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NEWSLETTER

of the

Coal Research Forum

Edited by: Dr Svenja Hanson

EDITOR'S COMMENTS:

Spring time is AGM time and in keeping with that most of this Newsletter is taken up by the account of our 13th Annual General Meeting held on the 24th of April at the Institute of Mechanical Engineers in London. The account may seem a little on the long side, but with so many distinguished guest speakers it is hard to be short. To go with the AGM, where funding was widely discussed, is a piece of coal research funding in the UK listing all current projects on which information could be unearthed, is featured.

Also contained in this edition is a quest for members' views on the style and manner of distribution of the newsletter. Please do not ignore it – unless you have no views on it at all. Is it time to modernise, or should be leave things as they are? Shall we save paper, reserve trees for biomass combustion, use the electricity to power up our PC's and make more use of the web-site? Incidentally, if you have any ideas for making our web-site more 'exciting' I would really like to hear about them too!

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The 13th Annual Meeting
24 April 2002, Institution of Mechanical Engineers, London

This years annual meeting was held on the 24th of April at the Institution of Mechanical Engineers situated in the heart of London, almost next-door to Buckingham Palace, with attractive views over St James Park. Many thanks to Brian Ricketts for organising the venue, which managed to add a touch of class to our AGM. To quote from the welcome speech of the Chairman Academe, John Patrick, the surroundings were 'palatial'.

The joint report by the Chairman and Secretary, delivered by the Secretary David McCaffrey, and the reports from the Divisional Chairmen, showed that the Coal Research Forum enjoyed another good year in 2001, with plenty of activities bringing together researchers from industry and universities. In February the Combustion Division held a meeting on Flue Gas Desulphurisation at Powergen's Ratcliffe power station, which included a guided tour of the FGD installation on site (see No 31). In March the Coal Conversion Division held a joint meeting with the British Carbon Group at the University of Nottingham looking at various aspects of coal-based carbon materials (see No 31). The 12th AGM was held almost to the day a year ago, hosted by RJB Mining, now UK Coal, at Harworth and included a number of presentations on their commercial and research activities (also reported in No 31). The Characterisation and Environmental Divisions held a joint meeting on the prediction of the environmental impact of combustion processes at the TXU's Drakelow Business Centre in June (see No 32). The autumn meeting was held at the University of Sheffield in November and offered the chance to hear a selection of UK presentations that would have been given at the ICCS in San Francisco had it taken place (see No 33). This year has already seen a joint meeting of the Advanced Power Generation and Combustion Divisions at Mitsui Babcock's Technology Centre in Renfrew in March, which is reported in some detail in this issue of the newsletter. The Coal Preparation Division, which has recently gained Chandu Shah as its new Chairman, is planning a meeting in June (see Calendar). The 4th UK Coal Conference organised by the Forum is set to take place in September this year at Imperial College. The response has been overwhelming, with nearly 90 abstracts received, over half from outside the UK. The brochure containing the programme and registration details is due to be distributed within the next month.

The Treasurers report was given by Mike Cloke, who has recently taken over from Mark Thomas. Outgoings roughly balance income, setting aside an advance payment for the September conference, which will hopefully be recovered. Membership is unchanged with 53 members, of which 27 are from academe, 21 from industry, 1 corporate and 4 individual.

Several of the positions on the Executive Committee were up for election, the Chairman Academe, Treasurer, two of the representatives from industry and all three from academe. For each position there was exactly one nomination and all candidates were elected unopposed. The Executive Committee is now composed of the following members:

Joint chairmen: Allan R. Jones (Industry)
John W. Patrick (Academe)
Secretary: David J. A. McCaffrey
Treasurer: Mike Cloke
Representatives from Industry:
Brian E. Ricketts
Mike K. G. Whateley
Ron R. Wilmers
Representatives from Academe:
Dennis R. Dugwell
Nigel V. Russell
Jenny M. Jones
Seconded Members:
Gerry Riley
Svenja Hanson (Newsletter Editor)

With the formalities of the AGM swiftly dealt with, the remainder of the day was given over to presentations from a number of distinguished speakers. Brian Ricketts took the lead by introducing the activities of the BCURA Industrial Panel. It has been formed to secure the continuation of BCURA funding of UK university research, which contributes to maintaining a pool of high-calibre postgraduate and postdoctoral researchers in coal-related subjects. 11 companies contribute £10k p.a. each to the funds, for which they get a representative on the Industrial Panel. The current composition of the Industrial Panel (from the BCURA web-site) is:

UK Coal plc., Mr B.E.Ricketts, (Chairman)
Corus UK Ltd., Dr.R.Poultney
Powergen plc., Dr.W.Quick
Innogy plc., Dr.G.S.Riley
TXU-Europe Ltd., Mr.P.R.Cooper
American Electric Power Ltd., Mr.M.Gee
Scottish Power plc., Mr.A.Corless
British Energy plc., Mr.S.Winter
Mitsui Babcock Energy Ltd., Mr.M.Farley
RockTron Ltd., Mr.P.G.Michael

The first call generated 16 proposals, of which 5 were funded and a further 4 are on the reserve list. The contents of the second call is still pending discussion. It may be more specific in terms of targeted areas, and may well include zero-emission issues. Brian Ricketts felt it necessary to stress the importance of quality of the proposals, not only in terms of the quality of the research proposed, but also in terms of putting it in context. An awareness of the state-of-the-art in the area is vital, as is a clear demonstration of what the expected benefits of the work are to industry and society at large.

David Holtum, EPSRC Associate Program Manager for the Engineering Program, talked about the funding of coal research by EPSRC. There are three programmes, the Engineering one (£59m p.a.), primarily in responsive mode, the Infrastructure and Environment one (£20m p.a.), aimed at multi-disciplinary work and consortia, and the Innovative Manufacturing one (£25m p.a.), also aimed at creating 'Centres'. Most of the coal proposals fall into the first category. Currently the first round of an energy-related special program called 'Supergen' is under way looking for applications under four themes: Future Network Technologies; Biomass, Biofuels and Energy Crop Utilization; Research of Alternative Fuels, Generation and Conversion Systems; and Nuclear Technologies and Waste Management. Some information can be found at http://www.epsrc.ac.uk/EPSRCWEB/SEARCH/Search_Frame.asp. Whereas there does not seem to be much scope for coal research in the first round, the topics currently under discussion for the second round, such as carbon sequestration, CO_2 capture, extending existing plant life, increasing energy efficiency and micro-generation/CHP, sound more promising. People wishing to make contributions to the discussion should contact Dr. Edward Clarke (e-mail:edward.clarke@epsrc.ac.uk).

Currently there are 8 projects listed under coal technology totaling £860k, 11 under mining and minerals extraction (£1920k) and 75 under combustion (£11830k), although the later mainly investigate ICE's. In 2001 nine applications for coal technology were made for a total of £1260k, of which 3 were funded (£296k). That is a success rate of 33% by number or 23% by value, compared with the average of 29% and 26% . The impression that coal research is in any way disadvantaged is thus not true; there are few projects funded because few applications are received. Details of projects carried out with EPSRC funding in the past 10 years can be found searching the database on www.nest.ac.uk. David Holtum also reminded us that nominations for new members for the college of referees will be called for soon – so keep an eye on the EPSRC web-site for it.

The last presentation of the morning was given by Brian Morris, Deputy Director in charge of Cleaner Fossil Fuel in the DTI, and concerned the recent review of the Cleaner Coal Technology R&D program. It has been running since April 1999 and three calls for proposals were made. In the first two the focus was mainly on 'conventional' power generation, coal science, combustion and gasification, efficiency increases, advanced materials etc, but in the third one the remit was widened to include topics such as co-firing with biomass. Out of 120 responses 40 were selected, 30 in the first two rounds and 10 in the third. The total funding amounted to £22m, of which the DTI provided £8m. 62% of the funded projects were concerned with pf combustion, 15% with gasification, 18% could be applied to either and 5% classify as 'other'. Four of the projects are completed, with the remainder set to be completed by 2005/6 at the latest. All of the projects were collaborative. 18 are run by equipment manufacturers, 11 by utilities and 11 by universities. Beyond R&D, ETSU was given responsibility for Technology Transfer and Export Promotion, as the promotion of British technology abroad was a key component of the program.
A review of the need for a CCT demonstration plant was undertaken. The options identified were, roughly, retrofitting CCT components to existing pf plant, retrofitting a coal gasifier to an existing gas-fired CCGT, building a new super-critical plant or a new ICCGT plant. The conclusion reached was that there was no need for a demonstration plant in the UK. Most of the technologies have been demonstrated elsewhere,

and it was also felt that by selecting one of the options the government would interfere in the market, which it did not feel was appropriate.
All the options were considered either with or without CO_2 capture. Brian Morris had commented earlier that the emphasis in terms of emissions had shifted from more 'traditional pollutants' like SO_2 and NOx to Greenhouse Gases. There is a definite need for work on CO_2 capture and incentives for its reduction are being put in place. He considers the UK well placed to adopt a leading role in CO_2 abatement.

After a pleasant buffet lunch, the meeting resumed with John Topper, Managing Director of the IEA Clean Coal Centre and Environmental Projects, presenting his organisation. I cannot imagine many coal researcher unaware of the IEA website (www.iea-coal.org.uk) or the excellent technical reports, which make our life so much easier. Apparently there were 15 of them published in 2001, which is about average. The IEA is financed by it's member countries, 12 at present. They are trying to broaden the membership base and have gained sponsorships from companies in India (BHEL) and Mexico (Cemex). Talks are also underway with South Africa and Australia. Members get access to databases and abstracts and expert advice including ad hoc consultation. Their technical focus lies on coal-fired power generation and related emissions, co-firing and greenhouse gases, with zero emissions technology from fossil fuel use gaining in importance. Their contribution to the zero emissions strategy is the collection, dissemination and distribution of information, advice on R&D needs, evaluation of projects and generally networking and bringing interested parties together. In view of this John Topper put a direct proposal to the CRF: Is there any interest in collaborating on Framework 6 in drawing together a Network of Excellence? Expressions of interest are due soon (7th June), and it was felt that the CRF could act as a focus for UK R&D in Greenhouse Gas abatement. Maybe a major event could be hosted in 2004 with specific emphasis on the issue?

The remaining 4 presentations were concerned with the ECSC and the pitfalls of trying to secure coal research funding from it. The first three focused on the experiences with the current system, from the perspectives of Robert Davidson (ECSC Coal Research Committee), Andrew Minchener (ECSC Combustion and Gasification Experts Committee) and Steve Frankland (ECSC Coal Preparation Experts Committee). They seemed to agree on the need for improved communications between the project proposers, the 'experts' and the 'advisers'. Some headway has been made in this respect, but the CRF could be instrumental in further improving the flow of information. UK members on committee should ideally be made aware of UK applications at an early stage, and furnished with a few steadfast arguments in support of the application in case it is discussed. On a more sobering note, it was felt that projects were often supported along national lines rather than on scientific merit.
Steve Frankland gave his personal view of potential areas of research in coal preparation. In his opinion it should be aimed at the current 'big' users and producers (China, India) with topics such as flotation and dewatering of Gondwana coals with high inertinite content, dry sorting (aimed at countries where water is scarce) or the drying of low rank coals.
Keith Wilkinson, who works for the European Commission, highlighted the changes to be expected after July 23rd when the original ECSC treaty expires. They were published in the Official Journal of the European Commission on the 23nd March this year (available on http://europa.eu.int/). The ECSC funds revert to the Community and will be managed by the commission from the 24th of July. The return from these assets will form the Research Fund for Coal and Steel, for which a research programme has been drawn up along the lines of the old ECSC RTD programmes. Originally €40m were thought to be available, but in 2003 it could be as much as €60m, so that the 27.2% share for coal amounts to €16m. This year 14 projects were funded with €20m, so the change is not that drastic.
The management structure has been changed to comprise three tiers. The Coal and Steel Committee assists the Commission in the allocation of funds and in drawing up the terms of reference for monitoring and assessment of the programmes. It will be composed of government representatives. Separate Coal and Steel Advisory Groups also assist the Commission more specifically in evaluating individual projects and monitoring them. The Coal Advisory Group will be composed of representatives of coal producers (8) and organisations thereof (2), coal users (8) and organisations thereof (2), organisations representing workers (2) and equipment suppliers (2). Finally there will be Coal and

Steel Technical Groups from the relevant sectors related to the steel and coal industry. A call for nominations / expression of interest will be published in the Official Journal.
An open and continuous call for proposals will be running until 2007, with the 15th September of each year being the cut-off date for submissions considered in that particular year. As before, multi-partner, multi-disciplinary projects are looked for with a threshold of around €1m. However, there will be a 3 year maximum on the running time with severe restrictions on prolongation. The rules on financial contributions and payments remain mostly the same. Financial matters will be handled by the DG of Energy and Transport.

One of the changes is that of the definition of coal, lignite no longer being excluded. Another new feature is the possibility of maintaining grants for training and mobility to allow young researchers to work at partner institutions while obtaining payment from their employer organisation.

John Patrick (Chairman Academe) made the fitting concluding remarks after a long day packed with presentations on many different topics: He thanked the speakers for their very interesting contributions that have given us much food for thought and equipped us to make much better informed choices as to where to go with our coal research from here. *s.h.*

Changes to the Web-site and Newsletter

Sadly it is not just the contents that counts – catching somebody's eye and inviting him to linger long enough to begin reading a web-page is becoming ever more difficult. Web-design has been advancing in great leaps since the CRF page has first come into being. Maybe it is time for a little facelift? All members are invited to voice their views about what they would like to see on their web-site and how they would like to see it displayed. It is fine as it is, of course, plain and simple, easy to use and ultimately practical. If you feel that things shouldn't be fixed unless they are broken – tell us. If you feel that there is room for improvement, let us know, any ideas and suggestions would be most welcome.
One idea that has so far been voiced is to update the web-site more regularly, replacing the 4-monthly newsletter with a News page to which news items are added as they arise.

For example, the Combustion and Advanced Power Generation Divisions Meeting in March had to wait six weeks for the next newsletter edition – even though it was written on the day of the meeting on long way back from Scotland. Similarly, the Coal Preparation Division Meeting, which will be held in June, will not appear in the newsletter and thus on the web-site until September, after lying dormant on my C-drive for some ten weeks. All members would receive an email as the site is updated, with a handy link to the site to view the update straight away if they so wish. How would you feel about receiving such e-mails instead of many of the mailshots (including the newsletter) that are going out at present? It could save the Forum a lot in photocopying and stamps; and convey information more quickly and efficiently.
Replies– ideally by e-mail – to the Newsletter Editor (svenja.hanson@nottingham.ac.uk).

Recent Developments in Power Technology and Visit to Mitsui Babcock's Technology Centre, 12 March 2002, Renfrew

The Advanced Power Generation and Combustion Divisions held a joint meeting in Renfrew near Glasgow this spring. The venue was the almost brand-new Technology Centre of Mitsui Babcock, to whom we would like to extend our gratitude for a very warm welcome. The meeting was indebted to Mitsui for the provision of a pleasant, modern venue, of all but one of the presenters, of a wholesome lunch and, last but by no means least, a highly informative tour of their research facilities. I hope I looked suitably impressed, because I most certainly was. The meeting was well attended with between 25 and 30 people present, including a larger than usual contingent from Scotland. The two division chairmen, Peter Sage (Advanced Power Generation) and Alan Thompson (Combustion) jointly chaired the morning session.

A welcome to Mitsui Babcock by Gerry Hesselmann was immediately followed up by a few introductory words about the company. The company itself dates back to 1867 when Babcock & Wilcox patented a water-tube boiler. The core business of the company is still power technology, for fossil fuel as well as nuclear, but the offshore, defence and marine industries also feature. In contrast to the long standing tradition of the company, the Technology Centre is very new. It was built in 2000/2001, and has only been fully inhabited since September 2001. It houses some 230 staff, of which 180 are graduates. He did think it necessary to warn the academics amongst us that the research conducted there is very much product driven. The Technology Centre provides a lead in new technologies, before they are taken out into the field and demonstrated at full scale. Current priorities for coal are NOx, efficiency and CO_2 and assessment of plant integrity. Mitsui Babcock has an ample NOx portfolio starting with low NOx burners in the 80's, such as those installed at Drax, moving on to advanced low NOx burners, overfire air and boosted overfire air. Gas-over-coal reburn has been demonstrated at Longannet and coal-over coal-reburn at Vado Ligure. SNCR and SCR have also been dealt with. Efficiency gains are expected to be delivered by supercritical steam conditions, such as targeted in Thermie 700. Oxyfuel operation could aid in the capture of CO_2. Plant integrity can, for example, be enhanced by the development of new welding techniques.

Tarik Naja, also from Mitsui Babcock, presented their latest NOx reduction technology SACR (Selective Autocatalytic Reduction). It works by simultaneous injection of propane or methane and ammonia (NH_3) and was originally developed for diesel engines. It has since been shown to work for pf flue gases at 160kWt and 40 MWt at Renfrew and is currently on the way to being demonstrated in the US in a unit of TVA's power station in Kingston, Tennessee. At 160kW NOx reductions in the order of 70-80% were achieved, from 300 to about 60 ppm. The injection of excess NH_3 must be avoided to prevent 'slip' and thus good injection control is vital. With the 40MW trial, with 300 injectors on lances covering $15ft^2$ divided into 6 zones, good control was shown and slip remained below 5 ppm NH_3.
Judging by the number of questions, SACR definitely captured the audience, for many of whom it held a genuine novelty value on account of the speed of the development of the process.

Nick Booth from Powergen's Power Technology Centre holds the honour of being the only non-Mitsui speaker of the day. His presentation was concerned with FGD, more precisely the comeback of Sea Water Washing (SWW). The arguments in favour of it were certainly sound. A diagram of a limestone-gypsum FGD plant was shown with all the components superfluous in SWW highlighted. SWW requires no solid reagents, so their preparation and handling are not required, and it produces no solid by-product in need of disposal. Of course, it is only applicable to coastal sites. To-date it has been implemented at a Powergen plant in Indonesia and it is favoured by a tropical climate, where large amounts of condenser water are used and the water is at higher temperatures. But it should not be ruled out for a temperate climate.

Following a well earned coffee break, Les King from Mitsui Babcock posed the question: Supercritical boiler technology – a retrofit option? Foregoing the conclusion, the answer was definitely yes. Best available technology at present could boost power plant efficiency from around 38-40% to around 45%, taking steam temperatures up to 600/620°C at 300 bar.

Eventually efficiencies in the 55% range and temperatures of 700°C are envisaged. Retrofitting a currently feasible supercritical plant in an existing power station of some 600MW was estimated at 30% of the cost of constructing it on a greenfield site. Even with CO_2 capture the costs are comparable with IGCC and popular renewables. Cycle efficiencies also match those for IGCC, but at an advantage of greater flexibility and lower risk. However, there is no reference plant in the UK where a retrofitting has taken place. It would be useful to achieve this in the near future, but that depends on funds being made available.

The final presentation by John Gillespie, Mitsui Babcock, focussed on CFD. As a predictative model it has its place alongside expensive and not always feasible full-scale tests and smaller scale tests with the compromises they usually impose. Models are, of course, only ever as good as the input that can be provided. Three levels of accuracy are distinguished, with the third level usually only being achieved under carefully controlled laboratory conditions. Test data from large scale plants often are level 1, e.g. a flame temperature with +/- 100°C accuracy. Nevertheless, CFD has proven useful in many areas, including controlling the flow velocity in ESP ductwork, increasing the throughput in mill classifiers and prediction of NOx and carbon-in-ash. What CFD delivers are trends and gross effects. Not too much emphasis should be placed on quantitative information, and it should certainly not be used in isolation, but in conjunction with large scale plant information. Used in the correct way it does provide solutions.

The presentations were to be followed by a little 'brainstorming session' on identifying priorities and research needs, in the hope of providing some of the cross-fertilisation between industry and academe the CRF aims for. Alan Thompson tried to kick off the session by jotting down the areas he personally regards as most pressing (not in order of importance):

- CO_2 removal from flue gases
- Renewables / biomass usage
- Air-toxics & fine particulate removal
- Boiler material development
- Gaseous emissions (NOx & SOx), improving efficiency and lowering cost
- Coal performance prediction / characteristics (unburnt carbon)
- Fly ash beneficiation

Somehow nothing got added to the list and the discussion soon turned into extra question time for the presenters. Maybe Alan Thompson's list was so comprehensive that there simply was nothing to add. Or, having such a session straight after a set of very interesting presentations was not a good move. My mind was definitely still on the topics presented and I have to plead guilty to joining into the questioning of the presenters.

The day was rounded off by an excellent buffet lunch and the eagerly awaited tour of the site. Highlight of the tour was – for me, who sees plenty of microscopes, TGAs and strength test apparatus in my line of research – the 90MW burner rig. Having been told that it is the largest of its kind anywhere probably helped in making up my mind. *s.h*

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DTI Co-firing Seminar, 6 February 2002, Nottingham

The DTI Co-firing Seminar, organised by AEA Technology plc, Programme Manager for the DTI'S Renewables Energy Programme and held on the 6th of February at the Nottinghamshire County Cricket Club, attracted some 80 delegates from central and local government, the power industry, biomass providers and consultants and, to a lesser extent, academe. The Seminar Chairman Peter Sage, Manager for the Biofuels Area of the Renewables Energy Programme (Peter is also Chairman of the CRF APG Division), presided over a total of nine very interesting presentations. Half of these focused on experiences gained outside the UK. Co-firing has been more wholeheartedly embraced in Scandinavia, the Netherlands and the US.

Bill Livingston (MBEL) set the scene by giving an overview of the issues involved in the decision to convert to co-firing biomass. The

options are to either use direct co-combustion, i.e. mixing the biomass with the coal, or indirect co-combustion employing a separate biomass gasification unit. In the second case additional decisions concerning the degree of gas cleaning and cooling need to be taken. Needless to say, the direct method is simpler and more economical, but carries higher risks. The major risks are increased fouling, slagging and corrosion. Additionally, the flue gas properties can be changed in such a way as to impair gas cleaning equipment. One of the prime issues for introducing co-firing is the quantification of such risks. Also, the security of supply needs to be addressed. Subsidising biomass under the pending renewables obligation may swing the balance in favour of co-combustion.

The Dutch perspective on the issue was presented by Ronald Meijier (KEMA). The Netherlands aim to provide 10% of their energy from renewable sources by 2020. This includes replacing 12% of their coal combustion by biomass, amounting to some 2million tonnes – more than is available in the country. As energy crops are ruled out by high land prices, importing biomass may become necessary if that target is to be met. A special interest has recently developed in meat and bone meal, which can no longer be used as animal feed. Trials are being currently undertaken.
Much experience has been gained in the 1990s. Wood co-firing at the CG13 plant has been undertaken since 1995 employing separate storage and milling facilities and two specially installed biomass burners. It is aimed at increasing the energy replacement from the current 3% to 13%. At the E.ON Maasvlakte 1 plant, pellets made from wood, sewage sludge and paper pulp have been co-fired with up to 8% replacement. A 15kt meat and bone-meal storage facility is under construction. Indirect co-firing is also being pursued, with a 30MW CFB gasifier at Amer 9. Extensive gas cleaning is employed. Further CFB gasifiers are planned. This includes a feasibility study into using some biomass in the Buggenum IGCC plant. He concluded that although direct co-firing has a strong economic pull, it is unlikely to provide all the biomass capacity needed, and the lesser proven, but more fuel-flexible, indirect route will also have to be employed.

Larry Baxter (Brigham Young University) presented the US experience, which seems vast with the number of co-firing and stand-alone biomass plants approaching 100. Co-firing has been undertaken in plants from 100 to 725MW with up to 10% replacement. The experience shows that in terms of efficiency co-firing compares favourably with stand-alone biomass pants, which is not to say that converting to co-firing saves costs for a utility. The incentive is purely environmental. But where coal burning utilities already exist, co-firing is definitely the best of the biomass utilisation options. The effects of co-firing on the power plant operation depend on the nature of the biomass chosen. For example, co-firing high quality wood has a beneficial effect on NOx emissions, whereas switchgrass tends to emit more NOx than coal. Deposition in the boiler decreases in the order of wheat-straw, straw, coal only, switchgrass, wood. Wood is the most attractive biomass for co-firing, herbaceous plants are more problematic. In either case though, a separate handling system is required. Co-grinding has been found to be impossible. Corrosion can usually be avoided provided an oxidising atmosphere is maintained.

Harry Lampenius (Foster Wheeler International) described the development of CFB gasification technology in Finland. About 200 installations have been delivered since the first fluidised bed gasifier commenced operation in 1979, to a large extent to the paper industry. After a 10 year slump in demand due to low oil prices, interest revived in the mid-1990s, resulting in the addition of a biomass gasifier to the Lahti power plant, which was completed in 1997. The plant uses no gas clean-up and has 2 special burners for the biomass gas, which makes up 15% of the fuel input. The gasifier operates at 850-900°C using recirculating hot sand. Conversion of 96-97% is achieved and virtually no carbon loss occurs. The availability of the gasifier was very good (>95%). Wood, demolition wood, ‘recycled fuel’ and shredded tyres have been used. The use of shredded tyres has been discontinued. ‘Recycled fuel’ is organic waste collected from households, offices, shops and constructions sites, mainly composed of food residues, cardboard and plastics. Its use has been successful and is on the increase. The Lahti experience has been a positive one; the installation costs were low compared with stand-alone biomass units, no additional operators were required and the fuel preparation was out-sourced. Nevertheless, a renewables incentive was required to make the plant feasible.

Lars Fenger (Energi E2) gave a presentation on wood and straw pellet co-firing in Denmark. Currently 130 000t of biomass are used annually in Denmark. The aim is to increase this to 800 000t. The Avedore 2 power plant will contribute to this increase, being designed as a state-of-the-art multi-fuel plant. Initially, it will co-fire straw pellets with natural gas or coal, but later also wood chip pellets. An on-site wood pelletising plant is under construction which will use steam from the power plant. At Amager power station in Copenhagen a unit has been modified for co-firing straw pellets. Pellets had to be chosen as bales are not allowed into the town. 1.4mt a year are eventually to be burnt. The burning of biomass in Denmark is encouraged by guaranteeing the price for electricity produced from it.

Bill Livingston (MBEL) returned to the 'speakers podium' to review past co-firing studies. In the last few decades a lot of experience has been gained in both, direct and indirect biomass co-firing. For example, the wood pellet co-firing plant in Hasselby, Sweden, has been operating since the early 1990s, and similar designs have been built in Vasteras and Helsingborg. Straw co-firing was demonstrated at Studstrup, Denmark, and demolition wood in Nijmegen, Netherlands. The indirect, gasification, method was also shown to operate satisfactorily, for example in the European BIOCOOMB project based in Austria. This does not even include projects in the US. However, few of the plants were operated long-term on a commercial basis. The case of the trials at Methil power station near Glasgow are typical, funded by European R&D money they were discontinued when the funding ran out. In summary, the technical resources for implementing co-firing in the UK are available, but, at least in the short term, financial incentives are required for it to become reality. Another issue that was raised was the question of supply. For co-firing to be feasible, biomass must be available in large quantities, on long-term contracts with reliable quality specifications. The question whether this is possible in the UK today was hotly disputed between representatives from the agricultural sector and from the power sector.

Jim Williamson (ICSTM), the only speaker from the academic sector, presented methods of biomass characterisation. Of particular interest is the chemical composition of the ash. Though it is not easy to give general figures on the composition, as it changes seasonally (new growth containing more mineral matter) and locationally (variations with the soil chemistry have been observed). The difference between coal and biomass ash in the broadest terms is the much higher alkali content of the later, especially of CaO and K_2O. Deposited on ash particles, they can alter the surface properties. Low ash melting points can result from lime being present in higher quantities than in coal ash, which is mainly composed of alumina – silica.

The penultimate presentation was given by Neil Bond (Anglian Straw), and concerned the straw supply to the UKs first straw burning power station near Ely. Whereas it does not deal with co-firing as such, it touches on the apparently controversial question of supply. Gathering the required 200 000t of straw per annum seems to have presented some difficulties. Straw is not a waste material and there is competition with other users, the harvesting season is short (4-6 weeks) and on-site, indoor storage is extremely limited. Supply comes from small businesses, which are slow to adapt, and a lot of effort is required to make it worthwhile for them. Long-term contracts are hard to come by. It might be worthwhile considering energy crops for greater security of supply, such as miscanthus, for which trials will be conducted.

Finally Richard Hotchkiss (Innogy) considered the economics and risks in the UK context. He initially elaborated on public perception and acceptability, in view of the fact that few members of the public are thought to form opinions on a well-informed basis and companies cannot afford customers. This impinges especially on MSW. 55mt are produced in the UK every year, with a potential to recover 6GWe from it. 5% are currently used, but expansion is difficult because of low public opinion of waste incineration. Biomass so far has a positive image, but that may change if, for example, transportation inconveniences local residents near plants. The economics of biomass plants are not easy to determine, as they depend on many variables. As an example the result from a model devised by ADAS was given: If the plant is likely to make any profit appears to be highly dependent on the cost of the biomass, here wood. Compared to coal even the lower price is very high, especially considering the lower calorific value, and a kWh electricity from biomass is likely to cost three times that of one

produced using coal. The prospects improve if co-firing is considered and part of an existing plant can be used, although it is not yet clear how big the savings are for modifications to existing plant as opposed to building new installations.

Installation Cost	Wood Supply Cost	
	Low(£40/dry tonne)	High (£55/dry tonne)
Low (£120-160/kW)	Overall Return: 6 to 7% First profit: Year 6	Overall Return 0 to -1 % First profit: Year 6
High (£200-220/kW)	Overall return: 1 - 2 % First Profit: Year 6	Overall return -8 to -9 % First Profit: none

It would be safe to say that building new plants does not look attractive. With the absence of a turn-key supplier in the UK it certainly seems the riskier option.

One other point is the question of getting started with biomass. Coppice needs to be planted well in advance of when it is first required. To bring in one harvest by 2006, planting would need to be done this year. There could be a role in co-firing to initiate energy crops and pave the way for biomass plants once a supply infrastructure is in place.

It was an interesting seminar, and I felt that there was a consensus that co-firing biomass with coal or natural gas is technically feasible, even if a few remaining problems will have to be addressed. Furthermore, it was largely agreed that the economics are more or less neutral, so that implementation depends on an incentive being created. The environmental benefits of using biomass are undisputed and if there is a will to stimulate increased biomass use, co-firing would be a good starting point. Co-firing is much more likely to deal with the as yet patchy supply structure for biomass than stand-alone plants. There seemed to be some dispute over what is or is not deliverable in terms of biomass supply. Both sides did, however, agree on the need for subsidy to get started along the 'green' road of biomass co-firing. It was generally felt that co-firing has an important role to play in meeting the renewables targets set to combat global warming. *s.h.*

The Energy Policy Review

The PIU "Energy Review" was published in February with the view to becoming an Energy White Paper after full public consultation later this year. I have to admit that I have not braved the full 218 pages of it, which can be found at http://www.cabinet-office.gov.uk/innovation/2002/energy/report/TheEnergyReview.PDF. According to a Cabinet Office press release on the 14th February the key points of the report include:

- There is no immediate crisis in relation to the security of energy supplies or the move to imported gas. However, we need to keep issues of security of supply under constant review, recognising that in the future this needs to be thought of in global terms, involving for example, the further liberalisation of energy markets within the EU, and diplomatic work to support stability in old and new energy producing areas.
- The liberalisation of EU energy markets is important for energy security.
- The Government must continue to pay attention to long-term incentives for investment in the regulated energy utilities, even though current levels of investment are healthy.
- Although the UK seems likely to have to make large cuts in carbon emissions over the next century, there is little sense in doing so and incurring large costs that harm our competitiveness if other countries do not take the same action.
- Keeping options open will need support for innovation in energy technologies. The focus of UK policy should be to establish new energy sources that are low cost and low carbon.
- While immediate priorities should be on energy efficiency and promoting renewables, the options of new

investment in clean coal and nuclear power need to be kept open.

- The government should use economic instruments to bring home the cost of carbon emissions to all energy users and enable UK firms to take part in international carbon trading.
- New targets are needed for energy and vehicle efficiency. The Government should set a 20% target for improved efficiency in the domestic sector by 2010 with a further 20% in the following decade.
- The target for the amount of electricity generated from renewable sources should be increased to 20% by 2020.
- Urgent action is needed to break down institutional barriers to investment in renewable and combined heat and power.
- The Government should set up a new cross-cutting Sustainable Energy Policy Unit to draw together all aspects of UK energy policy

Coal was mentioned in connection with security and diversity of the energy supply, in the name of which it is desirable to keep existing power stations operating. 'New' coal technologies were considered in Annex 6. Whereas IGCC plants were labelled uncompetitive and not fully commercially proven at present, they were declared a 'benchmark' for 2020.

The UK coal industry reacted quickly and sounded quite pleased with the outcome as the following extracts from an article in OXERA's '*The Utilities Journal'* in March 2002 by Gordon McPhie, Chief Executive of UK Coal, show: "The review appears to present a rational assessment of the UK energy scene, and most will be able to find words of comfort within its many pages; UK COAL has, and is pleased to see energy security taking centre stage in recommendations that could so easily have focussed solely on the environmental dimension of sustainability. …….
The coal industry has a clear view of the way forward and this is largely mirrored by the PIU:

- Existing coal-fired generation is the cheapest source of electricity in the UK and it is vital that these power stations continue to be upgraded to improve their performance. Maintaining coal-fired plants in strategic reserve, as suggested by the PIU, is an interesting concept that would need examining carefully from a fuel efficiency and cost perspective.
- New, clean coal power stations need support and we have proposed a "clean coal obligation". Without this, the medium-term prospects for clean coal depend on gas prices. We predict a growing interest in retrofitting coal gasifiers to those CCGT power stations that are already uneconomic, or will become so as the low-cost gas supply contracts from the 1990s expire.
- In the longer-term, CO_2 capture and sequestration could herald a new era for coal: production of hydrogen with near-zero emissions and enhanced oil recovery from the North Sea. The cost per tonne of carbon saved is well below the renewables option, and the potential far greater. "

Energy World (No 298, April 2002), published by the Institute of Energy, seems to be divided as to how far the commitment to the environment of the Review goes. In the same introduction they state that "Despite plenty of rhetoric about the environment in general, and CO_2 in particular, measures to help privatisation, liberalisation, deregulation, market reform…have generally held sway" and that "(it) attempts to rebalance the equation in favour of the environment, while largely dismissing security of supply as an issue." They also perceived the future of coal as critically linked to the CO_2 question: "In the medium term coal has a continuing role to play in the energy mix. Its longer-term contribution depends on there being a practical way of handling the CO_2 that it produces. CO_2 capture and sequestration – whereby carbon is taken out of fossil fuel and stored

- could be a means to preserve diversity of fuel sources, while meeting the deep cuts in CO_2 emissions
- has the potential to allow fossil fuel to be a source of hydrogen for transport and other applications without large-scale carbon release into the atmosphere; and
- seems to be well suited to UK circumstances, since the UK has potential repositories in the Continental Shelf, and the carbon could possibly be used to get more oil from exsiting wells.

At the moment uncertainties surrounding costs, safety, environmental impacts and public and

investor acceptability are large. Steps should be taken to reduce these uncertainties –as discussed more fully in the DTI Clean Coal Review. As part of this work, the legal status of disposing of CO_2 in sub-sea strata needs to be clarified, in the light of possible conflicts with the London and OSPAR Conventions." Energy World also warns that "the implementation of an ambitious low carbon policy would be a demanding task."and that "there will be some hard choices, and there will be losers as well as winners."

Jon Evans in 'Chemistry in Britain', April 2002 edition, found the review rather vague, and pointed out that consulting around 400 organisations and individuals is bound to lead to the inclusion of a wide variety of viewpoints in order to try to please as many of them as possible. Also, the time scale, up to 2050, would introduce a degree of uncertainty. Who knows how energy research and technology will advance in the next 50 years?

Publically funded Coal Research in the UK

It goes without saying that one of the fundamental questions in coal research is how to get it funded. The newsletter has therefore always included listings of awards to undertake research. The sources of funding considered are EPSRC, ECSC and BCURA. It is unlikely that I have succeeded in compiling a complete list, so if I left anybody out, please let me know. Also, previously the survey was undertaken one source at a time and published separately in the three editions over the year. I propose to do this once a year, for the May edition, to get a more complete picture. Comments on the change are invited, and the old system will re-instated if that is the prefered option.

i) EPSRC

The EPSRC web-site currently lists 10 projects under coal technology, totalling just under £1m in funding (Appendix A). Out of a grand-total of 6731 projects sharing £1.5bn this seems a small slice of the cake. However, as we have been emphasising for quite a while now that funding will be more forthcoming with the relation of the project to coal is given a low profile, the chances are that there are 'hidden' projects elsewhere in the programmes. I have included another 5 projects listed under 'combustion' that are clearly relevant to coal. There are many other projects concerned with, for example, the behaviour of granular solids, ceramic filters, advanced materials for turbines etc that could have useful outcomes for coal utilisation, but are not unique to it.

In the five weeks prior to this article (up to the 25th of March) no new coal related projects were funded. Out of the 228 projects only two were even energy related – one on flame modelling and one on wind power.

And, of course, none of the top 20 by value awards went to the energy sector.

ii) BCURA

Currently running projects, according to the report of the Technical Officer David McCaffrey to the BCURA Council in January this year, are listed in appendix B. There are 11 projects in total funded with £590.9k. With the exception of a grant for maintaining the CRE Coal Bank, all the projects are undertaken by UK universities. The magnitude of the awards varies considerably, but reflects partially the duration of the projects ranging from 1 to 3 years.

Following the recent formation of the BCURA Industrial Panel the first call for proposals to a coal research programme to be carried out at British Universities went out late last year with a closing date of 28th February 2002. Successful projects from this round of applications will start later this year. A second call with a 31st August 2002 closing date is expected to follow and will be found at the BCURA web-site (http://www.bcura.org/)

iii) ECSC

Getting information about current ECSC projects, unless one is well connected, is a difficult task. It is just about possible to unearth details on projects that have been completed, reported and double-checked by officials on Cordis. After a long search, I found a list of projects funded in 1998-2000 on http://europa.eu.int/comm/energy/en/coal-technology.html, which has been included as Appendix C. As it only lists the principle

investigator or co-ordinator it does not give the full picture. Also, projects funded in 2001 are missing.

83 coal-related projects were funded between 1998 – 2000, of which 32 are co-ordinated by UK organisations. In those it is possible that other UK organisations are partners. In the remaining 51 projects UK organisations are collaborating as partners (as a minimum in 3 projects of which I know for certain, as I am doing part of the work involved).

I was completely unable to find any information on the magnitude of the awards for the projects as a whole, not to mention to the individual partners. If there is anybody out there who could help getting 'better' information on ECSC awards, please contact me. *s.h.*

Appendix A

EPSRC – funded Projects

1* GR/R90314/01
A Study of the Combustion of Coal by Imaging the Burn-Out of Carbon and the Formation of Ash, Imperial College of Science, Technology & Medicine, Department: Chemical Engineering & Chemical Technology, April 1 2002 - Mar 31 2004, £178,690, Standard Research, Jones, Professor AR

2* GR/R41040/01
An Innovative Coal Gasifier Utilising Steam From Waste Incineration Raised to Ultra-High Temperature, University of Sheffield, Chemical & Process Engineering, July 30 2001 - July 29 2004, £66,588, Fast Stream, Russell, Dr NV

3* GR/L82557/01
Development of an Innovative Methodology for Modelling Variations in the Composition of Coal Seams, University of Nottingham, School of Chemical, Environmental & Mining Engineering, May 1 1998 - January 31 2002, £49,274, Standard Research, Large, Dr DJ

4* GR/M98678/01
ESR21:The Development of Advanced on-line pf Flow Monitoring and Control, University of Nottingham, School of Mechanical, Materials, Manufacturing Engineering & Management, June 1 2000 - May 31 2003, £131,336, Standard Research., Aroussi, Dr A

5* GR/R62854/01
JREI: Thermal Analysis Equipment to Underpin the Fuel Technology Programme Encompassing Clean Coal Research, University of Nottingham, School of Chemical, Environmental & Mining Engineering, December 1 2001 - November 30 2004, £65,256, Joint Research Equipment Initiative (JREI), Snape, Professor CE

6* GR/R27464/01
New Catalysts For the Hydrocracking of High RMM Fractions of Coal Derived Liquids and of Heavy Hydrocarbon Liquids, Aston University, School of Engineering & Applied Science, October 1 2001 - Sep 30 2004, £94,361, Standard Research, Bridgwater, Professor AV

7* GR/R27471/01
New Catalysts For the Hydrocracking of High RMM Fractions of Coal Derived Liquids and Heavy Hydrocarbon Liquids, Imperial College of Science, Technology & Medicine, Chemical Engineering & Chemical Technology, December 1 2001 - November 30 2004, £110,715, Standard Research, Kandiyoti, Professor R

8* GR/N24148/01
Ropa: An Investigation into the Effects of Matrix Swelling on Coal Permeability for ECBM and CO_2 Sequestration, Imperial College of Science, Technology & Medicine, Environmental Science & Technology, September 1 2000 - October 31 2002, £85,860, Realising Our Potential Awards (ROPA), Durucan, Professor S

9* GR/R02030/01
The Development & Implementation of an Advanced Coal Combustion Sub-Model For CFD Codes, University of Leeds, Department of Fuel and Energy, January 1 2001 - December 31 2002, £130,484. Standard Research, Williams, Professor A

10* GR/R02788/01

The Link Between Coalbed Methane Sorption & Microlithotype Structure, University of Nottingham, School of Chemical, Environmental & Mining Engineering, September 1 2000 - August 31 2003, £62,602, Standard Research, Lester, Dr E

Combustion

1* GR/R46120/01
Advanced Methodologies for Simultaneous NOx/SOx Control form Combustion Sources, University of Leeds, Department of Fuel and Energy, January 1 2002 - December 31 2004, £194,281, Standard Research, Hampartsoumian, Dr E
2* GR/R31669/01
Advanced Sensors for On-line Measurement and Characterisation of Pulverised Coal and Gas Fired Flames, University of Greenwich, School of Engineering, October 1 2001 - September 30 2003, £94,168, Standard Research, Yan, Dr Y
3* GR/M99729/01
Development of a light Scattering Probe to measure Particle Size and Concentration in Industrial Furnaces, Imperial College of Science, Technology & Medicine, Chemical Engineering & Chemical Technology, January 5 2000 - January 4 2002, £146,638, Standard Research, Jones, Professor AR
4* GR/M19864/01
Dynamics of Particles and Droplets in the Vincinity of Flames, Imperial College of Science, Technology & Medicine, Mechanical Engineering, January 20 1999 - June 19 2002, £81,191, Standard Research, Hardalupas, Dr I
5* GR/N12893/01
The Prediction of Fine Particulate Emissions from Oil– and Pulverised-Coal-Fired Combustors, Imperial College of Science, Technology & Medicine, Mechanical Engineering, January 1 2001 - Dec 31 2003, £175,735, Standard Research, Lockwood, Professor FC

Appendix B
BCURA-funded projects

1 - B47 **'A Comparison of Prediction and Experimental Observations of Trace Element Partitioning during combustion of PF with Inert Additives in a 20kW Combustor'**, University of Sheffield / University of Leeds, 1 April 2001 – 31. July 2002, £40,100, Thompson, Dr D / Gibbs, Dr B M
2 - B49 **'NOx Emission Modelling for the Operation and Control of Power Generation Boilers'**, Queen's University of Belfast, 1 April 2000 – 31 September 2002 , £83,300, Thompson, Dr S
3 - B51 **'Neural Modelling and Control of Coal Fired Boiler Plant (NEUROMON)'**, University of Glamorgan, 1 November 1999 – 30 April 2003, £53,000, Wilcox, Dr S J / Ward, Professor J
4 - B52 **'The Use of Laser Ablation ICP-MS for the Analysis of PFA'**, University of Sheffield, 1 April 2001 – 31 March 2002, £14,100, Spears, Professor D A / Booth, Dr C A
5 - B53 **'Covalent Molecules or Aggregates? An Investigation of "Large" Coal-Derived Molecules'**, Imperial College, 1 April 2001 – 31 October 2003, £49,700, Kandiyoti, Professor R / Dugwell, Dr D R / Herod, Dr A A
6 - B54 **'Arching Propensity in Coal Bunkers with Non-symetric Geometries'**, University of Edinburgh, 1 September 2001 – 31 August 2004, £65,200, Ooi, Dr J Y / Rotter Professor J M
7 - B55 **'Investigation of the Reactivity of Gasification Chars and the Optimisation of Process Design'**, Imperial College, 1 April 2001 – 31 March 2004, £107,500, Kandiyoti, Professor R / Dugwell, Dr D R / Paterson, Dr N P M
8 - B56 **'Advanced Characterisation of Industrially Important Coal-Based Carbons'**, University of Bath, 1 October 2001 – 30 September 2004, £75,700, Mays, Dr T J
9 - B57 **'Maintaining the CRE Coal Bank'**, EMC Environmental Engineering, 1 April 2001 – 31 March 2004, £18,000, Richards, Dr D G
10 - B58 **'Advanced Image Analysis for Coals, Chars and Blends'**, University of Nottingham, 1 October 2001 – 30 September 2003, £34,000, Cloke, Dr M / Lester, DR E / Langston, Dr P
11 - B59 **'The High Pressure Interactions of Coal with CO_2: Implications for CO_2 Disposal and CH_4 Displacement from Coal Seams'**, University of Strathclyde, 1 October 2001 – 30 September 2004, £50,300, Hall, Professor P J

Appendix C

Projects financed by the ECSC between 1998 - 2000

Mining Technology

1-Use of virtual reality for mine operations and safety, University of Nottingham et 7220-PR032

Coal Preparation

21 Prediction of propensity of coal for spontaneous ignition in storage, preparation and firing systems, CRE Group et al. 7220-PR038

24 The development and technical and economic evaluation of novel advanced coal desulphurisation techniques, CRE Group et al. 7220-PR065

25 evaluation of the economic benefits of pneumatic dry cleaning processes, University of Nottingham et al. 7220-PR066

28 Advanced demineralization of coal, University of Nottingham et al. 7220-PR099

29 Improved manufacture of coke for non-ferrous applications with environmental, operational and market benefits, CPL et al. 7220-PR100

Coal Conversion

36 New coal tar-derived products with added value, University of Strathclyde et al. 7220-PR043

40 New coal-based strategies for treating pollution from coke oven-derived PAHs and industrial waste water, University of Strathclyde et al. 7220-PR070

Coal Combustion & Gasification

42 Cost effective reduction of nitric oxide emissions from coal-fired power plant (MINNOX), ABB Combustion Services Ltd et al. 7220-PR045

44 Development of an expert system for the monitoring of slagging and fouling in PF boilers, CRE Group et al. 7220-PR047

46 Development of improved ash deposition prediction under low NOx firing conditions CRE Group et al., 7220-PR048

46 Adding value to coal combustion residues, University of Leeds et al. 7220-PR049

47 Measurement and control techniques for improving combustion efficiency & reducing emissions form coal-fired plant, PowerGen et al. 7220-PR050

48 Development of advanced characterisation tools for the prediction of reburn performance in pf combustors, CRE Group et al. 7220-PR051

49..The co-combustion of coal with a high-energy fuel recovered from plastics and paper waste, CRE Group et al. 7220-PR052

50 Gas turbines in advanced co-fired energy system, Cranfield University et al. 7220-PR053

51 Nitrous oxide reduction in circulating fluidised beds through reburn (REBED), Imperial College of Science, Technology and Medicine et al. 7220-PR054

52 The prevention of mill fires and explosion (MILFIRE), Imperial College of Science, Technology and Medicine et al. 7220-PR060

53 Optimisation of coal blend preparation for improved combustion efficiency, Imperial College of Science, Technology and Medicine et al. 7220-PR071

63 Neural modelling and control of coal-fired boiler plant, University of Glamorgan et al. 7220-PR081

65 Optimised grinding of coal, CRE Group et al. 7220-PR083

66 Advanced heat exchanger for combustion/gasification, Cranfield University et al. , 7220-PR084

68 Minimising the plant operating costs and environmental impacts of utilizing low grade fuels in conjunction with coal in pulverised coal-fired boilers, CRE Group et al. 7220-PR086

69 Improving the performance and reducing the environmental impact of co-combustion of coal and waste in FBC boilers designed for coal firing, CRE Group et al. 7220-PR087

72 The safe and effective preparation of coal and biomass for furnace combustion (COBIFLASH), Imperial College of Science, Technology and medicineet al. 7220-PR103

74 On-line measurement of particle size in fine coal transport systems, CRE Group et al. 7220-PR105

75 Improved coal utilisation strategies by standardization and wider use of drop tube furnace evaluation methods, CRE Group et al. 7220-PR106

78 Reduction of greenhouse gas emissions from utility scale circulating fluidised bed boilers, Mitsui Babcock Energy et al. 7220-PR109

81 Decreasing the cost of power generation by improved utilisation of low volatile coals, PowerGen et al. 7220-PR112

82 The abatement of environmentally unfriendly species in combustion and gasification processes, University of Newcastle et al. 7220-PR113

83 Atmospheric impact of particulate matter from solid fuel combustors (PANAMA), Imperial College of Science, Technology and Medicine et al. 7220-PR114

Non-UK Co-ordinators

Mining Technology

2-Improved ventilation, gas drainage and air cooling systems for the improvement of coal face performance, DMT et al. 7220-PR033

3-Optimisation of material transport systems, Ruhrkohle Bergbau AG et al. 7220-PR034

4-Reduction of environmental impact of mining-induced ground movements, Ruhrkohle Bergbau AG et al. 7220-PR035

5-Reduction of environmental impact of opencast mining, ENDESA et al., 7220-PR036

6-Stress distribution analysis by numerical models for the optimisation of underground coal mine design, Geocontrol et al. 7220-PR055

7-Improvement of working conditions in high -temperature environment, DMT et al., 7220-PR056

8-Consequences of mine closure in water circulation, Deutsche Steinkohle AG et al. , 7220-PR057

9-Improved support systems for highly stressed roadways, Rock Mechanics Technology et al. 7220-PR058

10-Development and demonstration of automatic ground hazard monitoring systems, Deutsche Steinkohle AG et al. 7220-PR059

11-Prediction of fire effects in mines, DMT et al, 7220-PR061

12-Alarm and evacuation systems, AITEMIN et al. 7220-PR062

13 -Improvement of safety, reliability, and operational life of electrical and electronic equipment used in hazardous explosive atmospheres, AITEMIN et al. 7220-PR090

14 Improved understanding of reinforcement behaviour/testing, DMT et al 7220-PR091

15 Advanced geotechnical instrumentation for detecting rock failure and monitoring support loads, Rock Mechanics Technology et al. 7220-PR092

16..Reduction of energy consumption in coal mining through optimized belt conveyor systems, Rheinbraun et al. 7220-PR093

17 Fire fighting systems, DMT et al. 7220-PR094

18..Assessment and sustainable reclamation of mine sites for post mining use, IMC Technical Services et al. 7220-PR095

19..Assessment of hazardous gas emissions to the surface over former mine areas, IMC Technical Services et al. 7220-PR096

Coal Preparation

20 In situ diagnostic methods in basic processes of coal preparation, DMT et al. 7220-PR037

22 On-line monitoring of the abrasion behaviour of grinding elements of coal mills for condition-based maintenance, DMT et al. 7220-PR063

23 Modelling systems for coal properties monitoring and preparation analysis, DMT et al. 7220-PR064

26 Characterization of coal-wash slurries and their impact on fine coal preparation, DMT et al 7220-PR097

27 Advanced demineralization of high sulphur coal by bioleaching and bioflotation, CIEMAT - Instituto deMedio-Ambiente et al. 7220-PR098

30 Development of measures and tools for improvement of coke oven operation related to aspects of carbon deposits, DMT et al. 7220-PR101

31 Super Coke 2000, Centre de Pyrolyse de Marienau et al. 7220-PR102

Coal Conversion

32 Reduction of environmental emissions in coke making, University of Alicante et al. 7220-PR039

33 Improved inspection, testing and in situ repair of coke ovens, DMT et al. 7220-PR040

34..Improved energy efficiency and coking process operation and control, Centre de Pyrolyse de Marienau et al. 7220-PR041

35 Development of catalysts supported on activated carbon fibre-based monoliths for low temperature reduction of NOx, Instituto Nacional del Carbón et al. 7220-PR042

37 Production and application of special coke for environmental purposes, Rheinbraun et al. 7220-PR067

38 Improved metallurgical coke properties, Centre de Pyrolyse de Marienau et al. 7220-PR068

39 Study of parameters involved in coking pressure generation. Laboratory, pilot and industrial test measurements, Instituto Nacional del Carbón et al. 7220-PR069

Coal Combustion & Gasification

41 Improved flue gas cleaning in connection with electrical precipitator performance and its relation to coal quality, EVN Energie et al. 7220-PR044

43 On-line coal flow and chemical composition measurement and control (ONLICOAL), Associación de Investigación y Cooperación industrial de Andalucia et al. 7220-PR046
54 NOx emission reduction and performance improvement by primary (in-furnace) measures in large power plants (PRIME project), INERCO et al. 7220-PR072
55 Numerical investigation of coal-fired equipment using combustion optimisation algorithms University of Zaragoza et al. 7220-PR073
56 Burning behaviour of coal and biomass in fluidised bed boilers, VTT et al. 7220-PR074
57 On-line management system for the advanced control of utility boiler efficiency (SICOBO), TECNATOM et al. 7220-PR075
58 Development of innovative instrumental techniques for coal combustion (DITEC), Centro Sviluppo Materiali et al. 7220-PR076
59 Predictive tools for the optimisation of coal combustion, DMT et al. 7220-PR077
60 Development of alternative use of marginal coal achieving a thermal improvement blending with biomass, Associación de Investigación y Cooperación industrial de Andalucia et al. 7220-PR-078
61 Development of a hybrid collector concept for the control of fine particles and air toxics in coal power plants, Associación de Investigación y Cooperación industrial deAndalucia et al. 7220-PR079
62 Reliability improvements for combustion plants, Technical University of Denmark et al. 7220-PR080
64 Reburning and SNCR for Nox reduction in pulverised coal fired boilers, SNET-CERCHAR et al. 7220-PR082
67 Leaching properties of co-processed residues as a function of fuel composition, combustion conditions and end-use, SNET-CERCHAR et al. 7220-PR085
70 Mercury removal through reactive adsorption under flue gas conditions, CINAR et al. 7220-PR088
71..Comparison of combustion and gasification technologies to process coal and waste mixtures, INETI et al. 7220-PR089
73..Experimental, numerical and theoretical investigation on pressurized pulverised coal combustion, RWE et al. 7220-PR104
76 Upgrading treatments of solid residues arising from co-combustion - manufacture of a calcic sulphoaluminate cement as an alternative to disposal, SNET-CERCHAR et al. 7220-PR107
77 Emissions minimization in coal/solid waste co-combustion by primary measures, Aristotle University of Thessaloniki et al. 7220-PR108
78 Reduction of greenhouse gas emissions from utility scale circulating fluidised bed boilers, Mitsui Babcock Energy et al. 7220-PR109
79 Efficiency, plant damage and NOx optimization for power plants operating with variable loads and coals (VAR-OPT PROJECT), INERCO et al. 7220-PR110
80 Cost optimization in coal power plants by the development of an integrated advisor for operation improvement of air preheaters (PREADVISOR PROJECT), INERCO et al. 7220-PR111

CALENDAR OF COAL RESEARCH MEETINGS AND EVENTS

Date	Title	Location	Contact
19th June 2002	**International Coal Preparation Review and Recent Developments**	**University Staff Club, University of Nottingham**	**Dr Chandu Shah SChEME The University of Nottingham Nottingham NG7 2RD Tel: 0115 9514104 Fax: 0115 9514115 e-mail: chandu.shah@nottingham.ac.uk**
24th - 25th June 2002	Final Symposium on the ECSC Coal Research Programme	Luxemburg, details to be announced	Mr J K Wilkinson, Commision of the European Communities, Rue de la Loi 200, Brussels, Belgium, B-1049 Tel : 00322-295-5576 Fax : 00322 -296-6016 E-mail: keith.wilkinson@cec.eu.int
7-10 July 2002	4th International Symposium on Coal Structure 2002 – Structure and Reactivity of Carbonaceous Materials	Gliwice, Poland	Dr Janusz Pajak Polish Academy of Sciences Institute of Coal Chemistry Gliwice, Poland Tel: 48 2380 770 Fax: +48 32 2312 831 E-mail: cs2002@karboch.gliwice.pl Web: http://www.karboch.gliwice.pl/cs2002
21-26 July 2002	29th International Symposium on Combustion	Sapporo, Japan	Prof Ken-ichi Ito Hokkaido University Kita 8 Nishi 5, Kita-ku Sapporo, Japan e-mail: ito@york-me.eng.hokudai.ac.jp web
16-18th September 2002	**4th UK Meeting on Coal Research and its Applications**	**Imperial College, London**	**Dr A W Thompson SChEME University of Nottingham Nottingham NG7 2RD Tel: 0115 9514198 Fax: 01159514115 e-mail:alan.thompson@nottingham.ac.uk**
23-27th Sep 2002	19th Annual International Pittsburgh Coal Conference	Pittsburgh, PA, USA	Program Secretary, The Pittsburgh Coal Conference, University of Pittsburgh, 1249 Benedum Hall, Pittsburgh, PA, 15261, USA Tel: +1 412 624-7440 Fax: +1 412 624-1480 Email: pcc@engrng.pitt.edu
21-23th Oct 2002	International Conference on Clean Coal Technologies for our Future	Sardinia, Italy	Clean Coal Technology Conference, Sotocarbo SpA, c/o Centro Servizi CNISI, 09010 Portoscuso(CA), Italy Tel: +39 0781 509047 Fax: +39 0781 508349 Email: cct2002@tiscalinet.it Internet: www.iea-coal.org.uk/cct2002
6-9 November, 2002	2002 China International Hi-tech Symposium and Exhibition on Coal Chemical Industry and Conversion	Beijing International Convention Centre	Room 3001/3003, West Building Building No. 16, Qiqu, Hepingli Beijing 100013, P.R. China Contact Person: Ms. Zhang Yuan and Mr. Han Wenxue Tel: 0086 10 64217764 Fax: 0086 10 64225383 E-mail:chinacccf@asiabchem.com.cn Or visit our website: Http://www.chinacccf.com