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NEWSLETTER

of the Coal Research Forum

EDITOR'S COMMENTS:
Arrangements are now in full swing for the premier event in the Coal Research Forum's calendar, namely our biennial conference to be held this year at Cardiff University from 3rd to 5th September. We have an excellent programme lined up and the Registration and Programme document will be available in early July. Note also that preceding the conference will be a one-day workshop available to you at no charge with lunch and refreshments also provided - what a deal! It is organised by Robert Davidson of IEA Clean Coal Centre and this year's theme is "Perspectives on Cofiring and Coprocessing". Please contact Robert directly at robert@iea-coal.org.uk for more information or to register.

In April a joint meeting of the Combustion, Characterisation and Coal Conversion Divisions was held at the University of Nottingham. Brief notes of this meeting appear in this newsletter. In addition, a joint CRF/BCURA meeting to present recently completed BCURA projects has recently taken place on 4th June at Imperial College London. We are also pleased to announce the China-UK Summer School, which is being jointly organised by Professor Yong Yan, (University of Kent), and Professor Zhou to take place in Zhejian University, China on 7th to 19th September 2008, (see article in this Newsletter).

Just a final thought. With the price of crude oil what it is now surely the economics are right for commercial coal to liquid conversion and gasification even if some of the technical challenges still remain.

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CRF/CUSG Annual Meetings together with a joint Combustion/Coal Characterisation/Coal Conversion Divisional Meeting
University of Nottingham
10 April 2008

This meeting was the first at which three of the CRF divisions had met jointly and the consensus seemed to be that it was a good idea and one which might be repeated, albeit with other divisions, sometime in the future.

The welcome address from John Patrick was just about over when with inimitable timing, Jon Gibbins, the chairman of the Combustion Division, walked through the door!

John welcomed the first speaker who was Ben Goh from E.ON who gave a talk entitled "Current oxyfuel combustion activities at E.ON UK plc". The second paper was from Doosan Babcock Energy Ltd. and was presented by David Fitzgerald. It was entitled "Current oxyfuel combustion activities at Doosan Babcock Energy Ltd". John Griffiths of Jacobs Engineering Ltd made the next presentation entitled "IGSC: A pressurised oxyfuel cycle that uses water as a coolant". This was an update of the concept which he had earlier described at a CRF meeting at Didcot in November 2006.

Mr Dafydd Wynn of Ferrybridge Power Station, Scottish and Southern Energy described their "Experience with biomass co-firing". This included the history of coal-biomass firing at SSE and some of the problem areas and successes encountered over the previous six years that this process had been in operation.

"Coal/biomass combustion prediction using image analysis methods" was presented by Dr Ed Lester of University of Nottingham in his special, 'user-friendly' style. In his talk Ed described the trials and tribulations of the early petrographers and how the advent of image analysis not only made their lives easier but revealed so much more about coal and char structures. Ed then described how a combination of modeling and advanced image analysis could result in viable burnout predictions and also described some of his work on biomass char structures and burnout.

Dr Alan Herod of Imperial College London presented some of his work entitled "Coal-derived material characterisation" who was followed by Mr George Bradley of TES Bretby who gave a talk on "Commercial coal analyses and the BCURA Coal Bank". His talk described some of the test procedures currently in use and also allowed the audience to be made better aware of the coal standards available, generally at no cost, in the BCURA Coal Bank.

The third and final session took place after the AGM of the CRF and contained three presentations of the Coal Conversion Division. The first was by Stuart James of E.ON and was entitled "Advancements in coal gasification". As a result of the UK Governments recent preference for supporting post-combustion capture, Stuart was faced with trying to update people on what proposed IGCC plants were still in the running and which had been parked, albeit maybe temporarily, like E.ON's Killingholme project.

There then followed a talk entitled "Recent developments in coal liquefaction" by Mr Gordon Couch of IEA Clean Coal Centre. Gordon described a recent project in which he had been involved which focused on the production of transport fuels

from coal. He described the types of liquefaction process that are currently available and also that coal is not an ideal starting material to produce petrol or diesel. Although the rocketing prices of crude oil would seem to make the development of coal liquefaction a no-brainer there appear to be a number of serious cost issues and technology and reliability issues yet to be solved,.

"Carbolite furnaces in coal analysis and coking research" was a presentation by Mr Ken Blackett of Carbolite which described the main items of coal testing and analysis equipment available from this supplier.

Several of the presentations from this meeting are available on the Coal Research Forum website at http://www.coalresearchforum.org/pastmeetings.html

Centre for Innovation in Carbon Capture & Storage opened

8 February 2008

A research centre dedicated to reducing the planet's carbon footprint will be launched at The University of Nottingham this week. The £1.1m Centre for Innovation in Carbon Capture and Storage (CICCS) will explore cutting edge technology that 'captures' polluting carbon dioxide and stores it permanently — preventing its damaging release into the atmosphere.

CO_2 and other greenhouse gases are the main contributors to global warming and climate change. By investigating new technologies that will store the gases safely and efficiently, the research can help to reduce their impact on the planet's climate and eco-systems.

From governments and environmental pressure groups to oil producers and energy-intensive industry, research taking place at the centre will have a potentially global impact.

Experts in clean energy technologies and carbon capture will speak at the launch event, which takes place on Friday 8th February. Keynote speakers include Lord Ronald Oxburgh, President of the Carbon Capture and Storage Association, Dr David Clarke, Director of the Energy Technologies Institute, Martin Maseo, Technical Director of the Energy Institute and Dr Keith Burnard, Chief Technical Consultant of AEA Energy and Environment. MP Nick Palmer, Parliamentary Private Secretary to Energy Minister Malcolm Wicks, will welcome guests at the event on his behalf.

The centre will be led by Professor Mercedes Maroto-Valer, of the University's School of Chemical and Environmental Engineering. But the research will be cross-disciplinary, bringing together engineers, mathematicians, bioscientists, geographers and geologists. Research projects conducted in the centre will include the storage and conversion of CO_2 into materials and fuels.

The Engineering and Physical Sciences Research Council (EPSRC) will fund the centre over the next five years through its Challenging Engineering initiative.

Professor Maroto-Valer, Director of the Centre for Innovation in Carbon Capture and Storage, said: "We are excited about the prospects for CICCS to become a world leader in the field. We will continue to develop new processes that will make a significant impact in finding solutions for climate change and protecting the planet.

"We will present the research, training and outreach activities planned by CICCS at the launch event. The response to the centre has been outstanding so far."Dr Nick Palmer MP added: "I'm delighted to help launch the centre, as its technology may well be crucial to Britain's future. Britain has huge coal reserves, which could have a greatly enhanced future to guarantee our energy security if carbon capture technology were more advanced."
http://www.innovations-report.de/html/berichte/umwelt_naturschutz/bericht-102946.html

New programme for the Research Fund for Coal and Steel

20 May 2008
On the 20th May 2008 the European Commission published official notification of the Council decision from the 29th April 2008 for the adoption of The Research Programme for the Research Fund for Coal and Steel.

The Research Programme shall support the competitiveness of the Community sectors related to the coal and steel industry and shall be consistent with the scientific, technological and political objectives of the Community, and shall complement the activities carried out in the Member States and within the existing Community research programmes, in particular the framework programme for research, technological development and demonstration activities.

Research objectives for coal
Research projects shall aim to reduce the total costs of mining production, improve the quality of the products and reduce the costs of using coal. Research projects shall encompass the entire coal production chain as follows:

- Modern techniques for surveying deposits.
- Integrated mine planning.
- Highly efficient, largely automated excavation and new and existing mining technologies corresponding to the
- geological characteristics of European hard coal deposits.
- Appropriate support technologies.
- Transport systems.
- Power supply services, communication and information,
- transmission, monitoring and process control systems.
- Coal preparation techniques, oriented to the needs of the consumer markets.
- Coal conversion.
- Coal combustion.

Research projects shall also aim to achieve scientific and technological progress with a view to gaining a better understanding of the behaviour and control of deposits in relation to rock pressure, gas emissions, the risk of explosion, ventilation and all other factors affecting mining operations.
For research objectives for steel see.
http://euroalert.net/en/news.aspx?idn=7130

New call By US DoE to fund coal research

20 May 2008
The U.S. Department of Energy is calling on U.S. colleges and universities to propose new projects to enhance the long-term use of coal. Officials said the announcement marks the start of the 30th year of the

department's University Coal Research program -- its longest-running student-teacher research grant project.

Since the program's inception in 1979, nearly 1,765 students have received hands-on research experience investigating long-term solutions for clean and efficient use of coal, officials said.

This year, the program will make available $2.4 million to fund projects with a maximum of $300,000 per project. Each 36-month project will involve one or two colleges or universities.

Research proposals are being sought in three areas of interest: computational energy sciences, material science and novel materials for sensing or monitoring in extreme environments of fossil energy systems.

Proposals are due by June 10. The National Energy Technology Laboratory, which implements the program for the Energy Department, will name the winning projects in December.

http://www.upi.com/NewsTrack/Science/2008/05/20/us_energy_dept_to_fund_coal_research/9768/

Future cloudy for FutureGen?

22 February 2008

It was meant to be the start of a new era for the US coal industry, a project that promised to save the mineral's role as a major fuel for power generation in an era of climate change and in the face of competition from alternative fuels that generated fewer (or, in the case of nuclear, effectively no) carbon emissions. It was the US Department of Energy's (DoE's) FutureGen clean coal, including carbon capture and sequestration (CCS), project. As usual with big, expensive, high-profile, American research and development projects, it attracted international attention, including the attention of the South African coal industry.

But on January 30, the US DoE called time-out on FutureGen. Although the project had advanced to the point that a site had been chosen for the demonstration plant – a small town called Mattoon, in the state of Illinois – US Energy Secretary Samuel W Bodman announced that the project was to be restructured. The reason was simple – huge cost overruns.

When FutureGen was announced on 27th February 2003, its estimated cost was $1-billion; by December 2007, this figure had ballooned to $1.8-billion. Although intended as a public–private partnership, the DoE was going to bear by far the bulk of the costs – 74%. The near doubling of the cost was a budget breaker.

Indeed, in mid-December, DoE Acting Principal Deputy Assistant Secretary for Fossil Energy James Slutz issued a statement warning that "projected cost overruns require a reassessment of FutureGen's design . . ." "The DoE believes that public interest mandates that FutureGen deliver the greatest possible technological benefits in the most cost-efficient manner.

This will require restructuring FutureGen to maximise the role of private-sector innovation, facilitate the most productive public–private partnership, and prevent future cost escalation." Slutz did preface these remarks with an assurance that "clean-coal technology is a vital component of the Bush Administration's vision for a cleaner, more secure energy future". "FutureGen, which seeks to demonstrate

integrated clean-coal technologies with carbon capture and sequestration, remains a cornerstone of this vision."

When he announced last month that FutureGen was to be restructured, Bodman also unveiled a budget request of $648-million for coal research, development, and deployment for the 2009 financial year (FY) Federal budget.

This would be the largest coal budget for more than 25 years, and would be divided into $407- million for coal research (including programmes such as the development of more efficient gasification and turbine technologies, as well as large-scale CCS injection tests), $241-million to demonstrate technologies for cost-effectively capturing and storing carbon from coal-fuelled power stations – including $156- million for the restructured FutureGen – and $85-million for the DoE's clean-coal power initiative.

This FY2009 request is $129-million higher than the FY2008 coal programme budget request. Note that the US Congress is free to increase or decrease the coal programme budget, or any part of that budget, as the legislators see fit.

"This restructured FutureGen approach is an all-round better investment for Americans," asserted Bodman. "As technological advancements have been realised in the last five years, we are eager to demonstrate CCS technology on commercial plants that, when operational, will be the cleanest coal-fired plants in the world.

Each of these plants will sequester at least one-million metric tons of carbon dioxide annually and help meet our nation's rapidly growing energy demand . . . the Department of Energy is . . . focusing on demonstrating advanced technology like carbon capture and storage so that the technology can be perfected and rapidly deployed across the country."

So, what now for FutureGen? The original project, launched in early 2003, sought to create a prototype plant which would generate some 275 MW of electricity and also produce hydrogen; at least 90% of the plant's carbon dioxide emissions were to be captured. It proved overambitious. But, as the US consumed 1.1 billion tons of coal last year, and as this is expected to increase to about 1.7 billion tons in 2030 (these are DoE figures), the country cannot just abandon CCS. Hence, the restructuring of FutureGen.

Under the new plan, the co-production of hydrogen as an integral part of the project has been dropped. And the idea of a single large-scale R&D plant has been abandoned. Instead, the focus is now on developing multiple commercial-scale demonstration plants.

Exploiting the progress in the development of IGCC technology over the last five years, the idea is to integrate CCS with IGCC plants. The DoE reports that more than 30 IGCC plants are at various proposal stages in the US. The intent of the DoE is that it will fund the addition of CCS systems to IGCC plants, which will be built by the private sector on a commercial basis.

The number of plants that will be involved has yet to be determined – that will be done in cooperation with the industry – but each will have to have a production capacity of at least 300 MW. To this end, a request for information has been issued to US industry.

The deadline for responses is 3rd March. In this way, the DoE hopes to see commercial operation of IGCC-CCS plants beginning in the 2015/16 timeframe.

The DoE is also hopeful of gaining international cooperation for the programme. FutureGen is most definitely not dead. Nor is it the only such programme in the world.

The WEC reports CCS programmes in Australia, Canada, France, Germany, Italy, Japan, Norway, and the UK, although not all are focused on coal, and none are anywhere as big as FutureGen.

Last March, CBC reported that the Canadian Federal Government was contributing Can$156-million to a feasibility scheme into a Can$1,5-billion project for a pipeline that would carry carbon dioxide from power stations and tar sands producers to natural gas fields, where it would both help extract the last of the gas and be sequestrated.

Across the Pacific, China launched its GreenGen near-zero emission coal power demonstration project. Coal provides China with the bulk of its electricity. Of a total installed capacity of 620 GW in 2006, some 75% was generated by thermal power stations, of which 95% used coal as their fuel. Power generation accounts for some 50% of all Chinese carbon dioxide emissions.

GreenGen is structured as a company, set up by a number of Chinese government departments and agencies, energy companies, and the State Development and Investment Company.

The objectives of GreenGen are R&D and demonstration of integrated coal gasification, hydrogen production, hydrogen power generation and carbon dioxide sequestration; the achievement of highly efficient coal-fuelled electricity generation, with zero emissions of all pollutants, including carbon dioxide; to master all the requisite core technologies and systems integration and create technologies which are Chinese intellectual property; and to carry out commercial demonstrations at acceptable costs, allowing the sustainable development of coal-based generation.

GreenGen hopes to build a 400-MW engineering/demonstration plant, which would produce hydrogen and electricity, and have CCS, in the 2013 to 2015 period. China is co-operating with Australia, the UK, and the European Union (EU), on different elements of the programme.

In fact, it is the EU, and not any single country, that is responsible for the biggest single CCS programme outside the US – Hypogen. Like GreenGen, and the original FutureGen, Hypogen – which is an acronym for Hydrogen and power generation – also includes the objective of producing hydrogen. However, Hypogen is not aimed solely at coal.

Launched in 2004, Hypogen is a Framework Programme 6 R&D project. The first phase of the project is being undertaken by the 30-partner, 14-nation, Dynamis consortium, with a €4- million EU grant. This year is the last of this three-year phase, which has the objectives of determining whether it would be practical, by 2012, to achieve large-scale power generation employing advanced power cycles using hydrogen-fuelled gas turbines or other decarbonised power systems; using coal or gas as fuel; and with hydrogen 'export' production equivalent to 0 MW to 50 MW. The hydrogen produced will have to be compliant with the specifications of EU infrastructure. There would have to be a 90% carbon dioxide capture rate; and a 50% reduction in the cost of carbon capture.

Dynamis has identified four sites for further Hypogen studies, to take place during phase two of the project. These are Mongstad, in Norway, a natural-gas-based

plant with offshore carbon dioxide storage; a site near Hamburg, in Germany, which is a bituminous coal-powered plant, with offshore or onshore sequestration; a bituminous coal-based plant in the East Midlands of England; and another English bituminous coal-based plant, this time in the North East of that country; both English plants would use offshore carbon dioxide storage.
http://www.miningweekly.co.za/article.php?a_id=127084

'Stern' warning that climate change is far worse than 2006 estimate

17 April 2008

Lord Stern, the economist whose report on climate change helped galvanise world leaders behind the green energy movement when it was published 18 months ago, has admitted that the situation is far worse than the assumptions that formed the basis of his ground-breaking report.

"We badly underestimated the degree of damages and the risks of climate change," said Lord Stern in a speech in London yesterday. "All of the links in the chain are on average worse than we thought a couple of years ago."

When it was first published, the Stern Review and its recommendations – zero-emission automobiles around the world by 2050, for example – brought plaudits and brickbats from the different sides of the climate change debate. A year and a half on from its publication, Lord Stern dismissed the doubters and renewed his call for urgent global action: "People who said this was scaremongering are profoundly wrong. If anything, I was too reticent. What we are playing for is the transformation of the planet," he said.

Greenhouse gas emissions are growing much faster than previously thought because of several factors that were not fully appreciated before, including the release of methane from thawing permafrost, the acidification of oceans, and the decay of carbon sinks. The worsening situation increases the need, he argued, for a global pollution-cutting agreement to be reached by next year's climate conference in Copenhagen. He also reiterated his previous estimates that governments and business must invest the equivalent of between 1 to 2 per cent of global GDP annually up to 2050 in new technologies and efficiency measures or face climate change of catastrophic proportions. A global carbon trading system would be the "glue" for a worldwide climate deal, he said.

The sector to be most heavily affected by any global climate deal would be the energy industry, which accounts for roughly two-thirds of emissions. "We need to have zero carbon electricity, or very close to it, by 2050. That means carbon capture and sequestration (CCS) in electricity by 2050, it means nuclear, it means renewables," he said.

The soaring use of coal in electricity generation, principally from China where a new coal-fired power station comes into operation every week, means that CCS – a technology that remains unproven on an industrial scale – will be absolutely crucial. "We need to get better at carbon capture and sequestration very quickly," Lord Stern said.

Not only is coal the dirtiest fuel, it is also the only major fossil fuel source where big consumer nations still have large stores within their borders, and it is relatively cheap. For these reasons, most economists and energy analysts expect its consumption to grow massively. Lord Stern gave his revised views on the same day that the price of oil hit a new high at $114.43 per barrel amid rising demand from Asia and industrialised nations.

He said: "This is about buying down risk. Starting now, that means it requires at least 1 per cent of world GDP. That is small relative to a planetary catastrophe."

http://www.independent.co.uk/news/business/news/stern-warns-that-climate-change-is-far-worse-than-2006-estimate-810488.html

'Adapt to climate change, don't combat it' say scientists

26 March 2008

The world would be better off adapting to the consequences of climate change rather than trying to fight the causes, according to scientists. They accept the scientific consensus on global warming but differ about what needs to be done about it. The group, including Mike Hulme, the founding director of the Tyndall Centre for Climate Change Research at the University of East Anglia, also believe that climate change may not necessarily be as catastrophic for the planet as has been forecast.

Their controversial view, which they accept will lead to them being branded as "the new pariahs of global warming", is that the world would be better off fighting the consequences of climate change - hunger, storm damage and disease - rather than spending billions of pounds trying to stabilise CO_2 emissions across the planet. Roger Pielke Jr, an environmental policy expert at the University of Colorado at Boulder, told the journal Natural Hazards Review: "Everything has been put on the back of carbon dioxide, and carbon dioxide cannot carry that weight." He went on: "I've been accused of taking money from Exxon or being a right-wing hack. I would characterise us as realists. Realists on what is politically possible."

Daniel Sarewitz, a public policy expert at the Arizona State University, told the Los Angeles Times this view represented the "radical middle".

The United Nations estimates that global warming would increase the number of people at risk of hunger from 777m in 2020 to 885m by 2080, a 14% rise, if current development patterns continue.

But Prof Hulme said that increase could be tackled by funding better irrigation systems, drought-resistant crops and more-efficient food transport systems, rather than fighting global warming. "If you're really concerned about drought, those are much more effective strategies than trying to bring down greenhouse gas concentrations," he said.

And on malaria - which could be carried by mosquitoes into Africa's highland regions with higher temperatures - Paul Reiter, an expert on mosquito-borne disease at the Pasteur Institute in Paris told the newspaper: "We should be more concerned with controlling the disease than trying to change the weather." He recommended heavier use of pesticides to kill mosquitoes - the same strategy that eradicated malaria in the United States and elsewhere.

Hans von Storch, director of the Institute of Coastal Research in Germany, added that the problems were already so big that the burdens caused by rising temperatures would be relatively small. It would be like driving at 160 kilometres per hour when "going 150... is already dangerous," he said.

But many scientists believe downplaying the importance of emissions reductions is dangerous. Stephen Schneider, a climatologist at Stanford University, said: "You can't adapt to melting the Greenland ice sheet. You can't adapt to species that have gone extinct."

Other scientists said that if adaptation were so simple, it would have already been done. Professor Sir Andrew Haines, director of the London School of Hygiene and Tropical Medicine, said: "I agree we need better strategies to combat malaria and increasing resources are being devoted to this end. "However, malaria is only one of a number of health outcomes that are likely to be affected by climate change. "There are also major health co-benefits from policies to promote more equitable access to clean energy, for example by reducing exposure to indoor and outdoor air pollution and by promoting active transport policies."

http://www.telegraph.co.uk/earth/main.jhtml?xml=/earth/2008/03/26/eaclim126.xml

Can CO_2 capture and storage really deliver?

9 May 2008

Great hopes are being placed on undeveloped technology. Capturing and storing carbon dioxide is predicted to be one of the most important measures to counter the threats to our climate. But the technology still hasn't been tested in full scale, and the complications and risks it entails may have been grossly underestimated.

This is the conclusion drawn in Anders Hansson's dissertation at the Department of Technology and Social Change, Linköping University, in Sweden. He studied documents from the EU and the UN Climate Panel about CCS (Carbon dioxide Capture and Storing), as well as some of the research they are based on. The UN Climate Panel released its most thoroughly considered report ever last year, supported by an uncommonly unanimous research community.

The Climate Panel sees CCS as offering great potential. In various scenarios it accounts for between 15 and 55 percent of the reduction of greenhouse gases by 2100. The EU also is promoting CCS, suggesting that it be included in the trading of emission rights, for example. Carbon dioxide that is captured in energy production, for example, and is placed in long-term storage in the crust of the earth would thus be counted as never having been produced, according to the EU proposal. The consequence is that coal power, which is the biggest area of application for CCS, is being called sustainable coal and is equated in many respects with renewable energy.

The problem is, according to Anders Hansson, that CCS is still a relatively untested method. "There are a number of small facilities, in Norway, for instance, where they capture and store a million tons of carbon dioxide per year. Swedish Vattenfall is starting a pilot facility in eastern German this summer."

Globally, a total of some millions of tons per year is being stored today within the framework of CCS. But to live up to the hopes placed on CCS requires the storage of several billion tons. In other words, this involves gargantuan volumes. In fact, carbon dioxide would be the world's largest transported good.

"In full scale this technology only exists in the imaginations of the people developing it," says Anders Hansson. "It's overly optimistic to place such great faith in it, considering all the uncertainties found in the scientific literature."

Several researchers studying CCS point out themselves that their models and scenarios in many respects are based on insufficient factual foundations, unrealistic assumptions, and major oversimplifications. The economic calculations, which are often carried out with a hundred-year horizon, rarely factor in external and social costs, which may entail that the costs are hugely underestimated. The EU is counting on CCS to be working in full scale in about 15 years. But despite the fact that this technology will touch the lives of many people, very few people know much about it and its projected scope. Interview-based studies have shown that at most only 20 percent of the general public has heard of CCS. "CCS needs to become known and be debated," says Anders Hansson. "Otherwise there is a risk of a backlash similar to what happened with nuclear power."

This has already occurred in California, where popular protests last year stopped a law about carbon dioxide storage. Anders Hansson also wonders whether CCS would delay or hasten long-term sustainable solutions to energy and climate problems. "After all, we all agree that fossil fuels will run out. Renewable energy is the only long-term path. In that perspective, a large-scale commitment to CCS seems to be an unnecessary detour."
http://www.sciencedaily.com/releases/2008/05/080508142552.htm

Increased knowledge about global warming leads to apathy, study shows

28 March 2008
The more you know the less you care -- at least that seems to be the case with global warming. A telephone survey of 1,093 Americans by two Texas A&M University political scientists and a former colleague indicates that trend, as explained in their recent article in the peer-reviewed journal Risk Analysis.

"More informed respondents both feel less personally responsible for global warming, and also show less concern for global warming," states the article, titled "Personal Efficacy, the Information Environment, and Attitudes toward Global Warming and Climate Change in the USA."

The study showed high levels of confidence in scientists among Americans led to a decreased sense of responsibility for global warming.

The diminished concern and sense of responsibility flies in the face of awareness campaigns about climate change, such as in the movies An Inconvenient Truth and Ice Age: The Meltdown and in the mainstream media's escalating emphasis on the trend.

The research was conducted by Paul M. Kellstedt, a political science associate professor at Texas A&M; Arnold Vedlitz, Bob Bullock Chair in Government and Public Policy at Texas A&M's George Bush School of Government and Public Service; and Sammy Zahran, formerly of Texas A&M and now an assistant professor of sociology at Colorado State University.

Kellstedt says the findings were a bit unexpected. The focus of the study, he says, was not to measure how informed or how uninformed Americans are about global warming, but to understand why some individuals who are more or less informed about it showed more or less concern.

"In that sense, we didn't really have expectations about how aware or unaware people were of global warming," he says.

But, he adds, "The findings that the more informed respondents were less concerned about global warming, and that they felt less personally responsible for it, did surprise us. We expected just the opposite.

"The findings, while rather modest in magnitude -- there are other variables we measured which had much larger effects on concern for global warming -- were statistically quite robust, which is to say that they continued to appear regardless of how we modelled the data."

Measuring knowledge about global warming is a tricky business, Kellstedt adds. "That's true of many other things we would like to measure in surveys, of course, especially things that might embarrass people (like ignorance) or that they might feel social pressure to avoid revealing (like prejudice)," he says.

"There are no industry standards, so to speak, for measuring knowledge about global warming. We opted for this straightforward measure and realize that other measures might produce different results."

Now, for better or worse, scientists have to deal with the public's abundant confidence in them. "But it cannot be comforting to the researchers in the scientific community that the more trust people have in them as scientists, the less concerned they are about their findings," the researchers conclude in their study. http://www.sciencedaily.com/releases/2008/03/080327172038.htm

Now you can measure your own carbon footprint

27 February 2008
An innovation called Carbon Hero may help reduce global warming by making people more aware of their carbon footprint. Regional prize winner in the 2007 European Satellite Navigation Competition, sponsored by ESA's Technology Transfer Programme, the device uses satellite navigation technology to track journeys. Concerned about global warming, many people are now looking for ways to reduce their generation of carbon dioxide (CO_2). One option is to use public transport and limit journeys by car and plane; however, although this can significantly reduce each person's carbon footprint, until now the benefits have been difficult to measure.

"With Carbon Hero calculating your carbon footprint is easy," explains Andreas Zachariah, a graduate student from the Royal College of Art in London and inventor of Carbon Hero. "This easy-to-use mobile system uses satellite navigation data to calculate the environmental impact of travel. With its specialist database and algorithm, it can determine the mode of transport and its environmental impact with almost no user input."

It was back in 2006, that Andreas Zachariah came up with the idea of a small and practical device to track personal CO_2 emissions during travel. It determines the carbon footprint of travellers using different modes of transport by using satellite navigation data to measure the distance, identify the type of transportation and calculate the amount of CO_2 released into the atmosphere through travel.

In April 2007, Oxford graduate student Nick Burch joined Zachariah in his effort to bring Carbon Hero to life. Burch has produced a number of open source, mobile and navigation location-based applications and with this expertise the team developed the device. "We have now tested our application using GPS and it has proved to be very efficient. Once Galileo, the European global navigation

satellite system, becomes fully operational its increased accuracy will aid Carbon Hero to measure journeys and then determine their carbon footprint," says Zachariah.

Galileo, a joint initiative of the European Commission and ESA, will provide a highly accurate, guaranteed global positioning service under civilian control. The system will deliver real-time positioning accuracy down to better than one metre, a range unprecedented for a publicly available system, and by using dual frequencies Galileo will guarantee worldwide high-integrity (Safety-of-Live Service) for safety-critical applications, such as maritime, aviation and rail, where guaranteed accuracy and availability is essential.

With Carbon Hero, to see the effect a journey is having on the environment you just need to look at your mobile phone. "The feedback loop is almost immediate," says Zachariah. It is also educational in that by giving an idea of the environmental impact of different types of transport - whether by train, plane, bike or by foot - it allows users to easily compare one kind of travel with another and calculate the environmental benefits daily, weekly and monthly. For more visit, http://www.sciencedaily.com/releases/2008/02/080225122328.htm

Largest biomass plant planned for Drax

19 May 2008
Drax plc has signed up France's Alstom Power to build a biomass fuel processing plant to help cut carbon emissions from Britain's biggest coal fired power station, the company said.

Drax supplies 7% of the UK's electricity mostly from burning coal, and as a result is also one of Europe's top five sources of the greenhouse gas carbon dioxide (CO_2), at 4% of Britain's total emissions. The company plans to cut those emissions by 15% within three years by burning less coal and installing more efficient turbines.

The new £50M ($97.3 million) contract is to process wood and nut shells to burn in Drax's furnaces, part of a bid to produce a tenth of the company's total 4,000 megawatts of electricity from biomass by 2011. That could make it the largest project biomass plant in the world, said Drax, capable of burning up to 1.5 million tonnes of wood and other organic and waste material a year.

The power station near Selby in North Yorkshire produced 22.5 million tonnes of carbon dioxide last year, compared to the UK total last year of 543.7 million tonnes of the planet-warming gas. Unlike coal, the dirtiest fuel used to make power, wood pellets are seen as clean energy because the forests can be replanted and trees soak up CO2 when they grow. Burning wood along with coal will enable Drax to earn more money through the government's Renewable Obligation Certificates scheme, which guarantees income for each megawatt produced using renewable energy.

It also means Drax will have to buy fewer permits to emit CO_2 under the European Union Emissions Trading Scheme. Although it is scouring the globe for pellets and may have to transport them from North America, Drax is confident the overall effect on the environment will be positive, a spokeswoman for the company said.

Drax said in a statement it expected to award contracts for the fuel injection equipment and unloading facilities in the next few months. The company said on

Monday its full-year profit expectations had improved slightly since its preliminary results statement in early March.
http://uk.reuters.com/article/basicIndustries/idUKL1904070220080519?pageNumber=1

Burning biofuels may be worse than coal and oil, say experts

4 January 4 2008

Using biofuels made from corn, sugar cane and soy could have a greater environmental impact than burning fossil fuels, according to experts. Although the fuels themselves emit fewer greenhouse gases, they all have higher costs in terms of biodiversity loss and destruction of farmland.

The problems of climate change and the rising cost of oil have led to a race to develop environmentally-friendly biofuels, such as palm oil or ethanol derived from corn and sugar cane. The EU has proposed that 10% of all fuel used in transport should come from biofuels by 2020 and the emerging global market is expected to be worth billions of dollars a year.

But the new fuels have attracted controversy. "Regardless of how effective sugar cane is for producing ethanol, its benefits quickly diminish if carbon-rich tropical forests are being razed to make the sugar cane fields, thereby causing vast greenhouse-gas emission increases," Jörn Scharlemann and William Laurance, of the Smithsonian Tropical Research Institute in Panama, write in Science today.

"Such comparisons become even more lopsided if the full environmental benefits of tropical forests - for example, for biodiversity conservation, hydrological functioning, and soil protection - are included."

Efforts to work out which crops are most environmentally friendly have, until now, focused only on the amount of greenhouse gases a fuel emits when it is burned. Scharlemann and Laurance highlighted a more comprehensive method, developed by Rainer Zah of the Empa Research Institute in Switzerland that can take total environmental impacts - such as loss of forests and farmland and effects on biodiversity - into account.

In a study of 26 biofuels the Swiss method showed that 21 fuels reduced greenhouse-gas emissions by more than 30% compared with gasoline when burned. But almost half of the biofuels, a total of 12, had greater total environmental impacts than fossil fuels. These included economically-significant fuels such as US corn ethanol, Brazilian sugar cane ethanol and soy diesel, and Malaysian palm-oil diesel. Biofuels that fared best were those produced from waste products such as recycled cooking oil, as well as ethanol from grass or wood.

Scharlemann and Laurance also pointed to "perverse" government initiatives that had resulted in unintended environmental impacts. In the US, for example, farmers have been offered incentives to shift from growing soy to growing corn for biofuels. "This is helping to drive up global soy prices, which in turn amplifies economic incentives to destroy Amazonian forests and Brazilian tropical savannas for soy production."

They added: "The findings highlight the enormous differences in costs and benefits among different biofuels. There is a clear need to consider more than just energy and greenhouse gas emissions when evaluating different biofuels and to pursue new biofuel crops and technologies."

Andy Tait, campaign manager at Greenpeace, said: "We're already bought into mandatory targets for the use of biofuels with very little thought of what the environmental impacts will be. This study further confirms that there are serious risks associated with first generation biofuels, particularly from corn, soya and palm oil."

He said that the biofuel technology had been oversold by industry and politicians. "It's clear that what government and industry are trying to do is find a neat, drop-in solution that allows people to continue business as usual.

"If you're looking at the emissions from the transport sector, the first thing you need to look at is fuel efficiency and massively increasing it. That needs to come before you even get to the point of discussing which biofuels might be good or bad." http://www.guardian.co.uk/science/2008/jan/04/sciencenews.biofuels

Recycling carbon dioxide into petrol

3 January 2008
A new reactor could make chemically recycling carbon dioxide back into petrol a worthwhile endeavour, US scientists say. Researchers at Sandia National Laboratories, New Mexico, are to test a prototype device this spring, which will use concentrated solar energy to drive chemical reactions that split carbon dioxide molecules to get carbon monoxide. The same system was originally designed to split water to form hydrogen; and these two products can then be combined to synthesise liquid hydrocarbon fuels - such as methanol or petrol.

Splitting the stable carbon dioxide molecule is so tough that many researchers think the most economic course of action is simply to bury the greenhouse gas underground. And solar plants usually generate electricity, rather than split CO_2.

But the Sandia team led by Jim Miller, Nathan Siegel and Richard Diver, who work on the 'Sunshine to Petrol' (S2P) project, think their device's chemical reactions are efficient enough to make it a worthwhile way of producing liquid fuels from CO_2 . Ellen Stechel, manager of Sandia's fuel and energy transitions department, explained to *Chemistry World* that the ultimate aim is to have a series of solar-powered reactors, each collecting around 22kg of carbon dioxide and 18kg of water daily, and churning out some 2.5 gallons of petrol, based on target conversion efficiencies. 'Liquid fuels can be stored in trucks or piped using existing infrastructure,' Stechel pointed out.

A complete demonstration system is three to five years away, said Stechel, and to prove its commercial value will take much longer. But one key sticking point - CO_2 splitting - is what the S2P researchers hope to crack.

The Sandia reactor consists of rotating rings, made of a cobalt-doped ferrite (Fe_3O_4) ceramic. Concentrated sunlight is directed onto a ring, heating it up to around 1500°C and driving off oxygen gas. The reduced material (FeO) rotates into a second chamber containing carbon dioxide, from which it takes back oxygen at a lower temperature, leaving carbon monoxide behind. It then cycles back into the sunlight again, so that the CO_2 splitting should be a continuous process.

This simple chemical cycle also splits water into hydrogen and oxygen. But it is only plausible on a larger scale because of an engineering trick which conserves the heat entering the system. The reactor holds a series of stacked rings rotating in opposite directions; so that a heated ring moving out of the sun will heat up

cooler rings about to face the sun. This arrangement limits the total energy input required.

So far, Stechel said, the researchers have shown this works for a batch process, but need to speed up their reactions to allow the more efficient series of continuous cycles. The final system, christened the Counter Rotating Ring Receiver Reactor Recuperator (CR5), should be about four times larger than the beer-keg sized prototype.

The Sandia team reckon their system is one of the most promising approaches to splitting CO_2 for fuel. They have a few competitors, such as the company Los Alamos Renewable Energy (LARE), who claim to use solar power to directly split CO_2 at very high temperatures; chemists who are taking catalytic approaches to split CO_2 with hydrogen; or the alternative of electrolytic splitting. But if splitting CO_2 is worthwhile at all, 'it's hard to imagine anything that will show better thermodynamics or kinetics,' said Stechel. Richard Van Noorden, http://www.rsc.org/chemistryworld/News/2008/January/03010801.asp

Promising new material for capturing carbon dioxide from smokestacks

4 March 2008
Researchers have developed a new, low-cost material for capturing carbon dioxide (CO_2) from the smokestacks of coal-fired power plants and other generators of the greenhouse gas. Produced by a simple one-step chemical process, the new material has a high capacity for absorbing carbon dioxide – and can be reused many times.

Combined with improved heat management techniques, the new material could provide a cost-effective way to capture large quantities of carbon dioxide from coal-burning facilities. Existing CO_2 capture techniques involve the use of solid materials that lack sufficient stability for repeated use – or liquid adsorbents that are expensive and require significant amounts of energy.

"This is something that you could imagine scaling up for commercial use," said Christopher Jones, a professor in the School of Chemical and Biomolecular Engineering at the Georgia Institute of Technology. "Our material has the combination of high capacity, easy synthesis, low cost and a robust ability to be recycled – all the key criteria for an adsorbent that would be used on an industrial scale."

Details of the new material, known as hyperbranched aluminosilica (HAS), are scheduled to appear in the March 19th issue of the Journal of the American Chemical Society. The research was supported by the U.S. Department of Energy's National Energy Technology Laboratory.

Growing concern over increased levels of atmospheric carbon dioxide has prompted new interest in techniques for removing the gas from the smokestacks of such large-scale sources as coal-fired electric power plants. But to minimize their economic impact, the cost of adding such controls must be minimized so they don't raise the price of electricity significantly.

Once removed from the stack gases, the CO_2 might be sequestered in the deep ocean, in mined-out coal seams or in depleted petroleum reservoirs. If the CO_2 capture and sequestration process can be made practical, America's large resources of coal could be used with less impact on global climate change.

Working with Department of Energy scientists Daniel Fauth and McMahan Gray, Jones and graduate students Jason Hicks and Jeffrey Drese developed a way to add CO_2-adsorbing amine polymer groups to a solid silica substrate using covalent bonding. The strong chemical bonds make the material robust enough to be reused many times.

"Given the volumes involved, you must be able to recycle the adsorbent material for the process to be cost-effective," said Jones. "Otherwise, you would be creating large and expensive waste streams of adsorbent."

Production of the HAS material is relatively simple, and requires only the mixing of the silica substrate with a precursor of the amine polymer in solution. The amine polymer is initiated on the silica surface, producing a solid material that can be filtered out and dried.

To test the effectiveness of their new material, the Georgia Tech researchers passed simulated flue gases through tubes containing a mixture of sand and HAS. The CO_2 was adsorbed at temperatures ranging from 50 to 75 degrees Celsius. Then the HAS was heated to between 100 and 120 degrees Celsius to drive off the gas so the adsorbent could be used again.

The researchers tested the material across 12 cycles of adsorption and desorption, and did not measure a significant loss of capacity. The HAS material can adsorb up to 5 times as much carbon dioxide as some of the best existing reusable materials.

The HAS material works in the presence of moisture, an unavoidable by-product of the combustion process.

Adsorption of the CO_2 generates considerable amounts of heat, which must be managed and thermally recycled. Removal of the carbon dioxide requires heating the adsorbent.

"How to manage this heat is one of the most critical issues controlling the economics of a potential large scale process," Jones added. "You must control the production of heat by the adsorption step, and you don't want to put any more energy into the desorption process than necessary."

Because of their chemical structure, the amine groups provide three different classes of binding sites for carbon dioxide, each with a different binding energy. Optimizing the production of binding sites is a goal for future research, Jones said.

Beyond the material, other components of the separation and sequestration process must also be improved and optimized before it can become a practical technique for removing CO_2 from flue gases. The best way to expose the flue gases to the adsorbent material is also key issue.

"There are many pieces that must fit together to make the overall economics of carbon dioxide capture and sequestration work," Jones added. "The biggest challenge for this whole field of research right now is to do this as inexpensively as possible. We think that our class of materials – a hyperbranched amine polymer bound to a solid support – is potentially ideal because it is simple to make, reusable and has a high capacity."
http://www.sciencedaily.com/releases/2008/03/080303163804.htm

Impressive properties of carbon nanotube fabric

2 March 2008
Blowing smoke is considered bad in the business world; spinning it, however, might just work. "We also call it 'carbon candy,' " Peter Antoinette, founder of Nanocomp Technologies, joked as he watched a visitor goggle at chemical furnaces that create a wispy "smoke" of floating nanotubes that's pulled from the air and spun into thread stronger than steel. It does look like a tiny cotton candy machine; although one that uses black carbon instead of pink sugar. Not palatable, but maybe profitable.

That also goes for Nanocomp's newest product, the world's largest sheet of material made from nanotubes, those billionths-of-a-meter molecular structures that hold so much promise. "You can blend this into superstructures; it conducts (electricity), has the strength of steel and won't fatigue, is lighter than titanium . . . and integrates with carbon fiber – has the same coefficient of expansion. You tell that to engineers and they say, 'I could do a lot with that,' " said Antoinette, who has lived in Nashua since 1996.

He gestures at a 3-by-6-foot sheet of fabric so thin it ripples in the breeze, which he says could revolutionize satellite and military jet technology. "The plan is to make this comparable in cost to aviation (composite) fiber by 2011 or 2012," he said. The 20 employees working in Nancomp's 11,000-square-foot facility in Concord sure hope so.

Born with small infusions of military research and development funding, the 4-year-old company grew with $160,000 from winning a business-plan competition sponsored by the state (now cancelled, alas), and then drew more attention in 2006, when it won Product of the Year from the New Hampshire High Tech Council. It received some venture capital funding (from the late Mort Goulder, of Hollis, among others) and is going to the series B round of venture capital funds – $6 million worth, they hope.

But Nanocomp knows it's facing the dreaded "valley of death," the term for companies beyond the grants-for-research phase but not yet into the cash-flow-from-production phase. That's where the sheet of material made from nanotubes comes in.

The idea that launched Nanocomp is a proprietary method of creating long carbon nanotubes, as long as a millimeter (which is a lot in nano land). They pump secret "fuel" into a chemical vapour deposition furnace that creates a floating organometallic catalyst, which collects carbon molecules that, in the proper temperature gradient, creates the tubes, so tiny that even in the millions, they look like smoke.

This is chemistry at its most applied, resulting in smoke made of structures that are perhaps five or 10 atoms wide. They won the High Tech Council prize for weaving that smoke into "nanoyarn," a fabric made of nanotubes that's incredibly strong, flexible and (perhaps best of all) conducts electricity. Their newest machine is a $150,000 furnace and roller, half of whose cost comes from computerized controls, which collects the nanotubes and turns them not into thread, but into sheets of fabric. "Like laying down filo dough," Antoinette said. "We were an 1830s textile mill; now we're a 1920s paper plant."

Because the basic nanotubes are long (by nanotube standards, anyway), the sheet is remarkably strong. "The length is key. Chipboard isn't as strong as oak

because oak has long fibers – it's the same here," said Antoinette, drawing on a lumber metaphor.

With their conductivity, the sheets could be cut up and used for such things as preventing signal "bleed-through" in cell phones or replacing heavy metal wiring in high-cost devices.

"There are 4,000 pounds of cable in a 737," Antoinette said. "In the average satellite, one-third of the weight is copper." This is why tiny Nanocomp worked so hard to become a certified vendor for defense contractors Lockheed-Martin and Northrop Grumman, companies that might find it worthwhile to buy expensive ways to conduct electricity. It's expanding to fill its entire rented space and doing some serious customer hunting.

With any luck, producing kilometers of thread and hectares of fabric is in Nanocomp's near future. Such production would require moving to a much larger facility, closer to the Massachusetts line to snag employees. But Antoinette's vision is a company with lots of manufacturing workers, not a "Ph.D. ghetto." "First, you convince people you're not a science fair – then convince them you can deliver," he said. "We can do that."
http://www.nashuatelegraph.com/apps/pbcs.dll/article?AID=/20080302/BUSINESS/824337446

Carbon nanotubes may need health warning study shows

22 March 2008
A major study published in Nature Nanotechnology suggests some forms of carbon nanotubes -- a poster child for the "nanotechnology revolution" -- could be as harmful as asbestos if inhaled in sufficient quantities.

The study used established methods to see if specific types of nanotubes have the potential to cause mesothelioma -- a cancer of the lung lining that can take 30-40 years to appear following exposure. The results show that long, thin multi-walled carbon nanotubes that look like asbestos fibers, behave like asbestos fibers.

Discovered nearly 20 years ago, carbon nanotubes have been described as the wonder material of the 21st Century. Light as plastic and stronger that steel, they are being developed for use in new drugs, energy-efficient batteries and futuristic electronics. But since their discovery, questions have been raised about whether some of these nanoscale materials may cause harm and undermine a nascent market for all types of carbon nanotubes, including multi- and single-walled carbon nanotubes. Leading forecasting firms say sales of all nanotubes could reach $2 billion annually within the next four to seven years, according to an article in the U.S. publication Chemical & Engineering News.

"This study is exactly the kind of strategic, highly focused research needed to ensure the safe and responsible development of nanotechnology," says Andrew Maynard, Chief Science Advisor to the Project on Emerging Nanotechnologies and a co-author on the paper. "It looks at a specific nanoscale material expected to have widespread commercial applications and asks specific questions about a specific health hazard. Even though scientists have been raising concerns about the safety of long, thin carbon nanotubes for over a decade, none of the research needs in the current U.S. federal nanotechnology environment, health and safety risk research strategy address this question."

Widespread exposure to asbestos has been described as the worst occupational health disaster in U.S. history and the cost of asbestos-related disease is expected to exceed $200 billion, according to major U.S. think tank RAND Corporation.

Anthony Seaton, MD, a co-author on the paper and a professor emeritus at the University of Aberdeen in the United Kingdom, says, "The toll of asbestos-related cancer, first noticed in the 1950s and 1960s, is likely to continue for several more decades even though usage reduced rapidly some 25 years ago. While there are reasons to suppose that nanotubes can be used safely, this will depend on appropriate steps being taken to prevent them from being inhaled in the places they are manufactured, used and ultimately disposed of. Such steps should be based on research into exposure and risk prevention, leading to regulation of their use. Following this study, the results of which were foreseen by the Royal Society in the U.K. in 2004, we can no longer delay investing in such research."

Researchers, led by Professor Kenneth Donaldson at the University of Edinburgh in the United Kingdom, examined the potential for long and short carbon nanotubes, long and short asbestos fibers, and carbon black to cause pathological responses known to be precursors of mesothelioma. Material was injected into the abdominal cavity of mice -- a sensitive predictor of long fiber response in the lung lining. "The results were clear," says Donaldson. "Long, thin carbon nanotubes showed the same effects as long, thin asbestos fibers."

Asbestos fibers are harmful because they are thin enough to penetrate deep into the lungs, but sufficiently long to confound the lungs' built-in clearance mechanisms for getting rid of particles.

Donaldson stresses there are still pieces of the puzzle to fill in. "We still don't know whether carbon nanotubes will become airborne and be inhaled, or whether, if they do reach the lungs, they can work their way to the sensitive outer lining. But if they do get there in sufficient quantity, there is a chance that some people will develop cancer--perhaps decades after breathing the stuff," states Donaldson.

There is a silver lining to this research. According to Donaldson, "Short or curly carbon nanotubes did not behave like asbestos, and by knowing the possible dangers of long, thin carbon nanotubes, we can work to control them. It's a good news story, not a bad one. It shows that carbon nanotubes and their products could be made to be safe."

But Donaldson added that the present study only tested for fiber-like behavior and did not exonerate carbon nanotubes from damaging the lungs in other ways. "More research is still needed if we are to understand how to use these materials as safely as possible," he notes.

Carbon nanotubes are atom-thick sheets of graphite formed into cylinders. They may be formed from a single layer of graphite or they may consist of multiple concentric layers of graphite, resulting in multi-walled carbon nanotubes. While the diameter of a nanotube can vary from a few nanometers up to tens of nanometers, they can be hundreds or even thousands of nanometers long. Carbon nanotubes come in many forms, with different shapes, different atomic arrangements, and varying amounts and types of added chemicals--all of which affect their properties and might influence their impact on human health and the environment.

"This is a wakeup call for nanotechnology in general and carbon nanotubes in particular," says Maynard. "As a society, we cannot afford not to exploit this incredible material, but neither can we afford to get it wrong--as we did with asbestos." http://www.sciencedaily.com/releases/2008/05/080520144004.htm

Could buckyballs hold the key to hydrogen storage?

March 24, 2008

Hydrogen could be a clean, abundant energy source, but it's difficult to store in bulk. In new research, materials scientists at Rice University have made the surprising discovery that tiny carbon capsules called buckyballs are so strong they can hold volumes of hydrogen nearly as dense as those at the centre of Jupiter.

"Based on our calculations, it appears that some buckyballs are capable of holding volumes of hydrogen so dense as to be almost metallic," said lead researcher Boris Yakobson, professor of mechanical engineering and materials science at Rice. "It appears they can hold about 8% of their weight in hydrogen at room temperature, which is considerably better than the federal target of 6%."

The US Department of Energy has devoted more than $1 billion to developing technologies for hydrogen-powered automobiles, including technologies to cost-effectively store hydrogen for use in cars. Hydrogen is the lightest element in the universe, and it is very difficult to store in bulk. For hydrogen cars to be competitive with gasoline-powered cars, they need a comparable range and a reasonably compact fuel system. It's estimated that a hydrogen-powered car with a suitable range will require a storage system with densities greater than those found in pure, liquid hydrogen.

Yakobson said scientists have long argued the merits of storing hydrogen in tiny, molecular containers like buckyballs, and experiments have shown that it's possible to store small volumes of hydrogen inside buckyballs. The new research by Yakobson and former postdoctoral researchers Olga Pupysheva and Amir Farajian offers the first method of precisely calculating how much hydrogen a buckyball can hold before breaking.

Buckyballs, which were discovered at Rice more than 20 years ago, are part of a family of carbon molecules called fullerenes. The family includes carbon nanotubes, the typical 60-atom buckyball and larger buckyballs composed of 2,000 or more atoms.

"Bonds between carbon atoms are among the strongest chemical bonds in nature," Yakobson said. "These bonds are what make diamond the hardest known substance, and our research showed that it takes an enormous amount of internal pressure to deform and break the carbon-carbon bonds in a fullerene."

Using a computer model, Yakobson's research team has tracked the strength of each atomic bond in a buckyball and simulated what happened to the bonds as more hydrogen atoms were packed inside. Yakobson said the model promises to be particularly useful because it is scalable, that is it can calculate exactly how much hydrogen a buckyball of any given size can hold, and it can also tell scientists how overstuffed buckyballs burst open and release their cargo.

If a feasible way to produce hydrogen-filled buckyballs is developed, Yakobson said, it might be possible to store them as a powder.

"They will likely assemble into weak molecular crystals or form a thin powder," he said. "They might find use in their whole form or be punctured under certain conditions to release pure hydrogen for fuel cells or other types of engines."
http://www.sciencedaily.com/releases/2008/03/080320095005.htm

Carbon-based molecules found to conduct electricity

17 April 2008
University of Pittsburgh researchers have discovered that certain organic—or carbon-based—molecules exhibit the properties of atoms under certain circumstances and, in turn, conduct electricity as well as metal. Detailed in the April 18 edition of *Science*, the finding is a breakthrough in developing nanotechnology that provides a new strategy for designing electronic materials, including inexpensive and multifunctional organic conductors that have long been considered the key to smaller, cheaper, and faster technologies.

The Pitt team found that the hollow, soccer-ball-shaped carbon molecules known as fullerenes can hold and transfer an electrical charge much like the most highly conductive atoms, explained project head Hrvoje Petek, a professor of physics and chemistry in Pitt's School of Arts and Sciences and co director of Pitt's Petersen Institute for NanoScience and Engineering. The research was performed by Pitt post-doctoral associates Min Feng and Jin Zhao.

When an electron was introduced into a fullerene molecule, the shape of the electron distribution mimicked that of a hydrogen atom or an atom from the alkali metal group, which includes lithium, sodium, and potassium. Moreover, when two fullerenes were placed next to each other on a copper surface, they showed the electron distribution of their chemical bond and appeared as H_2, a hydrogen molecule. The assembly exhibited metal-like conductivity when the team extended it to a wire 1-molecule-wide.

"Our work provides a new perspective on what determines the electronic properties of materials," Petek said. "The realization that hollow molecules can have metal-like conductivity opens the way to develop novel materials with electronic and chemical properties that can be tailored by shape and size."

Although the team worked with fullerenes, the team's results apply to all hollow molecules, Petek added, including carbon nanotubes—rolled, 1-atom-thick sheets of graphite 100,000 times smaller than a human hair.

The team's research shows promise for the future of electronics based on molecular conductors. These molecule-based devices surpass the semiconductor and metal conductors of today in terms of lower cost, flexibility, and the ability to meld the speed and power of optics and electronics. Plus, unlike such inorganic conductors as silicon, molecule-based electronics can be miniaturized to a 1-dimensional scale (1-molecule-wide), which may enable them to conduct electricity with minimal loss and thus improve the performance of an electronic device.

Traditionally, the problem has been that organic conductors have not conducted electrical current very well, Petek said. The Pitt team's discovery could enable scientists to finally overcome that problem, he added. "Metal-like behaviour in a molecular material—as we have found—is highly surprising and desirable in the emerging field of molecular electronics," he said. "Our work is a unique example of how nanoscale materials can be used as atom-sized building blocks for

molecular materials that could replace silicon and copper in electronic devices, luminescent displays, photovoltaic cells, and other technologies." http://www.zpenergy.com/modules.php?name=News&file=article&sid=2861

South Africa may limit coal exports to ease crisis

19 May 2008
South Africa, the biggest supplier of coal to European electricity companies, may limit exports of the fuel to ease a domestic power crisis under a plan ordered drawn up by Energy Minister Buyelwa Sonjica.

"The minister and director-general met today and instructed Nhlanhla Gumede, chief of hydrocarbons, to begin developing exactly that kind of strategy,'' Bheki Khumalo, a spokesman for the Department of Minerals and Energy, said in an interview today.

Sonjica issued the order after South Africa's energy regulator today said the government should investigate why state-run Eskom Holdings Ltd. exported double the power it needed to during a local electricity shortage that cost the economy about 50 billion rand ($6.7 billion).

"South Africa is struggling with their own supply and they want to supply Eskom first,'' Emmanual Fages, a Paris-based analyst at Societe Generale SA, said by phone today. ``It will restrict supply and exports from a major producer.''

Eskom declared force majeure on 24th January, saying it couldn't guarantee supply and halting production of gold and platinum for about five days at most mines in South Africa, the world's biggest precious-metals producer.

The utility exported 1,319 megawatts that day, compared with a contractual commitment of 554 megawatts, the National Energy Regulator said in an enquiry into the power crisis in Africa's biggest economy. Facility breakdowns, low coal stockpiles and the slow return to service of mothballed plants led to the crisis, it said.

"The decision to export power to neighboring countries above the firm contractual levels during power-system emergencies needs to be explained,'' said the Pretoria-based regulator in a report published on its Web site today. Most export commitments ``are not firm contracts,'' Johannesburg-based Eskom said in its response to the findings, annexed to the regulator's report. Fani Zulu, a spokesman for the utility, wasn't immediately available to comment when Bloomberg News called his Johannesburg office. "There's a general mis-planning, a shortsightedness, at Eskom,'' Fanie Joubert, economist at Efficient Research, a Pretoria-based research group, said by phone today.

Eskom, which blames the power crisis partly on a four-year delay in getting government approval for planned expansion, has said it will need to curb supply until at least 2012. Today's report comes three weeks before the regulator unveils a decision June 6 on whether to approve a 61 percent increase in Eskom's tariffs this year and 43% in 2009 to fund new capacity.

While the company anticipated increasing demand for power in South Africa, the actions it took to boost supply have been ``inadequate and slow,'' according to the report.

South Africa should also investigate ``complacency'' and ``poor'' management in Eskom's coal purchases and draw up a national plan for acquisition and management of the fuel to ensure security of supply, the regulator added. Eskom missed its own target for increasing coal stocks to a minimum of 20 days of use by April 30, raising the risk of power cuts with the onset of winter in the southern hemisphere. Stocks were at 16.2 days on May 14 after dropping below 10 days in January, when heavy rain further depleted stocks. The regulator recommended the government set up a unit independent of Eskom to buy power generated by industrial companies and other producers. South Africa may have to change rules forcing companies to sell electricity to Eskom, it said.
http://www.bloomberg.com/apps/news?pid=20601116&sid=agdz8v_ht4Fo&refer=africa

China-UK Summer School on Efficient and Environmentally Friendly Energy Generation from Biomass

7th - 19th September 2008, Hangzhou, China

Zhejiang University and the University of Kent are organising a China-UK Summer School on efficient and environmentally friendly energy generation from biomass in Hangzhou, China. The Summer School is financially supported by the Research Councils UK. It will run over a period of two weeks from the 7th to 19th September 2008. The objectives of the Summer School are:

• to provide a forum for younger researchers and engineers from both countries to benefit from face-to-face interactions with leading experts and scholars in the field;
• to establish stronger China-UK research capacity in the use of biomass for efficient and environmentally friendly energy generation;
• to improve the access to the best of available expertise and facilities for biomass combustion research in the UK and China with a long term sustainability.

The Summer School also bridges the gap between renewable energy research and fundamental combustion science and engineering concerning particle dynamics, multiphase flow, process instrumentation and computational modelling.

Activities of the Summer School

The Summer School comprises a series of technical presentations to be given by leading experts in the field from both countries, tours of research facilities and biomass/coal co-firing power plants in China and informal technical discussions on focused topics. Younger researchers (postgraduate students, postdocs, newly appointed lecturers or engineers) will also be given opportunities to present their work.

Technical topics that will be covered in the Summer School:

• Biomass/Coal Co-Firing - Fundamental issues to be addressed include (a) characterisation of biomass and biomass/coal blends in terms of physical, chemical and combustion properties, (b) on-line measurement and modelling of biomass/coal/air three-phase flow, and (c) burner condition and flame stability monitoring.
• Combustion of Biomass in Circulating Fluidized Beds - Issues to be covered include (a) modelling and optimisation of biomass fuelled CFBs, (b) on-line

measurement of biomass particles in CFBs, and (c) on-line monitoring of the flame field in CFBs.
• Hydrogen Production from Biomass - Issues to be discussed include (a) Hydrogen production from biomass through gasification, and (b) Hydrogen production from biomass through catalytic pyrolysis.

In addition to the technical sessions a diverse range of social activities have been arranged to enhance informal interactions between the participants. The working language of the Summer School is English.

Full details of the Summer School programme will be publicised shortly.

Who should attend the Summer School?

Early career researchers or engineers from both China and the UK, including postgraduate research students, postdoctoral researchers, newly appointed lecturers, and associate professors, are encouraged to attend the Summer School. There will be no fees payable for the attendance at the Summer School. However, participants will be responsible for the costs of travel and accommodation.

Some Key Speakers at the Summer School Prof. KF Cen, Prof. H Zhou and Prof. ZY Luo Zhejiang University, China Prof. HL Hu and Prof. TM Xu Xi'an Jiaotong University, China Prof. M Pourkashanian and Dr. L Ma University of Leeds, UK
Mr. S Cornwell RWE npower, UK Dr. E Lester and Dr. T Wu University of Nottingham, UK Prof. Y Yan and Dr. G Lu University of Kent, UK

About Hangzhou Hangzhou is the capital of Zhejiang Province and the central city of the southern Yangtze River Delta, one of the six largest city circles in the world. Endowed with a unique environment by nature and cultural accumulation of thousands of years, Hangzhou has many scenic wonders in southeast China. As one of China's seven ancient capitals, Hangzhou is a renowned scenic and tourist city as well as a famous historic and cultural city. The charm of Hangzhou city is in its breath-taking natural scenery whilst its soul lies in the profound cultural sediment. Hangzhou is regarded as the 'Most splendid and luxurious city in the world' (Marco Polo)', 'Capital of Leisure in the East', 'Paradise on Earth', 'Home to Silk' and 'Home to Tea'.

About the Host Organisation

Zhejiang University is one of leading research universities in P. R. China. The National Key Lab of Clean Energy Utilization within the Institute of Thermal Power Engineering at Zhejiang is one of the most reputable organisations in combustion research in P. R. China. The Lab is led by Prof. Kefa Cen, an academician of Chinese Academy of Engineering, and has strong expertise and test facilities in the areas of biomass utilization, low NOx coal combustion, measurement and simulation of multiphase flow and CFBC technologies. The fuel rich/lean coal combustion technology developed by the Lab has been deployed on more than 100 utility boilers across China. In recognition of this achievement they were awarded the National Prize for the Advance in Science and Technology in 2004. Other leading researchers in the Lab include Prof. H Zhou and Dr. F Wang.

Student Bursaries for 2008

Up to 6 travel and subsistence bursaries for up to £300 are on offer to bona-fide full-time students wishing to attend appropriate National and International coal-related conferences, such as the "7th European Conference on Coal Research and

its Applications" to be held at Cardiff University in September 2008, (please see the Calendar of Coal Research Events for details of both this and other events at the end of this Newsletter). To apply, please send the abstract submitted to the conference with a brief supporting letter from your supervisor to:

Prof. J.W. Patrick
School of Chemical & Environmental Engineering
The University of Nottingham
University Park
Nottingham NG7 2RD

The bursaries come with no obligations to the recipient other than to supply a short essay about his or her impressions of the conference to the Newsletter for inclusion in the next edition.

Update on new Research Fund for Coal & Steel (RFCS) Projects

The annual feature on new RFCS projects continues to be absent from this newsletter as previous sources of information are no longer available to the editor. If any reader is able to provide a source of the information the newsletter editor would be pleased to hear of it.

CALENDAR OF COAL RESEARCH MEETINGS AND EVENTS

Date	Title	Location	Contact
Wednesday 4 June 2008	**BCURA/CRF Research Event**	**Imperial College London**	**Dr David McCaffrey E-mail: mail@coalresearchforum.org**
11 June 2008	Seminar on the future for coal: four ways to capture CO_2	London, UK	Technical Networks Department, IChemE, Davis Building, 165-189 Railway Terrace, Rugby, CV21 3HQ, UK. Tel: +44 1788 578 214; Fax: +44 1788 560833.
18 June 2008	British Flame's technical meeting on new and unusual power generation processes	Cardiff, UK	Jeff Rhine, British Flame Membership Officer, 58 Howard Road, Kings Heath, Birmingham B14 7PQ, UK. Tel: +44 121 441 3865; Fax: +44 121 441 3865; Email: jmrbf@aol.com; Internet:www.britishflame.org.uk
1-3 July 2008	Coal-Gen Europe 2008 conference	Warsaw, Poland	Gil Burton, COAL-GEN Europe, PennWell Corporation, PennWell Publishing (UK), Warlies Park House, Horseshoe Hill, Upshire, Essex, EN9 3SR, UK. Tel: +44 1992 656 617; Fax: +44 1992 656 700; Email: exhibitcge@pennwell.com

26-29 August 2008	7th European coal conference	Lviv, Ukraine	Dr. Andriy Poberezhskyy, Institute of Geology and Geochemistry of Combustible Minerals, 3a, Naukova St., Lviv, 79060, Ukraine. Tel: +7 322 635 047; Fax: +7 0322 632 209; Email: igggk@mail.lviv.ua Internet: www.iggcm.org.ua
Tuesday 2 September 2008	**IEA Coal Science Workshop on "Perspectives on Cofiring and Coprocessing"**	**University of Cardiff, Cardiff**	**Robert Davidson. IEA Clean Coal Centre Gemini House, 10-18, Putney Hill, London, SW15 6AA. Tel : 0208-7890-2111. robert@iea-coal.org.uk**
Wednesday 3-Friday 5 September 2008	**7th European Conference on Coal Research and its Applications**	**University of Cardiff, Cardiff**	**Dr A W Thompson Tel : 02476-192-569 or 01332 514768 e-mail : awt_crf@btinternet.com**
7th - 19th September 2008	China-UK Summer School on Efficient and Environmentally Friendly Energy Generation from Biomass	Zhejiang University, Hangzhou, China	Contact Details China: Professor H Zhou State Key Lab of Clean Energy Utilization, Zhejiang University Hang zhou, Zhejiang 310027 P R China Tel: +86 57187952598 Email: zhouhao@cmee.zju.edu.cn UK: Professor Y Yan and Dr. G Lu Department of Electronics University of Kent Canterbury, Kent CT2 7NT, UK Tel: +44 1227 823015/823706 Email: y.yan@kent.ac.uk; g.lu@kent.ac.uk
Thursday 23 October 2008	**The Environmental Impact of CO_2 Storage (CRF, RSC (ES), Geological Society and IChemE)**	**The Geological Society, Burlington House**	**Dr Michael Whitehouse E-mail: michael.whitehouse@rwenpower.com Tel: 01793 894 118**