas, coal bed methane and coal gasification and their possible future contributions to UK energy supply. Regarding shale gas, the latest BGS estimates for the Bowland Shale deposits indicate 1,329 trillion cubic feet (tcf) gas in place. Assuming a 10% recoverable figure this would result in 133tcf production. With current UK gas consumption at ~3tcfpa, this implies potentially over 40 years supply! But with so much uncertainty over proven reserves much more exploration and study is required to determine a realistic resource and some commercial sites need to start operating to determine actual recovery levels.

In order to encourage local communities to embrace fracking there are community impact payments available which may encourage site development. These are currently proposed at £100,000 per drill site, £20,000 per horizontal drill and 1% of revenue. In many cases this will amount to a large sum of money and how this is allocated and spent by local communities could have a big impact on public acceptance. Recent proposals by Ineos could further alter this. The latest situation is demonstrated by the PEDL submissions (the 14<sup>th</sup> Round) for developing new fracking sites which ended October 2014. Currently there are 120 oil and gas production sites in the UK plus a further 300 applications for a further 98 sites.

William ended his presentation not claiming to have all of the answers but he certainly asked all the right questions. Is it commercially sound in the current low oil price scenario to press ahead with such a controversial technology, despite it being such a success in the USA? They have gone from net importers of gas to exporters of gas on the back of fracking albeit in very different circumstances from the UK but even so some sites have become uneconomic at current energy prices. Will the UK consumer be prepared to pay above the market price for their energy in order to have some degree of energy security? Will the Government’s need for tax income lead them to promote UK production at the expense of imports?

The main questions following the presentation were based on the need to establish realistic estimates of shale gas reserves in the UK, whether or not it is commercially viable to process them at present. It is more about determining what we have for the future should it become commercially or strategically sensitive to develop.

## Newsletters from other organisations

IEA Clean Coal Centre Newsletter No. 87 June 2015

[http://www.iea-coal.org.uk/publishor/system/component\\_view.asp?LogDocId=83705&PhyDocId=9404](http://www.iea-coal.org.uk/publishor/system/component_view.asp?LogDocId=83705&PhyDocId=9404)

EU Energy Focus June 2015 Bulletin (see link below)

<https://uk-mg42.mail.yahoo.com/neo/launch?.partner=bt-1&.rand=b1tg7i81rpphp#mail>

EU Energy Focus July 2015 Bulletin (see link below)

<https://uk-mg42.mail.yahoo.com/neo/launch?.partner=bt-1&.rand=b1tg7i81rpphp#mail>

Brown Coal Innovation Australia Issue 14 (2015)

<http://www.bcinnovation.com.au/Issue142015>

Bettercoal Progress Report 2012 to 2014

[http://bettercoal.org/reporting?utm\\_source=International+Stakeholders&utm\\_campaign=b0a06647ab-Bettercoal\\_Newsletter\\_April\\_2015&utm\\_medium=email&utm\\_term=0\\_e715cda974-b0a06647ab-37270253](http://bettercoal.org/reporting?utm_source=International+Stakeholders&utm_campaign=b0a06647ab-Bettercoal_Newsletter_April_2015&utm_medium=email&utm_term=0_e715cda974-b0a06647ab-37270253)

## ARTICLES FROM THE TECHNICAL PRESS

### News alerts in coal and energy research

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

### German backlash grows against coal power clampdown

14th April 2015, Arthur Neslen, *The Guardian*

German energy companies say that construction of over half the country's planned power plants could be scuppered if the country goes ahead with a leaked plan to set emissions budgets for the country's biggest polluters. The proposed law would impose stiff financial penalties for the oldest and most inefficient coal and lignite plants, to be paid in the form of emissions trading certificates.

Clean energy industries and environmentalists see the plan, which would be phased in from 2017, as an essential step to meeting the government's energiewende blueprint for a 40% cut in carbon output by 2020. But a German energy industry association survey found that 53% of investors in power plants scheduled to come online in the next decade had frozen their involvement in the projects because of political uncertainty.

"If politicians carry on as they do now then there will be no new, modern power stations. There are no incentives whatsoever for investments, despite politicians emphasising all the time that they aim to change this," BDEW's managing director said in a statement on Monday. "It is also likely that further closures will follow."

For more visit:- <http://www.theguardian.com/environment/2015/apr/14/german-backlash-grows-against-coal-power-clampdown>

### Is switching from coal to gas better for the climate?

22<sup>nd</sup> April 2015, Harleigh Hobbs, *World Coal*

Switching from coal to gas is often considered one of the main ways to reduce greenhouse gas (GHG) emissions from the energy sector. Coal combustion releases large amounts of CO<sub>2</sub>, the main GHG, while natural gas (mostly methane) releases less CO<sub>2</sub> on combustion. However,

methane is a more powerful GHG than CO<sub>2</sub>, so if there is much leakage before the gas is used, the benefits of fuel switching will be diminished.

Methane is an important GHG, with a global warming potential (GWP) about 25 times that of CO<sub>2</sub> (over 100 years). However, the climate impacts of methane have been considered less harmful than CO<sub>2</sub> as less methane is emitted from combustion. It also has a relatively short residence time in the atmosphere (about 12 yr) compared to CO<sub>2</sub>. However, recent research is challenging this perception.

For more visit:- <http://www.worldcoal.com/power/22042015/Switching-from-gas-to-gas-better-for-climate-2203/>

### **US DoE: 'Clean coal' projects have captured, stored 10 million tons of CO<sub>2</sub>** **24<sup>th</sup> April 2015, Jaclyn Brandt, Fierce Energy**

The Department of Energy (DOE) has announced the safe capture of 10 million metric tons of carbon dioxide (CO<sub>2</sub>) from projects supported by the department through carbon capture and storage (CCS). According to DOE, the number is equivalent to removing more than 2 million vehicles from the roads in the United States for a year.

"This milestone builds on the Obama administration's goals of providing clean energy, supporting American jobs, and reducing emissions of carbon pollution," DOE said in a statement. "Rapid commercial development and deployment of clean coal technologies, particularly CCS, will help position the United States as a leader in the clean energy race."

For more visit:- <http://www.fierceenergy.com/story/doe-projects-saved-10-million-metric-tons-co2/2015-04-24>

### **From the carbon bubble to 'dirty energy'** **27<sup>th</sup> April, Helen Briggs, BBC News**

Leaving the "dirty stuff" in the ground is fast becoming the mantra of environmentalists, with the global campaign to move money out of fossil fuels gaining momentum. There is pressure to divest from oil and gas companies on the basis that they represent a "carbon bubble" of overvalued assets, but the industry says this stance is "simply naive". Here are some of the key questions.

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#### **Where does the idea of divestment come from?**

Rewind 30 years to the 1980s, when divestment meant ditching shares in South Africa during the apartheid era. Academics argue that divestment increased public visibility of the injustices of South Africa's apartheid government and contributed to its decline. Since then, similar movements have targeted a host of issues, such as sweatshop labour, use of landmines, and tobacco advertising. The fossil fuel divestment campaign is based on encouraging people to move their money away from fossil fuels and invest in sustainable energy.

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#### **Who is leading the way in getting out of fossil fuels?**

The campaign started in the US and has spread around the world. Hundreds of institutions controlling about £30bn of assets have now pledged not to invest in companies seen to fuel global warming. Among those in the UK who have signed up are universities and organisations such as Glasgow University and the British Medical Association. The Church of England, which has an investment portfolio of £9bn, has warned it could withdraw its investments from oil giants BP and Shell unless they do more to tackle climate change. There are also consumer campaigns, such as Move Your Money, which wants customers to put pressure on their banks to cut ties with "dirty energy".

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#### **What does the science say?**

Scientific studies show that existing fossil fuel reserves are several times greater than can be burned if the world's governments are to fulfil their pledge to keep global warming below the limit of 2C regarded as the threshold of dangerous climate change.

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### **What are the pros and cons?**

Some charities, such as the **Wellcome Trust**, say it is better to work with the energy companies involved to become more environmentally friendly rather than sell out on them. Others, including some scientists, take the view that expensive technologies such as carbon capture and storage could be a solution to the problem of carbon emissions and will need financial investment from industry as well as government. Many oil companies accept that some reserves will have to remain in the ground to tackle global warming. The practical approach is to burn the fossil fuels that are most cost-efficient and least "dirty". But some environmentalists say fossil fuel companies will never play a leading role in any move towards a low-carbon economy.

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### **What happens next?**

One view is that the recent drop in oil prices presents a once-in-a-lifetime opportunity for governments to get rid of fossil fuel subsidies and introduce a price on carbon. This generally goes against government thinking and concern over job losses in the oil and gas industry. With the divestment campaign gathering pace - and momentum building for the Paris climate talks in December - there is renewed hope among campaigners. But with environmental policies getting little attention in the UK election, and coal, oil and gas companies continuing to spend billions on exploration, NGOs are already upping their rhetoric in calling for renewed government efforts over climate change.

Source:- <http://www.bbc.co.uk/news/science-environment-32399908>

### **Captured CO2 could fuel a giant underground battery**

**27<sup>th</sup> April, Patrick J. Kiger, Discovery News**

Carbon dioxide generated by burning fossil fuels and other human activities is a big problem, when it comes to **climate change**. But researchers say that it actually may be possible not only to capture and store CO2 in the ground, but to transform it into the equivalent of a battery that would store energy from renewable sources and solve the supply fluctuations that hinder them as a replacement for coal.

An international group of scientists, which includes Lawrence Livermore National Laboratory researcher Tom Buscheck, recently proposed a design for such a carbon battery in a **paper** presented at the European **Geosciences Union general assembly in Vienna**. The idea is to store energy generated by renewable sources such as wind and solar power when electrical demand is low, and then tap into it at peak times. (The system could also store energy generated by burning coal as well.)

For more visit:- <http://news.discovery.com/earth/global-warming/captured-CO2-could-fuel-a-giant-underground-battery-150527.htm>

### **How the Fukushima disaster crippled Japan's climate plans**

**28<sup>th</sup> April 2015, Tim McDonnell, Mother Jones**

Japan used to have a pretty good reputation on climate change. Thanks to its robust industrial economy, it has the fourth-largest carbon footprint in the G20 nations. But it gets a sizable chunk of its power from zero-carbon sources like hydro dams and, at least until the 2011 disaster at Fukushima, nuclear plants. And in 2009, the country agreed, along with the other G8 nations, to reduce its carbon emissions 80 percent by 2050.

Back in 1992, Japan played host to the negotiations that led to the Kyoto Protocol, the first time a group of countries agreed to reduce their greenhouse gas emissions. Even though the United States never ratified the Kyoto Protocol, it was a groundbreaking agreement. But today, in the context of a decade and a half of additional scientific research, policy advances, and public pressure, it's woefully insufficient to ward off the worst effects of climate change. That's why the international community is planning to craft a new agreement to replace it in Paris later this year. And this time around, Japan isn't looking so hot.

For more visit:- <http://www.motherjones.com/environment/2015/04/fukushima-climate-shinzo-abe-obama>.

## **Germany to be hit by Vattenfall's coal-ateral damage**

**28<sup>th</sup> April 2015, Hardy Graupner, Deutsche Welle**

Swedish energy group Vattenfall has reported a steep drop in quarterly profits and announced job cuts. In Germany, the company wants to sell its lignite-fired plants, but one research institute has an alternative.

State-owned Vattenfall of Sweden reported Tuesday it would have to slash about 1,000 jobs of a global workforce of 30,000, citing a hefty plunge in first-quarter earnings. The company announced a 42-percent drop in bottom-line profits in the first three months of the year to 4.68 billion kronor (\$542 million, 499 million euros), compared with the same period a year earlier. Chief Executive Magnus Hall said reducing costs was the order of the day: "Demand for electricity remained weak during the first quarter of the year, and electricity prices have continued to fall." Besides operations in its home country, Vattenfall is active in Finland, Denmark, the Netherlands, Britain and Germany. Last year alone, electricity prices fell by an average of 22 percent in the Nordic countries, while in Germany they dipped by 13 percent.

For more visit:- <http://www.dw.com/en/germany-to-be-hit-by-vattenfalls-coal-ateral-damage/a-18413286>

## **Underground Coal Gasification future proposed for Longannet plant**

**5<sup>th</sup> May 2015, unattributed, The Courier**

A way to save Longannet's future has been mapped out by oil and gas industry veteran Algy Cluff. He believes his company's Underground Coal Gasification (UCG) development project can secure its future and help meet the UK's energy needs. A study has found as much as 335 million tonnes of coal near Kincardine and Cluff Natural Resources is seeking permission to build the UK's first deep offshore underground coal gasification project to extract it.

In the company's annual report, Mr Cluff said: "I believe the closure of Longannet poses a threat to the rest of the UK too and should lead to an increasing recognition of the importance of coal gasification in the country's energy equation." Mr Cluff said he was encouraged that a Scottish Government committee would this week report on how Scotland's energy mix should be constructed. "It is our corporate view that the future of Longannet (and Cockenzie and Grangemouth) can be secured by access to UCG," he said.

He estimated there was enough UCG coal in the Kincardine licence area to fire a major power station for 25 years. "The other two UCG licences in the Firth of Forth, which are larger, could provide energy security that Scotland requires without nuclear power," he continued. "The lower cost of UCG power generation would render export of electricity from Scotland again competitive."

Electricity generation from UCG syngas is independent of world natural gas prices which he said were sure to rise in the longer term. Another advantage is the output of a UCG production unit, unlike a conventional coal plant, was flexible and "an ideal match for the vagaries of renewable sources". The Scottish Government said it is taking a cautious, evidence-based approach to all issues relating to unconventional oil and gas, and UCG. There is also significant environmental opposition to UCG.

Source:- <http://www.thecourier.co.uk/business/news/underground-coal-gasification-future-proposed-for-longannet-plant-1.872003>

## **BANNED: "Experts agree - fracking won't cut our energy bills"**

**6<sup>th</sup> May 2015, unattributed, ClickGreen**

The Advertising Standards Authority (ASA) has this week banned a Greenpeace anti-fracking advert after ruling it is misleading because it claimed that fracking "won't cut our energy bills". Despite ruling that the statement can never be repeated in the form of an advert, it can be repeated as editorial here in the form of the 22 statements from experts and commentators submitted to the ASA to back up the claim...

1. Lord Browne, chairman of Cuadrilla: "We are part of a well-connected European gas market and, unless it is a gigantic amount of gas, it is not going to have material impact on price."

For more visit:-

<http://www.clickgreen.org.uk/opinion/opinion/125993-banned-experts-agree---fracking-wont-cut-our-energy-bills.html>

## **Activists call on EU to shut down £100m 'slush fund' for coal**

**15<sup>th</sup> May 2015, Arthur Neslen, The Guardian**

Environmentalists are demanding that the EU close a research fund which they claim offers coal companies tens of millions of pounds of public money in grants. The European commission's Research Fund for Coal and Steel (RFCS) has awarded €144m (£107m) to companies such as E.ON UK, RWE Npower and UK Coal Production Ltd, according to research by Greenpeace Energydesk.

Most of the money is spent on mining infrastructure, management and unconventional use of deposits, and on coal preparation and upgrading. Doug Parr, Greenpeace's chief scientist, said that the fund made little environmental, economic or scientific sense. "If big energy companies want to waste money on this kind of research, they should waste their own," he told the Guardian. "The EU should shut down this slush fund for the coal industry and use this money to foster innovation in the clean and smart technologies that will have to power our 21st-century low-carbon economy."

A commission spokesperson said that around €13m was given to the RFCS each year, and that the revenues should be considered "EU contributions" rather than public funds. The monies could provide up to 60% of costs for research projects, and half of pilot projects, the spokesperson added. Industry associations say that the fund is a trust that was mostly raised from its members before the European Coal and Steel Community was wound up in 2002.

"The funding is not 'public' [money] because the source of the money was a levy on the coal and steel industries. The commission administers the programme on behalf of member states," said Brian Ricketts, the secretary-general of Euracoal. "Given that 28% of electricity in EU comes from coal, it is not unreasonable to try to reduce emissions from that coal use," he added.

The EU is committed to reducing its carbon emissions 40% by 2030 on 1990 levels and funding for coal projects would seem to undermine this. But almost half of the fund's projects are for technologies that aim to reduce coal emissions, with 40% of the budget spent on 'clean coal' and carbon capture and storage technology.

Darek Urbaniak, the energy policy officer for WWF Europe, said: "Clean coal is an oxymoron the industry likes to use but it doesn't actually exist. The technology has never been implemented on an industrial scale. The Advertising Standards Authority (ASA) was quite clear in its ruling last year that it was misleading for coal firms to use the phrase."

Advertisement

The UK advertising watchdog ruled that 'clean coal' was an inaccurate term, because it implied that such coal did not produce CO<sub>2</sub>, or other emissions. A leaked statement to be issued by EU heads of state at a summit in June, seen by the Guardian, calls for member countries to encourage clean coal initiatives and technologies such as CCS as a means to completing the internal energy market.

Poland and the UK were prime movers in sculpting the text. In drafts also obtained by the Guardian, the UK successfully proposed that "indigenous resources" – code for shale gas and coal – be recognised as key drivers of energy security, instead of renewables. Britain also pushed for three positive references to "renewable energies" to be deleted from the statement.

The RFCS monies pale in comparison to the €10.1bn of subsidies that European countries gave to the coal industry in 2012 – the same amount as went to onshore wind, [according to an Ecofys study for the European commission](#).

Until this year, the commission had used its annual country-specific recommendations to call on states to reform their fossil fuel subsidies regimes. Such a call was for the first time absent from the 'streamlined' recommendations published on 13 May. Europe is currently the world's biggest producer of lignite, the world's dirtiest coal, and the third-largest importer of the fossil fuel. Source:-

<http://omnifeed.com/article/www.theguardian.com/environment/2015/may/15/activists-call-on-eu-to-shut-down-100m-slush-fund-for-coal>

### **Environmental risk assessment of sub-seabed carbon dioxide storage 15<sup>th</sup> May 2015, unattributed, ScienceDaily**

Can carbon dioxide (CO<sub>2</sub>) be stored safely below the seabed? A broad variety of experts from 27 institutions in nine European countries investigated possible risks of marine carbon dioxide capture and storage (CCS) and their consequences. The work of the multi-disciplinary consortium was coordinated at GEOMAR Helmholtz Centre for Ocean Research Kiel and funded by the European Union within its 7th framework programme with 10.5 million Euros. During expeditions to the Norwegian storage sites Sleipner and Snøhvit and to several natural CO<sub>2</sub> seepage sites (e.g. Aeolian Sea, Barents Sea, North Sea), ECO<sub>2</sub> scientists identified possible pathways for CO<sub>2</sub> leakages, monitored seep sites, traced the spread of CO<sub>2</sub> in bottom waters and studied the responses of benthic animals and plants to CO<sub>2</sub>. Their results and conclusions are compiled in a guide for the selection and monitoring of storage sites that has now been presented to the European Union.

For more visit:- <http://www.sciencedaily.com/releases/2015/05/150515083358.htm>

### **Thoresby Colliery to close in July 19<sup>th</sup> May 2015, unattributed, Chad**

Thoresby Colliery will close in July, coal bosses have confirmed. The remaining workers at the pit, which is thought to be between 300 and 400, will be paid up until then, even if all the coal from the existing seam has been mined. Hundreds have already been laid off as part of a winding-down operation since UK Coal announced last year that global coal prices had left it needing millions of pounds to remain open. Union chiefs argued that the mine was still profitable with enough coal in the ground to keep miners employed for a number years, and raised concerns over Britain's reliance on cheap, imported fuel.

For more visit:- <http://www.chad.co.uk/news/local/thoresby-colliery-to-close-in-july-1-7267566>

### **Germany may relax emission target of coal based power plants 19<sup>th</sup> May 2015, unattributed, Power Technology**

Germany is planning to soften the 2020 reduction targets for CO<sub>2</sub> emissions by coal power plants, after opposition to the plan. As per the previous plan, the coal-based power plants need to cut down their emissions by 22 million tonnes by 2020, but the revised plan could bring it down to 16 million tonne, Reuters reported.

The country's plans to impose a levy on the ancient and polluting energy generating facilities didn't go well with the industry. Thousands of workers in coal-fired plants protested in Berlin last month, as they believe that the step will affect their jobs. Germany has imposed the new regulations, as it intends to meet its target to bring down greenhouse gas emissions by 40% within five years, as compared to the 1990 levels.

German power developer RWE has however warned that enforcement of the levy would lead to immediate shut down of their lignite-fired power units. The original rule would require power plants aged 20 years or more to pay a penalty on CO<sub>2</sub> emitted above a limit of seven million tonnes per GW of installed capacity. The oldest facilities would receive an even harsher penalty.

The new proposal aims to increase the limit for older power stations by almost a third in order to push their profitability.

Reuters cited government sources as saying that the country will now support the use of combined heat and power plants since they are considerably more environmentally friendly. The proposal, which is yet to be approved by the authorities, is likely to help the country in achieving the remaining six million tonnes of CO2 emission cuts from the energy sector.

Source:- <http://www.power-technology.com/news/newsgermany-may-relax-emission-target-of-coal-based-power-plants-4580360>

### **Energy company SSE confirms Ferrybridge power station closure 20<sup>th</sup> May 2015, unattributed, BBC News**

A coal-fired power station deemed as "no longer economical" will close, an energy company has confirmed. SSE will shut the Ferrybridge power station on the West and North Yorkshire border by March 2016. Union leaders described the closure as "devastating news" for the plant's 172 employees, though SSE said it would redeploy staff "where possible". The firm is considering reopening the gas-fired power station at Keadby, near Scunthorpe, by the end of October. SSE said rising costs, the impact of environmental legislation and a forecast £100m loss over the next five years made the Ferrybridge site "unsustainable". Adjusted pre-tax profit for the 12 months to the end of March was £1.56bn, compared with £1.55bn the year before. It lost 500,000 customers in the period, which it blamed on competition from smaller providers.

For more visit:- <http://www.bbc.co.uk/news/business-32806766>

### **Carbon tax was misjudged and made coal uneconomic 26<sup>th</sup> May 2015, Tony Lodge, The Telegraph**

The shock announcement of the early closure of one of Britain's biggest power stations, at Ferrybridge in West Yorkshire – seven years before it needed to be closed – has come as a body blow to Britain's energy security. It comes just two months after Scotland's biggest power plant similarly announced it would close next year due to policies, introduced by the Coalition, which had rendered the plant uneconomic.

Ferrybridge, near Castleford, started generating electricity in 1966. It was one of the biggest coal-fired power stations in the country, generating over 2,000 megawatts of power for the National Grid. In 2014, half of the plant stopped operating, as it had not been updated to meet strict new EU emissions rules. But capacity for a crucial 1,000MW – enough power to supply electricity to around a million homes – was expensively updated to run for almost another decade.

So why has the power station closed early, citing soaring running costs, when coal prices are at an eight-year low and when it was modernised to stay open until 2023? The Carbon Price Floor is arguably one of the most hidden and unknown but ultimately damaging pieces of modern industrial taxation. To use a shorter and more descriptive title, this carbon tax is slowly forcing the premature closure of the backbone of our electricity generating base.

It comes at a time when electricity generating margins, according to National Grid, have never been tighter. Earlier this year Scottish Power announced the closure of the largest power station in Scotland, at Longannet in Fife. Longannet is a huge 2,400MW plant; the company had hoped this plant would be generating well into the 2020s and had recently invested significant capital. These closures together will combine to reduce Britain's peakload electricity generating capacity by 6pc.

So what is the Carbon Price Floor tax, why is it so damaging and why did a Conservative-led Treasury introduce it? In theory it is a straightforward new tax, enabling the Treasury to raise billions – but the side-effects were clearly never examined, understood or accepted. They are disastrous, as we are now seeing, by threatening future supplies. For more visit:-

<http://www.telegraph.co.uk/finance/newsbysector/energy/11631729/Carbon-tax-was-misjudged-and-made-coal-uneconomic.html>

## **Fossil industry faces a perfect political and technological storm**

**27<sup>th</sup> May 2015, Ambrose Evans-Pritchard, The Telegraph**

The political noose is tightening on the global fossil fuel industry. It is a fair bet that world leaders will agree this year to impose a draconian "tax" on carbon emissions that entirely changes the financial calculus for coal, oil, and gas, and may ultimately devalue much of their asset base to zero.

The International Monetary Fund has let off the first thunder-clap. An astonishing report - blandly titled "How Large Are Global Energy Subsidies" - alleges that the fossil nexus enjoys hidden support worth 6.5pc of world GDP.

This will amount to \$5.7 trillion in 2015, mostly due to environmental costs and damage to health, and mostly stemming from coal. The World Health Organisation - also on cue - has sharply revised up its estimates of early deaths from fine particulates and sulphur dioxide from coal plants. The killer point is that this architecture of subsidy is a "drag on economic growth" as well as being a transfer from poor to rich. It pushes up tax rates and crowds out more productive investment. The world would be richer - and more dynamic - if the burning of fossils was priced properly. For more visit:-

<http://www.telegraph.co.uk/finance/economics/11633745/Fossil-industry-faces-a-perfect-political-and-technological-storm.html>

## **Plan launched to prevent critical climate change by making green energy cheaper than coal**

**2<sup>nd</sup> June 2015, Steve Connor, The Independent**

Scientists and economists have joined forces to launch a global research initiative to make green energy cheaper than coal within 10 years, a target they believe is critical to avoid dangerous climate change. They have compared the goal to the Apollo programme of the 1960s when the United States stated that it would put a man on the Moon by the end of the decade. Leading academics, including former government chief scientist Sir David King, past president of the Royal Society Lord Rees, and economists Lord Stern and Lord Layard, in effect said that the world cannot be saved from global warming unless coal – the dirtiest fossil fuel – is put out of business.

They have called the plan the Global Apollo Programme and hope to recruit countries from around the world in an international commitment to boost research and development into key areas of renewable energy, storage and electricity transmission. By 2025, they hope the research will mean that wind, solar and other forms of green energy will be able to undercut the cost of burning coal to generate power, making it feasible to keep within the critical 2C increase in global temperatures needed to prevent dangerous climate change. For more visit:-

<http://www.independent.co.uk/news/science/plan-launched-to-prevent-critical-climate-change-by-making-green-energy-cheaper-than-coal-10290467.html>

## **How Europe's climate policies led to more U.S. trees being cut down**

**2<sup>nd</sup> June 2015, Joby Warwick, The Washington Post**

Oak City, N.C. USA. For the sake of a greener Europe, thousands of American trees are falling each month in the forests outside this cotton-country town. Every morning, logging crews go to work in densely wooded bottomlands along the Roanoke River, clearing out every tree and shrub down to the bare dirt. Each day, dozens of trucks haul freshly cut oaks and poplars to a nearby factory where the wood is converted into small pellets, to be used as fuel in European power plants.

Soaring demand for this woody fuel has led to the construction of more than two dozen pellet factories in the Southeast in the past decade, along with special port facilities in Virginia and

Georgia where mountains of pellets are loaded onto Europe-bound freighters. European officials promote the trade as part of the fight against climate change. Burning "biomass" from trees instead of coal, they say, means fewer greenhouse gases in the atmosphere.

But that claim is increasingly coming under challenge. A number of independent experts and scientific studies — including a new analysis released Tuesday — are casting doubt on a key argument used to justify the cutting of Southern forests to make fuel. In reality, these scientists say, Europe's appetite for wood pellets could lead to more carbon pollution for decades to come, while also putting some of the East Coast's most productive wildlife habitats at risk. For more visit:- [http://www.washingtonpost.com/national/health-science/how-europes-climate-policies-have-led-to-more-trees-cut-down-in-the-us/2015/06/01/ab1a2d9e-060e-11e5-bc72-f3e16bf50bb6\\_story.html](http://www.washingtonpost.com/national/health-science/how-europes-climate-policies-have-led-to-more-trees-cut-down-in-the-us/2015/06/01/ab1a2d9e-060e-11e5-bc72-f3e16bf50bb6_story.html)

## **Five G7 nations increased their coal use over a five-year period, research shows**

**8<sup>th</sup> June 2015, Jon Vidal, The Guardian**

Five of the world's seven richest countries have increased their coal use in the last five years despite demanding that poor countries slash their carbon emissions to avoid catastrophic climate change, new research shows. Britain, Germany, Italy, Japan and France together burned 16% more coal in 2013 than 2009 and are planning to further increase construction of coal-fired power stations. Only the US and Canada of the G7 countries meeting on Monday in Berlin have reduced coal consumption since the Copenhagen climate summit in 2009.

The US has reduced its coal consumption by 8% largely because of fracking for shale gas. Overall, the G7 countries reduced coal consumption by less than 1% between 2009-2013, the Oxfam research shows. The briefing paper comes as nearly 200 countries meet in Bonn ahead of crunch climate talks in Paris later this year, and shows that G7 coal plants emit twice as much CO<sub>2</sub> as the entire African continent annually, and 10 times as much as the 48 least developed countries put together. The result, says Oxfam, will be that G7 coal emissions alone could cost African countries over £40bn a year in climate-related costs by the 2080s. For more visit:- <http://www.theguardian.com/environment/2015/jun/08/five-g7-nations-increased-their-coal-use-over-a-five-year-period-research-shows>

## **China 'making progress on carbon emissions', say British researchers**

**8<sup>th</sup> June 2015, unattributed, The Telegraph**

In a boost for hopes to curb climate change, China's greenhouse gas emissions will probably begin to decline in 2025, five years earlier than its stated target, a study said on Monday. On current trends, the world's biggest polluter will reach a peak annual emission of 12.5-14 billion tonnes of carbon dioxide equivalent (GtCO<sub>2</sub>e) in ten years' time, after which emissions will decline, it said. The work was carried out by two research institutes at the London School of Economics (LSE). For more see:- <http://www.telegraph.co.uk/news/worldnews/asia/china/11658688/China-making-progress-on-carbon-emissions-say-British-researchers.html>

## **Fighting climate change, with cement**

**12<sup>th</sup> June 2015, unattributed, ScienceDaily**

Membrane-based technology developed at the Norwegian University of Science and Technology (NTNU) is one of four technologies that may be used in a full-scale CO<sub>2</sub> capture project -- in a cement factory.

Gassnova, Norway's state-funded effort to develop carbon capture and storage (CCS) technologies for commercial use, has identified Norcem's cement plant in Brevik and Yara's ammonia plant in Porsgrunn as the most promising candidates for a full-scale CCS demonstration project in Norway. The decision was submitted to Norway's Ministry of Petroleum and Energy (OED) as part of a pre-feasibility study on 4 May. "We've shown that

membrane technology works, and are hoping it will be included in the next test phase in Brevik," says May-Britt Hägg, a professor in NTNU's Department of Chemical Engineering. "If we succeed here, we'll have a prototype that will be of interest to both power stations and industry," she adds. For more visit:-

<http://www.sciencedaily.com/releases/2015/06/150612091148.htm>

## **Little faith in carbon capture in the EU and USA**

**29<sup>th</sup> June 2015, unattributed, ScienceDaily**

"There's a sombre mood among people who work with carbon capture and storage now. Lobbyists in the US and the EU wonder how much longer they can keep going," says Mads Dahl Gjefsen, a scientist at the TIK Centre of Technology, Innovation and Culture at the University of Oslo.

In his PhD thesis: "Vehicle or destination? Discordant perspectives in CCS advocacy", he has studied how different players work to gain support for CCS. Murkiness in the corridors of Power Norway has invested several billion kroner in the research and development of carbon capture and storage (CCS). The technology was intended to reduce emissions from the oil and gas industry, and in 2007 former Prime Minister Jens Stoltenberg said that CCS would be Norway's moon landing. But a full-scale treatment plant at Mongstad never came to fruition. The major challenge has been that the technology is energy-intensive and too costly for large-scale use. And this is not just a Norwegian problem.

According to Gjefsen, the enthusiasm for CCS in the corridors of power has gradually dissipated in both the USA and EU. "In the aisles at carbon capture conferences, you hear that things look bleak. Publicly, they speak of urgency and the fear that it will not work." During the last four years, he has observed and interviewed a number of players in the industry, environmental organizations and government. In formal interviews as well as more unofficial conversations, he found uncertainty about the technology's future. For more visit:-

<http://www.sciencedaily.com/releases/2015/06/150629080156.htm>

## **Carbon capture and storage safety investigated**

**1<sup>st</sup> July 2015, unattributed, ScienceDaily**

A significant step has been made for potential Carbon Capture and Storage (CCS) deployment, with the publication of the results from the world's first experiment into the realistic simulation of potential environmental impact of a submarine CO<sub>2</sub> leakage. These results were published in a special issue of the *International Journal of Greenhouse Gas Control* (IJGCC) recently.

This innovative research was conducted as part of the QICS project and forms part of a wider programme of UK research into CCS technology. The research found that, for a leak of this scale, the environmental impact was limited; restricted to a small area and with a quick recovery of both the marine chemistry and biology.

This ground-breaking experiment involved the injection of 4.2 tonnes of CO<sub>2</sub> into to a site 11 meters below the sea bed, and overlying water-column 15 m in depth in Ardmucknish Bay, West Scotland. The injection took place over 37 days via a borehole drilled through the seafloor bedrock. The progress of this injection was then monitored using a combination of geochemical and geophysical sensors and observations from divers. For more visit:-

<http://www.sciencedaily.com/releases/2015/07/150701115144.htm>

## **Germany to mothball largest coal power plants to meet climate targets**

**2<sup>nd</sup> July 2015, unattributed, The Guardian**

Germany agreed on Thursday to mothball about five of the country's largest brown coal power plants to meet its climate goals by 2020, after months of wrangling between the parties in chancellor Angela Merkel's coalition. But Merkel and the leaders of her two junior coalition partners also, in effect, agreed to set up a "capacity reserve" system where utilities could switch on the brown coal plants if there were power shortages in the country.

An economy ministry spokesman said the decision on brown coal would mean Germany could meet its goal of reducing German CO<sub>2</sub> emissions by 40% by 2020 compared to 1990. The goal is much more ambitious than the EU-wide target of the same cut by 2030. "Brown coal-fired plants with a capacity of 2.7 gigawatts will be mothballed. Those plants will not be allowed to sell any electricity on the normal power market," said a spokesman for the economy ministry after the talks which lasted four hours. In a television interview, economy minister Sigmar Gabriel expanded on the plans, which are part of Germany's switch to renewable energy away from nuclear and fossil fuels. For more visit:-

<http://www.theguardian.com/environment/2015/jul/02/germany-to-mothball-largest-coal-power-plants-to-meet-climate-targets>

### **New coal plants 'most urgent' threat to the planet, warns OECD head** **3<sup>rd</sup> July 2015, Fiona Harvey, The Guardian**

Governments must rethink plans for new coal-fired power plants around the world, as these are now the "most urgent" threat to the future of the planet, the head of the OECD has warned. In unusually strong terms for the organisation – best known as a club of the world's richest countries – its secretary general Angel Gurría, told governments to think "twice, or three, or four times" before allowing new coal-fired plants to go ahead. "They will still be emitting years from now," he warned. As a result, many could turn into "stranded assets", having to be mothballed decades before their economic lifetime had expired. "We are on a collision course with nature," he warned.

New research, published by the OECD on Thursday, has found that, on current trends, coal-fired power generation will result in more than 500bn tonnes of carbon dioxide released into the atmosphere between now and 2050. That is the equivalent of about half of the "carbon budget" – the amount of greenhouse gas that we can safely pour into the atmosphere – for this half-century, if we are to stay within the 2C limit that is widely agreed as the threshold for dangerous climate change. For more visit:-

<http://www.theguardian.com/environment/2015/jul/03/new-coal-plants-most-urgent-threat-to-the-planet-warns-oecd-head>

### **Brown coal wins a reprieve in Germany's transition to a green future** **7<sup>th</sup> July 2015, Christian Schwägerl, The Guardian**

The hole in the landscape that opens up in front of the group of visitors is so vast and deep that some of them simply stare, mouths agape. "This mine will be active until 2026 or 2027," says Barbara Wittig, a guide with a local operator of excursions into one of Germany's largest open-pit lignite mines.

Down below at the bottom of the mine, workers are busy running gigantic machines to remove the topsoil and dig deep into a layer of brown coal, or lignite. These rich seams of fossil fuel have provided the Lausitz region, 60 miles southeast of Berlin, with jobs and incomes for more than a century. "We certainly hope that mining will continue after 2027 and we keep producing reliable electricity in our beautiful power plants," Wittig says, pointing toward large cooling towers on the horizon, which send steam into the atmosphere.

These towers also spew a much more problematic gas: The three regional coal-fired power plants — Jänschwalde, Boxberg, and Schwarze Pumpe — are among the largest point-sources of CO<sub>2</sub> emissions in the world. In recent months, Welzow-Süd and other lignite mines have become the subject of heated controversy in Germany as their continuing operations clash with the country's ambitions of being a green energy powerhouse. That conflict has sparked a battle over imposing a special "climate fee" on coal-fired power plants.

Germany is Europe's largest economy, and its wealth depends heavily on exporting industrial goods made with cheap electricity. Lignite is the cheapest source of electricity from fossil fuels,

and Germany has the world's largest reserves of it. But lignite causes the highest CO2 emissions per ton when burned, one-third more than hard coal and three times as much as natural gas.

Yet Germany also has the most ambitious green energy strategy of all the industrialized nations — the *Energiewende*, or energy transformation. After the Fukushima nuclear disaster, Germany's conservative chancellor, Angela Merkel, vowed to phase out all nuclear power plants by 2022, while simultaneously sticking to the pre-existing goal of reducing national CO2 emissions 4% below 1990 levels by 2020 and by 80 to 90% by 2050. For more visit:-

<http://www.theguardian.com/environment/2015/jul/07/brown-coal-wins-a-reprieve-in-germanys-transition-to-a-green-future>

### **Study finds shale gas can be worse for the climate than burning coal**

**7<sup>th</sup> July 2015, unattributed, ClickGreen**

Drilling for shale gas is releasing so much potent greenhouse gas into the atmosphere it should now be considered more damaging to the environment than burning coal, a new study reveals.

Researchers from the University of Houston found that some natural gas wells, compressor stations and processing plants in the Barnett Shale leak far more methane (CH4) than previously estimated, potentially offsetting the climate benefits of natural gas. The study is one of 11 papers published in *Environmental Science & Technology*, all looking at fugitive methane emissions in the Barnett Shale. That region, site of the first widespread shale development in the United States, includes Dallas-Fort Worth and almost two dozen counties to the west and south. The studies were coordinated by the Environmental Defense Fund, with funding from the Alfred P. Sloane Foundation. All field measurements were conducted over 15 days in October 2013. For more visit:-

<http://www.clickgreen.org.uk/research/data/126243-study-finds-shale-gas-can-be-worse-for-the-climate-than-burning-coal.html>

### **This town has been burning for 50 years**

**13<sup>th</sup> July 2015, Julia Caldarone, Business Insider UK**

In what seems like the plot to a disaster movie, the quiet town of Centralia, Pennsylvania has endured a burning problem since 1962: It's been on fire, literally, for the past 53 years. And how this fire started still remains a mystery. But chemistry can help explain why it's still going. Today, the Centralia fire covers six square miles and spreads 75 feet per year. Shockingly, it could burn for another 250 years. For more read:- <http://uk.businessinsider.com/coal-mines-in-centralia-pennsylvania-have-been-burning-since-1962-2015-7?r=US&IR=T>

### **Coal is not dead: New study describes forces behind the 'coal renaissance'**

**13<sup>th</sup> July 2015, Clint Jasper, ABC On-line**

While some are calling the current depressed state of the coal market "the end of coal", a new study has revealed it is actually undergoing a renaissance. In fact, global coal consumption has risen dramatically in the past decade according to the paper, published in the *Proceedings of the National Academy of Sciences of the United States*. The amount of coal consumed by developing and emerging countries has risen from one gigatonne in 1990 to 3.7 gigatonnes in 2011.

Mercator Research Institute on Global Commons and Climate Change researchers Jan Steckel, Ottmar Edenhofer, and Michael Jakob chose to call it a renaissance, because not only is coal's share of the global energy mix growing, but its past role in fuelling the growth of industry in the developed world is being played out again in countries like Vietnam, Indonesia, and the Philippines.. In countries like Australia investment in coal-exporting capacity at ports has made coal accessible for countries that do not have their own reserves. China and India are often singled out as big consumers of coal, and emitters of CO2, but Mr Steckel said the investment in new coal assets like power stations was occurring among a much wider set of countries.

For more visit:- <http://www.abc.net.au/news/2015-07-13/world-witnessing-coal-renaissance/6607432>

### **Mercury scrubbers at power plant lower other pollution too** **15<sup>th</sup> July 2015, unattributed, ScienceDaily**

Portland General Electric added emission control systems at its generating plant in Boardman, Oregon, in 2011 to capture and remove mercury from the exhaust. Before-and-after measurements by a team of OSU scientists found that concentrations of two major groups of air pollutants went down by 40 and 72 percent, respectively, after the plant was upgraded. The study was published in the journal *Environmental Science & Technology* this month.

The pollutants in question are from a family of chemicals called polycyclic aromatic hydrocarbons (PAHs), which are formed from incomplete combustion of fossil fuels and organic matter. PAHs are a health concern because some are toxic, and some trigger cell mutations that lead to cancer and other ailments. For more visit:-

<http://www.sciencedaily.com/releases/2015/07/150715140904.htm>

### **New family of chemical structures can effectively remove CO2 from gas mixtures**

**15<sup>th</sup> July 2015, unattributed, ScienceDaily**

A newly discovered family of chemical structures, published in *Nature* today, could increase the value of biogas and natural gas that contains carbon dioxide. The new chemical structures, known as zeolites, have been created by an international team of researchers including Professor Xiaodong Zou and co-workers from the Department of Materials and Environmental Chemistry at Stockholm University. For more visit:-

<http://www.sciencedaily.com/releases/2015/07/150715130735.htm>

### **Fossil fuel emissions will complicate radiocarbon dating**

**20<sup>th</sup> July 2015, unattributed, ScienceDaily**

Fossil fuel emissions could soon make it impossible for radiocarbon dating to distinguish new materials from artefacts that are hundreds of years old. Radiocarbon measurements have a range of uses, from analysing archaeological finds, to detecting fraudulent works of art, to identifying illegal ivory trading, to assessing the regeneration of brain cells in neurological patients.

The new study suggests that some of these current uses will be affected over this century, depending on how much fossil fuel emissions increase or decrease. "If we reduced fossil fuel emissions, it would be good news for radiocarbon dating," said the study's author, Dr Heather Graven from the Department of Physics and the Grantham Institute - Climate Change and Environment at Imperial College London. For more visit:-

[http://www.sciencedaily.com/releases/2015/07/150720154505.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/2015/07/150720154505.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter+energy%2Ffossil+fuels+%28Fossil+Fuels+News+---+ScienceDaily%29)

### **Fracking impact on CO2 cuts in US emissions 'a myth'**

**22<sup>nd</sup> July 2015, Matt McGrath, BBC News**

New research suggests that the impact of shale gas on curbing US carbon emissions has been overstated. Politicians have argued that the US was able to significantly reduce CO2 between 2007 and 2013 because of fracking. But scientists now believe an 11% cut in emissions in that period was chiefly due to economic recession.

The study suggests that the future impacts of shale as a way of curbing carbon may be limited. Between 2007 and 2013 US emissions of carbon dioxide, mainly from the burning of fossil fuels, declined significantly. By 2012, levels of CO2 from the US were running 5% below the total for 1997. For more visit:-

<http://www.bbc.co.uk/news/science-environment-33612293>

## **Technology developed to reduce cost of purifying natural gas**

**29<sup>th</sup> July 2015, unattributed, ScienceDaily**

A team of researchers in the Queen's University Ionic Liquid Laboratories (QUILL) Research Centre has developed an innovative technology that uses a mixture of water and ionic liquids (salts which are liquid under ambient conditions) to remove carbon dioxide from raw natural gas extracted from natural reservoirs under the sea.

The new process is aimed at reducing the global environmental and economic costs of purifying natural gas, which is by far the cleanest burning fuel available in large amounts. In comparison to current conventional 'amine' purifying systems, which use volatile and corrosive materials, the new ionic liquid system is safer, more efficient, and more environmentally friendly.

For more visit:-

[http://www.sciencedaily.com/releases/2015/07/150729093020.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/2015/07/150729093020.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fmatter_energy%2Ffossil_fuels+%28Fossil+Fuels+News+---+ScienceDaily%29)

## **UK May thermal coal consumption at multi-year low: DECC**

**30<sup>th</sup> July, Gareth Carpenter, Platts**

The UK's thermal coal consumption in May slumped to 1.88 million mt, down 27% on the year and the lowest for the time of year since records started in 1995, according to data by the Department of Energy and Climate Change Thursday. Thermal coal burn in the first five months of 2015 was 15.86 million mt, down 20% on-year and also a record low for the 20-year period.

DECC said the decline in consumption was due to a number of reasons including outages at some power stations, the closure of the Uskmouth plant in Wales, the partial closure of the Ferrybridge C unit in 2014, a 645 MW unit at Drax Power converting to biomass and changes in the relative prices of coal and gas. For more visit:-

<http://www.platts.com/latest-news/coal/london/uk-may-thermal-coal-consumption-at-multi-year-26163313>

## **Obama to require steeper emissions cuts from US power plants**

**2<sup>nd</sup> August 2015, Josh Lederman, Yahoo News**

President Barack Obama will impose even steeper cuts on greenhouse gas emissions from U.S. power plants than previously expected, senior administration officials said Sunday, in what the president called the most significant step the U.S. has ever taken to fight global warming. A year after proposing unprecedented carbon dioxide limits, the Obama administration was poised to finalize the rule at a White House event on Monday. Obama, in a video posted to Facebook, said the limits were backed up by decades of data and facts showing that without tough action, the world will face more extreme weather and escalating health problems like asthma. For more visit:-

<http://news.yahoo.com/obama-unveil-final-power-plant-emissions-limits-monday-041509480--politics.html>

## **Stop burning fossil fuels now: there is no CO2 'technofix', scientists warn**

**3<sup>rd</sup> August 2015, Tim Radford, The Guardian**

German researchers have demonstrated once again that the best way to limit climate change is to stop burning fossil fuels now. In a "thought experiment" they tried another option: the future dramatic removal of huge volumes of carbon dioxide from the atmosphere. This would, they concluded, return the atmosphere to the greenhouse gas concentrations that existed for most of human history – but it wouldn't save the oceans. That is, the oceans would stay warmer, and more acidic, for thousands of years, and the consequences for marine life could be catastrophic.

The research, published in Nature Climate Change today delivers yet another demonstration that there is so far no feasible “technofix” that would allow humans to go on mining and drilling for coal, oil and gas (known as the “business as usual” scenario), and then geoengineer a solution when climate change becomes calamitous. For more visit:-

<http://www.theguardian.com/environment/2015/aug/03/stop-burning-fossil-fuels-now-no-co2-technofix-climate-change-oceans>

### **CU-Boulder researchers use wastewater treatment to capture CO<sub>2</sub>, produce energy**

**4<sup>th</sup> August 2015, unattributed, EurekAlert!**

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.

"This energy-positive, carbon-negative method could potentially contain huge benefits for a number of emission-heavy industries," said Zhiyong Jason Ren, an associate professor of Civil, Environmental, and Architectural Engineering at CU-Boulder and senior author of the new study, which was recently published in the journal *Environmental Science and Technology*.

For more visit:- [http://www.eurekalert.org/pub\\_releases/2015-08/uoca-cru080315.php](http://www.eurekalert.org/pub_releases/2015-08/uoca-cru080315.php)

### **New study calls on Indonesia to scrap coal and save lives**

**13<sup>th</sup> August 2015, Jean Chua, Eco-Business**

Indonesia's plan to build more than 100 new coal-fired power plants over the next five years could result in the premature deaths of as many as 28,300 people a year, according to new research done by Harvard University and Greenpeace Southeast Asia.

To prevent such unnecessary deaths, the researchers are calling on Indonesia to reduce or even eliminate the use of coal in power generation, which is the biggest source of greenhouse gases in the world. In a report published on Wednesday, the team at Harvard University's Atmospheric Chemistry Modelling Group revealed that each year, about 6,500 Indonesians already die from pollution generated by existing coal-fired plants, which fill the air with toxic substances including mercury, lead, arsenic, and cadmium. For more visit:-

<http://www.eco-business.com/news/new-study-calls-on-indonesia-to-scrap-coal-and-save-lives/>

## EPSRC new projects started after 1<sup>st</sup> September 2014

### Conventional Generation & Combustion Projects

Grant reference no	Title	Start date	End date	Organisation	Value (£)
EP/M015300/1	Advanced Gas Turbine cycles for high efficiency and sustainable future conventional generation	01.06.15	31.05.18	I.C. London	971,987
EP/M023893/1	CFD Modelling of the acoustic response of sprays	01.11.15	30.04.17	Loughborough University	97,129
EP/M005755/1	Evaporative Cooling of Internal Combustion Engines	23.02.15	22.02.18	University of Sussex	671,814
EP/N5084X/1	Innovative Low Carbon, High Fuel Efficiency Power Generation Technology	01.03.15	28.02.17	Brunel University London	230,046
EP/M002608/1	Investigation of vortex ring-like structures in internal combustion engines, taking into account thermal and confinement effects	01.06.15	31.05.18	University of Brighton	374,417
EP/50856/1	Multistage Ejectors for Flare Gas Recovery	01.07.15	30.06.16	University of Nottingham	74,862
EP/M015351/1	Opening New Fuels for UK Generation	01.07.15	31.03.18	Imperial College London	1,035,606
EP/M02203X/1	Pore-Scale Study of Gas Flows in Ultra-tight Porous Media	01.04.15	30.11.18	Heriot-Watt University	163,538
EP/M021475/1	Pore-Scale Study of Gas Flows in Ultra-tight Porous Media	01.06.15	30.11.18	University of Strathclyde	379,691
EP/M009424/1	Ultra Efficient Engines and Fuels	01.06.15	31.01.18	University of Brighton	2,999,605
EP/M01536X/1	Ultra-Supercritical (USC) steam power generation technology with Circulating Fluidized Bed (CFB): Combustion, Materials and Modelling (USC-CFB-CMM)	01.02.15	31.03.18	University of Nottingham	1,033,385

**£8,032,080**

### CCS projects

Grant reference no	Title	Start date	End date	Organisation	Value (£)
EP/K035355/2	Bio-inspired sulfide nanocatalysts: From proof of concept to 'real' catalysis	01.01.15	31.10.16	Cardiff University	769,968
EP/N508615/1	Combined Energy Recovery & CO2 Removal Project (CoECR Project)	01.01.15	31.12.15	Cranfield University	147,622
EP/M001369/1	Multi-scale Energy Systems Modelling Encompassing Renewable, Intermittent, Stored Energy and Carbon Capture and Storage (MESMERISE-CCS)	20.10.14	19.10.18	Imperial College London	996,574
EP/N007859/1	Multi-scale engineering toolbox for systematic assessment of porous materials in the context of adsorption and membrane separations	15.01.16	14.07.18	University of Edinburgh	764,651
EP/M001342/1	Organic Mixed Matrix Membrane Technologies (ORGMEMT) for Post-Combustion CO2 Capture	31.12.14	30.12.18	University of Liverpool	826,848

EP/M001458/1	Process Intensification for Post-combustion Carbon Capture using Rotating Packed Bed through Systems Engineering Techniques	01.10.14	31.03.18	University of Hull	1,274,437
EP/M001482/1	Selective Exhaust Gas Recirculation for Carbon Capture with Gas Turbines: Integration, Intensification, Scale-up and Optimisation.	01.12.14	30.11.17	Cardiff University	1,099,891

**£5,879,991**

### BIOENERGY projects

Grant reference no.	Title	Start date	End date	Organisation	Value (£)
EP/M007960/1	Design of advanced biofuels through optimisation of fuel molecular structure	01.03.15	28.02.18	UCL	306,773
EP/L014912/1	EPSRC Centre for Doctoral Training in Bioenergy	01.10.14	31.03.23	University of Leeds	4,336,514
EP/M013200/1	Measurement and Analysis of bioenergy greenhouse gases: Integrating GHGs into LCAs and the UK Biomass Value Chain Modelling Environment (MAGLUE)	01.03.15	28.02.18	University of Southampton	993,785
EP/M013162/1	Novel low energy plasma/catalytic gas cleaning process to deliver high quality syngas from the gasification of waste biomass	01.01.15	31.12.17	University of Leeds	911,539
EP/M01343X/1	<u>Real time control of gasifiers to increase tolerance to biomass variety and reduce emissions</u>	02.03.15	01.03.18	University of Glasgow	999,756
					<b>£7,548,367</b>

## CALENDAR OF COAL RESEARCH MEETINGS AND EVENTS

Date	Title	Location	Contact
16 <sup>th</sup> to 17 <sup>th</sup> September 2015	5 <sup>th</sup> IEA CCC Workshop on Co-firing Biomass with Coal	Drax power station, Yorkshire	For details visit:- <a href="http://cofiring5.coalconferences.org/ibis/cofiring5/home">http://cofiring5.coalconferences.org/ibis/cofiring5/home</a>
5 <sup>th</sup> to 8 <sup>th</sup> October 2015	International Pittsburgh Coal Conference	University of Pittsburgh, Swanson School of Engineering	For details visit:- <a href="http://www.engineeringx.pitt.edu/pcc/">http://www.engineeringx.pitt.edu/pcc/</a>
Tuesday 6 <sup>th</sup> October 2015	The 2015 Energy Science Lecture Organised by the Biomass and Fossil Fuel Research Alliance, (BF2RA), with sponsorship from the British Coal Utilisation Research Association, (BCURA), to be presented by Prof. Rachel Thompson, University of Loughborough	The Chartered Accountants' Hall, 1, Moorgate Place, London, EC2R 6EA	Mr. J.D.Gardner, BF2RA Company Secretary, Gardner Brown Ltd., Calderwood House, 7 Montpellier Parade, Cheltenham, GLOS , GL50 1UA. Tel : 01242-224886 Fax : 01242-577116 E-mail : <a href="mailto:john@gardnerbrown.co.uk">john@gardnerbrown.co.uk</a>

Thursday 15 <sup>th</sup> October 2015	<b>Carbon Capture and Storage : What Role for R&amp;D in Delivering Cost-competitive CCS Projects in the UK in the 2020s?</b> Joint Event between the CRF, CCSA, APGTF, UKCCSRC and the KTN	Mary Sumner House, 24 Tufton St, Westminster, London, SW1P 3RB	To register to attend this event please use the link below:- <a href="http://ccs-15oct2015.eventbrite.co.uk">http://ccs-15oct2015.eventbrite.co.uk</a> For more details of this event, please contact Jenni McDonnell <a href="mailto:Jenni.mcdonnell@ktn-uk.org">Jenni.mcdonnell@ktn-uk.org</a>
17 <sup>th</sup> to 20 <sup>th</sup> November 2015	11 <sup>th</sup> Workshop on mercury emissions from coal	GRT Grand Hotel, Chennai, Tamil Nadu, India	For details visit:- <a href="http://mec11.coalconferences.org/ibis/MEC11/home">http://mec11.coalconferences.org/ibis/MEC11/home</a>
Tuesday 1 <sup>st</sup> and Wednesday 2 <sup>nd</sup> December 2015 (Provisional dates)	<b>Joint Combustion Divisional Seminar with the UKCCSRC, "Options for Biomass Energy with CCS (BECCS) , the Theory and Practice"</b> (Provisional title)	<b>The Edge, University of Sheffield, Sheffield</b>	For more details contact:- Prof. Jon Gibbins Chairman of the CRF Combustion Division Tel : 0131-650-4867 E-mail : <a href="mailto:jon.gibbins@ed.ac.uk">jon.gibbins@ed.ac.uk</a>
8 <sup>th</sup> to 10 <sup>th</sup> December 2015	COAL-GEN 2015	Las Vegas Convention Center, Las Vegas, Nevada, USA	For more information visit:- <a href="http://www.coal-gen.com/index.html#showcase_3">http://www.coal-gen.com/index.html#showcase_3</a>
Wednesday 20 <sup>th</sup> April 2016	<b>Coal Research Forum Annual Meeting and joint Environment and Coal Characterisation Divisional seminar</b>  "The Control of Mercury and Trace Element Emissions"  "The Analysis and Characterisation of Coal for Utilisation", (provisional title)	<b>Imperial College, London</b>	<b>Dr. David J.A.McCaffrey</b> Secretary of the Coal Research Forum Tel : 01242-236973 E-mail : <a href="mailto:mail@coalresearchforum.org">mail@coalresearchforum.org</a>  <b>Dr. Bill Nimmo</b> Chairman of the CRF Environment Division Tel : 0113-343-2513 E-mail : <a href="mailto:w.nimmo@leeds.ac.uk">w.nimmo@leeds.ac.uk</a>  <b>Prof. Ed Lester</b> 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>
Monday 5 <sup>th</sup> to Wednesday 7 <sup>th</sup> September 2016	11 <sup>th</sup> European Conference on Coal Research & Its Applications, ECCRIA 11, Biennial Conference Organised by the Coal Research Forum	<b>The Edge, University of Sheffield, Sheffield</b>	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>