energy world

JULY/AUGUST 2005

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Why UK energy costs are rising

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17 October 2005
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EI Breakfast Briefing 2005

'Eradicating Fuel Poverty – real progress or a mathematical conjuring trick?' – 6 July 2005

Jacky Pett, Head of Research at the Association of the Conservation of Energy and a Member of the Energy Efficiency Partnership for Homes Fuel Poverty Group

The UK Government's Fuel Poverty Strategy sets out the statutory target: to eradicate fuel poverty amongst vulnerable people by 2010 and amongst all sectors by 2016, so far as possible. The review last year showed a considerable fall in the numbers of people in fuel poverty.

- What were the main reasons for this reduction?
- How does the calculation methodology affect the numbers reported?
- How many people 'dip in and out' depending solely on fuel prices?
- Could fuel poverty simply be defined out of existence?

Venue:	Energy Institute, 61 New Cavendish Street, London WIG 7AR
Time:	07.30: Registration and breakfast 08.00: Speech
Price:	Members: £15.00 (£17.63 inc VAT) Non-members £20.00 (£23.50 inc VAT)

To book your place please send your remittance to Arabella Dick, Energy Institute, 61 New Cavendish Street, London W1G 7AR. Please note that no invoices will be issued.

For more information on these forthcoming Business Breakfast Briefings, please contact Arabella Dick on t: +44 (0)20 7467 7106 f: +44 (0)20 7580 2230 e: arabella@energyinst.org.uk

www.energyinst.org.uk/businessbreakfast

EI Evening Lecture 2005

Oil Prices

Wednesday 7 September 2005, Energy Institute 61 New Cavendish Street, London, W1G 7AR

Representative from Argus Media

These days oil prices are forever in the news. In this talk, specialist energy publisher Argus examines the factors behind the determination of the oil price and reviews the outlook for the future.

- What is the price of oil?
- How is it discovered?
- Fundamentals behind oil prices – the role of supply and demand
- Long term v short term drivers
- How do analysts predict the price of oil?

Russian oil – price discovery in the internal and international markets

Monday 10 October 2005, Energy Institute 61 New Cavendish Street, London, W1G 7AR

***Peter Stewart*, European Oil Director, Platts**

These events are free, but you must pre-register to guarantee your place.

For more information and booking details, please contact Jacqueline Warner on t: +44 (0)20 7467 7116 f: +44 (0)20 7580 2230 e: jwarner@energyinst.org.uk

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The Changshu power plant in China, where Mitsui Babcock has designed the first in the new generation of supercritical power plant boilers. Supercritical technology can add 20% to the efficiency of the plant – see page 10.

This issue of Energy World majors on fossil fuels – looking at cleaner coal technology for the UK, China and Australia, and examining the global oil supply/demand balance in the face of recent demand increases, starting on page 16.

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A return to rationing to meet the UK's Kyoto obligations?

The UK is not making the progress it should towards reducing carbon dioxide emissions. Could rationing be the answer?

For those who consider this a somewhat extreme proposal, I should start by pointing out that rationing is already in force in certain sectors of the economy. To some extent companies operating under Climate Change Agreements (CCA), and to an even greater extent those users engaged in carbon trading, have accepted caps on the amount of carbon dioxide their operations can emit and hence (by implication) the amount of carbon they purchase as fuel. True, the effect of carbon rationing is softened for them by having the ability to trade surplus allocations, but trading is a feature we can retain.

The weakness of the present regime is the exceptions. Energy suppliers, and especially oil suppliers, are assured the growing markets they crave because there is unregulated demand not just in businesses outside the CCA and carbon-trading schemes but in the domestic sector and transport (especially aviation, where energy use is encouraged by favourable taxation).

My suggestion would extend the cap on carbon emissions to all UK users, by capping the quantity of mineral carbon entering our economy in fuel (ie, domestic production, plus net imports, less fuels used as chemical feedstock). Importantly, though, the cap would be applied as a national limit, and individual users would be free to buy as much as they wish within the gradually-diminishing national supply. This merely turns the government's aspirational target into a self-fulfilling one, and is therefore no more painful than the present climate change programme would have been were it being successful.

A national carbon supply allocation, as well as being effective, would be a great deal easier to administer, since it only requires aggregate production, imports, and exports of mineral-carbon-based fuels to be controlled (there are minor complications like fuel for feedstock but these are as nothing compared to the Byzantine bureaucracy needed under the present regime). The controlled business is concentrated in a small number of enterprises whose activities the government already licenses or taxes, so it has the necessary mechanisms in place to set tapering allocations for producers and importers. How the government would distribute these quotas will be a thorny issue, but they have done it for fish (where other countries were involved) and for third generation mobile phone licences, so this should be a doddle by comparison. Indeed if they go for an auction they might even have a small windfall on their hands; and ultimately they can take comfort from the fact that any adverse decisions would affect companies, not voters.

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Photo: Chris Morris

Once the supply quotas are set, various subtle benefits could follow. Firstly the major players – keen, presumably, to ensure growth within a constrained market – may get into alternative and renewable energy supply in a serious way. And who would be better placed than they, to do the research and make the necessary investment, not just in supply but in infrastructure? At present, nobody with any clout or resources has much of an incentive.

Secondly, pricing regimes could well change, and will have to do so. This is because we cannot return to the post-war rationing era, when a works engineer could look out of his window at a pile of coal in the factory yard, and reflect that if he did not make it last, production would be halted. Nobody's gas is going to be turned off, and we need not return to the rota power cuts of the 1970s. Price mechanisms would be used instead to create a 'soft' limit. For example, although there might be a definite moving annual total supply cap associated with each producer licence, the government could introduce a per unit levy on supply in excess of (say) 90% of the licensed limit. The market would then move away from volume discounts for energy purchases and move towards 'rising block' tariffs where customers pay higher prices (perhaps much higher) for additional fuel used at the margin. This resembles the way that the half-hourly electricity market has operated for decades (even under nationalisation), reflecting the fact that the marginal cost of supply increases with demand. Wholesale suppliers of all fuels would reflect the risk of going into the penalty band by using retail price signals, and this is how end-user demand would be braked.

Rising-block tariffs encourage users to save energy because they increase the marginal price relative to average price, making energy efficiency investment more economical.

What of the effect on voters? Would households find themselves paying significantly higher prices, or unable to secure supplies at all? On the latter fear we can be reassured by the statutory duty already in place on the gas and electricity infrastructure companies to ensure continuity of supply and to act as suppliers of last resort. It will be their duty to secure wholesale supplies sufficient to prevent interruptions. The price issue is harder to call; I cannot say what is likely to happen. The optimistic view is that supply companies will continue to see the domestic market as a 'cash cow' and will continue to compete for custom (largely, as at present, on price). The advent of rising block tariffs would be beneficial, not just by creating a market in which the smaller user pays lower average prices, but through the increased energy saving efforts by major users already alluded to: what they save becomes available for smaller users.

How might a national carbon supply allocation interact with UK carbon trading, CCAs, and the EU Emissions Trading Scheme? I believe it would be completely compatible. Players could still trade carbon credits, and although the price might be depressed by increased availability, remember that the same should have happened anyway if our climate change programme were it being successful. In relation to international trading, the scheme would be good for the UK as it would tend to increase the supply of carbon credits for export. The compatibility of my proposed national supply constraint with existing schemes means that it could be introduced as soon as the political will is there to put it into effect.

Presently, the success of UK efforts to meet Kyoto obligations is in doubt; under my proposal it would be assured by definition. ●

GE imagines a cleaner energy future and expands its wind business

The US-based general Electric Company (GE) has committed itself to expanding its work in clean energy development, and is expanding its wind energy business as part of the move.

A relative newcomer to the wind industry, GE Energy says it has received orders and commitments for 2005 that total 2,400 MW of new wind power capacity worldwide. From $500 million in revenue in 2002, the company expects its wind energy revenue to grow to more than $2 billion this year. Supply orders calling for 1,600 wind turbines to be installed worldwide include 1,100 wind turbines, or a total of 1,650 MW, for the US – two-thirds of the maximum 2,500 MW of new capacity that the American Wind Energy Association has forecast for the US this year.

"Wind power continues to be the fastest growing segment of the global energy industry," said Mark Little, Vice President for Power Generation of GE Energy at the All Energy Opportunities conference in Aberdeen in May. "As evidenced by GE's recent 'ecomagination' launch, our commitment to cleaner energy solutions, including wind power, is at the forefront of our company's business initiatives."

General Electric CEO Jeff Immelt had previously announced ecomagination, a new initiative to aggressively bring to market new technologies that will help customers meet pressing environmental challenges. "Ecomagination is GE's commitment to address challenges such as the need for cleaner, more efficient sources of energy, reduced emissions and abundant sources of clean water," Immelt said. "And we plan to make money doing it."

Under ecomagination, the company says it will:

- double investment in R&D: GE will invest $1.5 billion annually in research in cleaner technologies by 2010, up from $700 million in 2004;
- introduce more ecomagination products each year; and
- reduce its greenhouse gas emissions by 1% by 2012 and improve its energy efficiency by 30% by 2008, both compared to 2004.

The company says it also continues to expand its engineering staff and R&D capabilities dedicated to wind-related technology development. Recent milestones include enhancements to one of the most widely sold megawatt class machines in the global wind industry, GE's 1.5MW turbine, which recently surpassed 3,000 installations worldwide. The company has also opened two customer support and training centres, located in Salzbergen, Germany and Tehachapi, California and a global research centre in Munich.

World's first CDM wind farm to be in China

A wind farm in China is expected to become the first in the world to be registered as a Clean Development Mechanism (CDM) project this summer. The 26 MW Huitengxile wind farm in Inner Mongolia will also be the first CDM project to be registered in China.

The CDM enables industrialised countries to meet their greenhouse gas emission targets agreed under the Kyoto Protocol by purchasing certified emission reductions from developing countries. Since the Protocol came into force in February emission reductions have become an increasingly valuable commodity in world markets.

The owners of the Huitengxile wind farm, the Inner Mongolia Long Yuan Wind Power Development Company, will receive over €2.5 million over the next 10 years from SenterNovem, which is buying the certified emission reductions on behalf of the Dutch Government. The CDM revenue will cover approximately 8% of the project development costs.

The Huitengxile wind farm consists of 22 wind turbines, 12 of which have a capacity of 900 kW, and 10 have a capacity of 1500 kW. Despite good wind resources in Inner Mongolia, wind farm projects can only compete with cheap large-scale coal-fired power stations, typically used in Northern China, by obtaining additional income via the CDM.

The UK-based renewable energy consultancy IT Power assisted the owner of the wind farm to obtain CDM funding and prepare the documentation needed for the project to be registered. The project design document, baseline study and monitoring and verification protocol can now be used to support other wind farms in developing countries.

Wind farms in Inner Mongolia have to compete with cheap coal-fired power stations

Carbon dioxide reduction trading rose in 2004

Traded volumes of carbon dioxide equivalent (CO_2e) emissions reductions created by projects around the world increased from approximately 78 million tonnes (Mt) in 2003 to 107 Mt in 2004 – a 38% increase, according to the US-based Natsource LLC in a piece of research commissioned by the World Bank.

This follows a doubling of traded reductions from 2002 to 2003. Trade in emissions *allowances* also increased dramatically, from approximately 2.6 Mt in 2003 to over 16 Mt in 2004, primarily in anticipation of the start of the European Union Emissions Trading Scheme (EU ETS) at the start of this year.

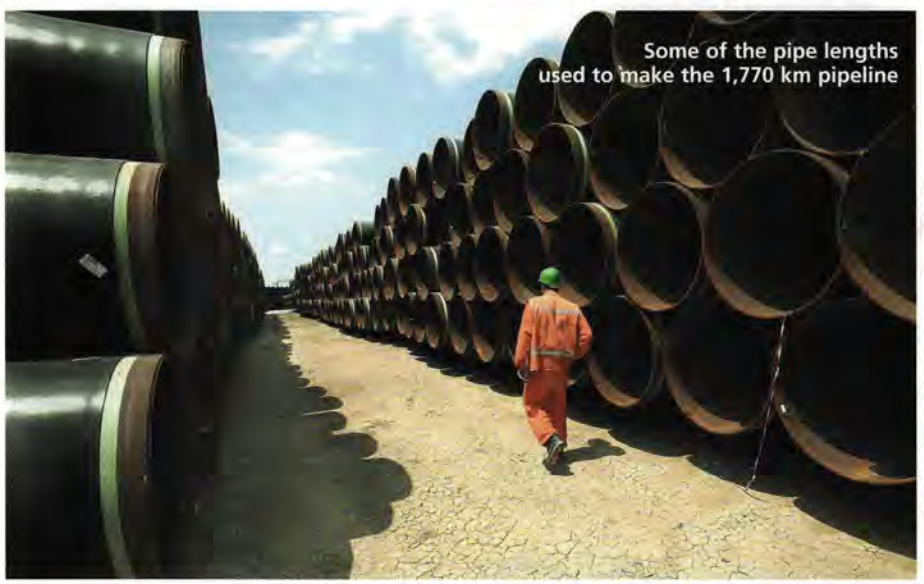
"Entry into force of the Kyoto Protocol and the beginning of the EU ETS increased firms' and governments' market demand for GHG reductions," said Jack Cogen, President of Natsource. "This increase in demand – combined with the Clean Development Mechanism Executive Board's actions to approve 24 project methodologies – has led to growth in trade. The increase in demand will continue. In order for the market to create the economic benefits that are possible for buyers and sellers, further progress must be made in developing the rules to create increased supply of project-based reductions."

Baku-Ceyhan pipeline brings Azeri oil towards Europe

BP has inaugurated the 1,770 km Baku-Tbilisi-Ceyhan (BTC) oil pipeline to carry one million barrels of oil a day from the BP-operated Azeri Chirag Gunashli oilfield in the Caspian Sea, via Georgia, to the eastern Mediterranean port of Ceyhan in Turkey, bypassing the sensitive and heavily used Bosphorous Straits. The inauguration of the oil pipeline marks a major step in the company's long-term strategy of delivering growing volumes of oil and gas from new hydrocarbon provinces around the world, says BP.

Previously, most oil from the Caspian was moved through Russian pipelines.

The pipeline was officially inaugurated at the Sangachal terminal, near Baku, by President Ilham Aliyev of the Azerbaijan Republic, President Mikhail Saakashvilli of Georgia and President Ahmet Sezer of Turkey, joined by President Nursaltan Nazarbayev of Kazakhstan. Speaking at the ceremony, BP Chief Executive Lord Browne described the project as: "an heroic engineering achievement, as ground-breaking in today's context as Prudhoe Bay and the Trans-Alaskan pipeline were 30 years ago."



Some of the pipe lengths used to make the 1,770 km pipeline

The pipeline opens up massive new fields in the Caspian Sea to world markets, enhancing security of supply for decades to come, says the company, and it does so in a way that avoids the transit of large numbers of tankers through the narrow and congested Bosphorous. New supplies of Azeri oil will go some way to reducing western dependence on oil from the Middle East.

BP is operating four major projects in the Caspian region on behalf of its consortium partners which already add up to more than $20 billion of investment, with a further $10 billion likely to be spent, mainly on offshore development by the end of the decade.

As well as the Azeri Chirag Gunashli oil field and BTC pipeline, projects include the Shah Deniz gas field and associated South Caucasus pipeline, which will be completed in 2006. Once fully on stream by 2008, Chirag Gunashli will provide approximately one million barrels of oil a day to world markets.

At current oil prices the major oil and gas fields and pipelines will provide revenues to Azerbaijan, Georgia and Turkey of more than $150 billion between 2005 and 2024, says BP.

Global PV market growth to weaken through low silicon supplies

The global market for solar photovoltaic power (PV) equipment rose to well above 1 GW in 2004 and, even with no confirmed overall figures of the European PV market in 2004, growth was impressive (eg more than doubled last year in Germany and increased by nearly half in Italy), says the European Photovoltaic Industry Association, EPIA.

The rate of growth of the photovoltaic market sector between 1997 and 2004 was around 40% per year. Demand in photovoltaic products is still growing but a temporary lack of silicon, one of the important raw materials to produce solar cells, will prevent the sector from growing as quickly in the immediate future, says the EPIA. Even where production capacities of photovoltaic cells and modules has been doubled in the last year, the EPIA expects growth of the market of about only 20% in 2005, with a slight growth increase in 2006.

"The chemical industry decided to start increasing production capacities at the end of 2004, in order to provide the raw material necessary to produce silicon cells; however these new capacities will not be available before 12 to 18 months" added President of the Association Dr. Hoffmann. The EPIA expects to get back to the current growth rates in 2007, when new silicon production capacities will come on stream.

EPIA estimates that half of the market growth in the next two years will still be supplied by silicon-based PV modules and the other half will benefit from thin-film technology.

'World's largest' tidal power plant for Korea

Austria's VA TECH HYDRO has been awarded a €75 million order from Daewoo Engineering & Construction for engineering and delivery of the main components for the world's largest tidal power plant – the Sihwa Tidal Power Plant – in South Korea.

The proposed plant is designed to be operated in one direction from the sea to the Sihwa Lake, allowing up to 60 billion tonnes of seawater to be circulated annually. In doing so, the plant will generate electrical power by utilising the head between the high tide and the reservoir level.

The plant project will consist of a powerhouse for 10 bulb-type turbines with direct driven generators with a total installed capacity of 260 MW. The tidal plant will serve another purpose, to flush the industrially-polluted Sihwa Lake with sea water. The project is scheduled to be completed by 2009.

Record demand, particularly in China, drove energy markets in 2004

Rapid growth in demand for all forms of energy dominated world energy markets in 2004, leading to rising prices. While growth in demand from China in particular was exceptional, the strength of demand growth was a global phenomenon, increasing above the 10 year trend in every region of the world.

"The world's overall energy consumption grew by 4.3% in 2004. In volume terms, this is the largest ever annual increase in global primary energy consumption and is the highest percentage growth since 1984. It is exceptional that this demand growth was so geographically widespread," said Peter Davies, BP's Chief Economist, speaking at the launch of the *BP Statistical Review of World Energy 2005*.

While China's economy grew by 9.5% in 2004, this was outstripped by the rise in Chinese energy demand – up 15.1% over the year. Over the past three years, Chinese energy demand has risen by 65%, accounting for over half the increase in global demand over the period, says BP. China now consumes 13.6% of the world's total energy.

Outside China, world energy demand rose by 2.8%, the fastest percentage increase since 1996 and twice the rate of the previous two years. While every region experienced above trend growth, demand from non-OECD countries (excluding China) grew by 4.8%, roughly three times as fast as from the OECD countries. Outside China, India was the single largest source of non-OECD energy growth, with demand rising by 7.2%.

Oil consumption in 2004 – up 3.4%, or 2.5 million barrels per day (b/d) – showed the fastest rate of growth since 1978. Rising Chinese demand accounted for over a third of this increase. The high demand came despite record oil prices, which averaged $38.3 a barrel over the year – up almost 33%.

Oil output rose to meet demand, exceeding 80 million b/d for the first time in 2004. Outside OPEC, production increased by 965,000 b/d in 2004, well above the 10 year average. Russian production once again rose fastest, with output up nearly 750,000 b/d. The largest declines were in the UK, down by 230,000 b/d, and the US, down by 160,000 b/d, adds the Review.

OPEC production also rose rapidly, by almost 8% to 32.9 million b/d, the highest level ever. This was the largest increase in OPEC production since 1986. The rise was led by Iraq – where production grew by 677,000 b/d to 2 million b/d – Saudi Arabia and Venezuela.

World gas consumption grew by 3.3% in 2004, above the 10 year average of 2.6%.

Gas production rose in every region except North America. In Europe, growth in The Netherlands, Russia and Norway more than offset the UK production decline. Pipeline shipments rose by more than 10%. Shipments of liquefied natural gas (LNG) rose by 5.4% last year, although below the 2003 growth rate. US LNG imports continued to rise rapidly, up 29%, compared to Japanese imports that declined by 3.5% as nuclear plants returned to operation following shutdowns in 2003.

Global coal consumption rose 6.3%, with three quarters of the rise coming from China. Coal was the fastest growing fuel globally, but was the slowest excluding Chinese demand. Apart from China almost all other demand growth came from the Asia Pacific region. Coal prices grew the fastest of all traded fossil fuels in 2004, with the European marker price rising 69% over the year, driven by declines in Chinese coal exports, shortages in high-grade coal and increases in transport costs.

After a rare decline in 2003, world nuclear consumption grew by 4.4%, with recovery in Japan accounting for half of the growth. Global hydroelectric generation rose by 5% in 2004.

The *BP Statistical Review of World Energy* is available at **www.bp.com/statistical review**

US sites studied for future nuclear plants

NuStart Energy Development LLC, a consortium of nine nuclear power companies and two nuclear reactor vendors, has taken a step toward reviving the US nuclear power industry by announcing its selection of six potential locations for future nuclear power plants – reports the US Department of Energy (DOE).

The six locations are in the states of Alabama, Louisiana, Maryland, Mississippi, New York and South Carolina, and five of the six sites are at existing nuclear power stations. By October, NuStart plans to pick two of the sites and move ahead with the licensing process for those sites.

Previously, NuStart signed an agreement with DOE to complete the designs for two advanced nuclear power plants and to demonstrate the Nuclear Regulatory Commission licensing process for those plants. Under the 50/50 cost sharing agreement, NuStart will complete the detailed engineering work for two designs: the Westinghouse Advanced Passive 1000 Reactor and the General Electric Economic Simplified Boiling Water Reactor.

Once the two plant locations are chosen, the design analyses will be integrated with the characteristics of the selected sites, and NuStart will develop comprehensive applications for two construction and operating licenses. NuStart says it expects to submit its license applications to the NRC in 2008.

- California Governor Arnold Schwarzenegger has announced an ambitious plan to return the state's emissions of greenhouse gases to 2000 levels by 2010, to 1990 levels by 2020 and then to reduce emissions to 80% below 1990 levels by 2050.

World's first wave farm for Portugal

The UK's Ocean Power Delivery (OPD) has signed an order with a Portuguese consortium, led by Enersis, to build the initial phase of the world's first commercial wave farm to generate renewable electricity from ocean waves.

The initial phase will consist of three 'Pelamis' P-750 machines located 5 km off Portugal's northern coast, near to Póvoa de Varzim. The €8 million project will have an installed capacity of 2.25 MW. A letter of intent has also been issued to order a further 30 Pelamis machines (20 MW) before the end of 2006, subject to satisfactory performance of the initial phase.

The project is being supplied by Ocean Power Delivery – Portugal S.A., a wholly-owned subsidiary of OPD with rights to manufacture Pelamis machines in Portugal. Construction of the project has begun.

Government launches new cleaner fossil fuel use and hydrogen programmes; CO_2 storage within a decade?

The Government has announced two new initiatives to clean up our use of fossil fuels, including funding for work towards carbon dioxide capture and storage projects, and to accelerate work towards a hydrogen economy.

Carbon capture and storage could be up and running within a decade, says the DTI, and is central to the new support package for emerging low-carbon technologies designed to stimulate demonstration projects for cleaner electricity generation from coal and gas.

The new Carbon Abatement Technology Strategy, worth £25 million, will advance all forms of carbon abatement technologies, including improving the efficiency and co-firing existing power plant with low carbon alternatives such as biomass, and the demonstration of carbon capture and storage. The latter is the most radical of the options and sets the new strategy separate from the previous Clean Coal Technology programme, says the DTI.

Launching the strategy, Energy Minister Malcolm Wicks said: "Reaching our ambitious target of cutting carbon emissions by 60% by 2050 means action now to support emerging technologies that will enable us to burn coal and gas more cleanly. At the same time, with major expansion of coal fired power generation expected in China and India, we want to put the UK at the forefront of what could be a valuable new export opportunity."

"We've consulted the industry closely and it's clear that the long term benefits of capture and storage, which could reduce emissions from power plant by up to 85%, merit significant investment now."

"We must, of course, maintain the push toward renewables and energy efficiency that deliver cuts in emissions here and now. But cleaning up our use of fossil fuels, developing the vast potential of hydrogen and fuel cells, and keeping UK industry on the front foot is a vital long term objective."

A Hydrogen Strategy, worth a further £15 million, was also announced. This will include demonstration programmes for hydrogen and fuel cells and the establishment of a Hydrogen Coordination Unit and, says the DTI, represents a step change in the Government's commitment to hydrogen energy. Previously disparate efforts on hydrogen and fuel cells R&D will be brought together for the first time within an overall strategy.

Adam Chase from E4Tech was involved in the development of the new hydrogen and fuel cell strategy: "Our analysis showed that hydrogen could provide competitive low carbon energy for transport from a range of secure energy sources. No other energy carrier offers all of these benefits. Although the technical and economic challenges are significant, hydrogen's long term potential is so great that the UK should put itself on a path to reap these benefits. A Hydrogen Co-ordination Unit and increased support for R&D and large scale demonstration projects are important ways to ensure that this is achieved."

But it is early days for the new programmes. The funding proposals are subject to the design of appropriate schemes and securing of EC State Aid Approval. The DTI expects to be able to invite calls for proposals under the new schemes towards the end of this year, with funding being spread over the following 3–4 years.

Oil and gas producers were quick to point out the challenges around carbon dioxide capture and storage.

The UK Offshore Operators Association (UKOOA) said that a number of its members have studied the feasibility of capturing or sequestering carbon dioxide emissions from onshore sources and storing it in depleted oil and gas fields, but had found considerable technical, regulatory and cost barriers still to be addressed.

Capturing carbon dioxide from an onshore location and transporting it offshore for re-injection through existing oil and gas pipelines and installations would require significant investment in new infrastructure both on and offshore, including substantial retrofitting of the offshore installations, where there are weight and space limitations, says UKOOA.

A further hurdle could be the legality of transferring carbon dioxide, officially designated a 'waste' product, from one location to another for disposal offshore, something which is not allowed under current international law (OSPAR and the London Convention), added the Association.

UK carbon trading gets underway

Companies covered by the EU Emissions Trading Scheme were finally able to open their UK carbon accounts in May, following publication of allowances for installations covered by Phase I of the Scheme. Emissions trading in the UK also started with the UK Registry becoming operational, allowing operators participating in the scheme to access their allowances, says the DTI.

These were the final steps towards full UK participation in the scheme, which is set to help reduce carbon dioxide emissions by around 65 million tonnes (around 8%) below the projected emissions of the installations covered by the Scheme over the next three years. Trading in the UK had been delayed by a row over Britain's initial allocation of emissions allowances.

Web based, the UK Emissions Trading Registry records carbon dioxide allowances held in companies' accounts and allows allowances to be transferred to other accounts both within the UK and in other participating countries. The Registry software, developed by Defra, has been licensed for use in 12 other States.

Andy Watson, Energy Manager at BAA, is the new Energy Manager of the Year, having been presented with the annual award by Louise Kingham, Chief Executive of the Energy Institute at the dinner of this year's NEMEX energy management conference and exhibition in May.

During four years as Energy Manager for BAA, Andy Watson has developed investment strategies for both the Heathrow site and across BAA's seven airports to achieve targeted reductions in carbon dioxide emissions. His work has led to carbon dioxide mitigation benchmarks to prioritise investment in on-site renewables.

FGD for Aberthaw, despite uncertainty over Euro Directive

RWE npower is to fit new flue gas desulphurisation technology to reduce emissions from its Aberthaw coal-fired power station near Barry in South Wales. The FGD plant, which will cost more than £100 million, will enable the power station to operate under new European environmental regulations due to come into force on 1 January 2008, says npower.

However the company also said that indecision by the Government on the method of applying the new Europe-wide Large Combustion Plant Directive (LCPD) in the UK had added significant extra cost to the project. Andrew Duff, Chief Executive of RWE npower, said: "We have been waiting since November 2003 and still have no decision from Government concerning the implementation of the LCPD. If we postpone any longer we will be unable to generate in 2008, with major implications for security of supply. It is time this lack of clarity came to an end so that industry can plan ahead."

Consent to fit FGD technology was granted in June 2004. A letter of intent has been signed with contractors Alstom/Amec and the project is scheduled to be complete by early 2008.

Also at Aberthaw, Siemens Power Generation (PG) has won a substantial contract to install a new instrumentation and control system in one of the three 500 MW units of the station, with options to install similar systems in each of the other two units. The first unit will have its replacement system in 2005, whilst the other two new systems will be installed by 2007.

New emissions control equipment will allow Aberthaw to operate legally beyond 2007

The new system will control the entire two-shift power generation process with new technology, ensuring more efficient event sequences for the daily boiler start-up and shut-down procedures.

Meanwhile, Mitsui Babcock has been awarded a contract worth around £30 million over four years at Drax Power Station, in Selby, North Yorkshire. Drax Power Limited has awarded its main boiler outage and pressure part maintenance contract for the 4,000 MW coal-fired power station following an intense negotiated tendering process. The contract will secure the future of more than 100 local jobs, whilst indirectly supporting a number of plant, equipment and service providers in the area, says Mitsui Babcock.

Grant support for more PV projects

Fourteen new solar photovoltaic (PV) energy projects across the UK are to receive £1.35 million in funding, bringing the total amount awarded to medium and large-scale PV projects since the Government established its scheme in 2002 to £18.8 million.

Among the 14 projects are London's transport museum in Covent Garden; a church in Little Walsingham, Norfolk; housing developments in Rotherham, Redcar and Manchester; and schools in East Lothian and Essex.

Since the establishment of the solar PV grant programme, funded by the DTI and managed by the Energy Saving Trust, 180 medium and large-scale projects throughout the UK have been granted funding and on completion will generate nearly 6000 kWp of electricity.

Corporate leaders call for tighter measures on climate change

Business is not averse to tighter long-term measures aimed at tackling climate change – or at least the chiefs of several companies are not.

Leaders from 13 major UK and international companies have offered to support the Government in developing new, longer-term policies for tackling climate change. In a letter to Prime Minister Tony Blair the companies argue that there is a need for urgent action to be taken now to avoid the worst impacts of climate change, and offer to work in partnership with the Government towards strengthening domestic and international efforts on reducing greenhouse gas emissions.

The group of CEOs and senior executives came together under the auspices of The Prince of Wales's Business and the Environment Programme in response to a challenge issued by the Prime Minister in a speech on climate change in 2004. In its letter, it points out that, at present: "The private sector and governments are in a 'Catch 22' situation with regard to tackling climate change, in which governments feel limited in their ability to introduce new climate change policy because they fear business resistance, while companies are unable to scale up investment in low carbon solutions because of the absence of long-term policies."

Companies represented include HSBC, BP, Johnson Matthey, BAA, John Lewis partnership, Scottish Power and Shell.

Three UK fuel cell companies push ahead

Three UK-based fuel cell companies have announced technology breakthroughs in the last few weeks.

First, Voller Energy Group, which manufactures portable fuel cell system for use as battery chargers and mobile generators, has started shipping the latest generation of its VE100 portable fuel cell.

The latest version, the VE100 v3, weighs just 9 kg and delivers 230 V, the equivalent to the power produced from a plug in the wall. The European version produces EU standard 230 V at 60 Hz and a US version is available producing 110 V at 50 Hz. The product is currently being shipped to Voller's distribution partners around the world, including Germany, the US and Taiwan.

The system is capable of delivering up to 200 W at peak power and 100 W at nominal performance, says Voller. The unit is completely self contained and does not require an external battery to start the system.

Second, Ceres Power says it has succeeded in making its fuel cell four times larger. This means that the fuel cell, which among other applications is destined for use in domestic boilers to generate electricity as well as heat, will become much cheaper to manufacture and simpler to incorporate into commercial products.

Ceres Head of Product Development Andrew Baker said: "Our development so far has used fuel cells the size of an After Eight mint. Now we can produce cells the size of a CD case, which produce four times as much power. This dramatic scale up in size should slash manufacturing costs and represents a key step towards using the cell in applications where greater outputs of electricity are needed."

Unlike most other fuel cells, the Ceres cell is manufactured using low cost materials and cheap mass production techniques. It does not need platinum as a catalyst, and will run on natural gas as well as hydrogen.

Last, CMR Fuel Cells Ltd has developed a working prototype of its unique, patented 'compact mixed reactant' (CMR) stack which is poised to deliver the low cost, long run-time power solutions that portable electronic products demand. CMR technology is targeted at a diverse range of electronic devices, from laptop computers, through power tools and back-up power supplies, right up to electric scooters and cars.

CMR technology reduces the size of fuel cell stack by a factor of ten – leaving more room for fuel and enabling dramatically longer run times compared to current portable power sources, says the company. Unlike conventional cells which rely on the complete separation of reactants, CMR's design works by flowing a mix of air and fuel through a porous stack system. This approach eliminates up to 90% of the volume and, as the reactants are mixed, the membrane they pass through can be much thinner, lighter and cheaper.

www.voller.com www.cerespower.com www.cmrfuelcells.com

Voller Energy's latest VE100 portable fuel cell will deliver 100–200 W

Investment in clean technology growing at 30%

Investment in clean technology is growing at 30% year on year, according to a new report commissioned by the Carbon Trust and carried out by Library House.

Investment in clean technology is bucking the overall trend in the technology arena, where venture capital investment has fallen since the end of the technology boom. If growth in clean technology investment continues at the present rate, the annual investment rate in the UK market could grow to a size in excess of £2 billion by 2015, with the global market potentially reaching an annual investment rate of £50 billion in the same period.

The report: *Investment Trends in UK Clean Technology 2000–2004* shows that venture capital investors provided half of the total investment in UK clean technology between 2000 and 2004, with the remainder coming from public markets or mergers and acquisitions. As is typical of new investment markets, few private equity investors have made clean technology a significant part of their investment strategy during the last five years. However, changing market conditions in the last 18 months, such as growing energy prices, increased supplier competition, new legislation and heightened consumer awareness have provided the clean technology sector with a new impetus.

Clean technologies incorporate a wide range of products, services and processes, such as renewable technologies, fuel cells, energy storage devices and energy efficient electronic equipment designed to reduce or eliminate the environmental impact of currently available technology.

Record year in prospect for UK wind industry

The newest and most powerful wind farm in the UK has been switched on in what is proving to be a record year for the UK wind industry, according to the British Wind Energy Association.

The opening of Rothes wind farm in Scotland is the eighth commissioning of new wind projects so far this year. The 22 turbine, 51 MW project brings the total UK wind power portfolio to 979 MW from 1234 turbines, representing some 0.7% of total UK electricity supply, says the BWEA.

This figure is set to rise to 1.5% of supply by the end of 2005 as other projects currently under construction are commissioned, including the third of the UK's large-scale offshore wind farms, Kentish Flats, off the coast of Kent.

A total of 18 new wind farms will be commissioned this year, representing some 500 MW of capacity, adds the BWEA, and this success is echoed in new wind farms receiving consent. Some 11 new projects, with a total of 218 MW have been approved so far this year. An additional 6,200 MW of capacity is in the planning system, representing some 6% of UK electricity supply.

Meanwhile, the Co-operative Group and ScottishPower are teaming up to build an eight turbine wind farm at Coldham in Cambridgeshire and construction work is underway. The scheme is being developed on a small part of the Co-operative Group's agricultural estate in Cambridgeshire and the land will continue to be farmed by Farmcare, the Group's farming business. Vestas Celtic, based in Campbeltown, Argyll, will manufacture the turbines, which will be commissioned later this year.

Marine Projects International Limited has been awarded the contract for the offshore construction phase of the Barrow Offshore Windfarm for Vestas Kellogg Brown & Root. The £20 million contract, won despite stiff competition from European rivals, includes transportation of foundations from Belgium, operation of the onshore base in Belfast, and offshore installation of foundations, turbines, sub-station, inter-turbine cables, and main transmission cable to shore.

Barrow Offshore Windfarm, to be situated 7 km south west of Walney Island in the Irish Sea, will consist of 30 Vestas V-90 offshore wind turbines supplying up to 90 MW of renewable power into the national grid for operator BOWind, a joint venture between UK energy group Centrica and Danish Oil & Natural Gas (DONG).

MPI will employ its flagship turbine installation vessel M/V Resolution, operating from Belfast, for the majority of the offshore construction tasks.

Wind power 'requires no back-up plant' – SDC

The latest organization to back responsible siting and use of wind energy is the Government's Sustainable Development Commission (SDC), which says in a new report that wind power must be made to work to tackle the problems of climate change and energy security.

The report: *Wind Power in the UK* aims to help policy makers and planners balance genuine local concerns with wider environmental and social needs, so the benefits of renewable energy are realised through careful design and consultation.

SDC Chairman Jonathon Porritt said: "Climate change will have a devastating impact unless urgent action is taken to boost the contribution of renewables, alongside energy efficiency measures. For this to happen, good decision-making is needed, and this requires reliable, up to date information, based on the best available scientific evidence. We believe wind power is a critically important part of the overall energy mix, and hope that this authoritative guide will ensure wind power is harnessed in the most responsible way to ensure that emissions of carbon dioxide are reduced."

The report goes on to suggest that technological advances mean there are no limits to the amount of wind capacity that can be added to an electricity system, and that wind energy requires no dedicated 'back-up' plant. Onshore wind is one of the cheapest forms of renewable energy and increasing supply to 20% by 2020 would present only a very modest increase in cost for consumers that compares well with other energy sources. Indeed, as fossil fuel prices increase and wind turbines become cheaper to build, wind power may become one of the cheapest forms of electricity generation over the next 15 years, adds the SDC.

Wind energy company commits to first wave farm

The first wave power could be arriving at our shores within the next few years as Ocean Prospect has announced its intention to place up to ten wave energy converters in waters off the north Cornwall coast. The project will use Pelamis P750 devices developed by Ocean Power Delivery to convert the power of the ocean into useful, green electricity. Ocean Prospect is a subsidiary of the Wind Prospect Group and has been created to develop marine renewables in the UK and Australia

The announcement follows the South West Regional Development Agency's recently unveiled plans to progress with the Wave Hub project (see *Energy World* April 2005). The hub is critical to Ocean Prospect's plans as it will provide the electrical infrastructure required to take the electricity generated by the fleet of Pelamis back to shore.

Helen Plowman, Marine Renewables Manager for Ocean Prospect said: "These have been a momentous few weeks for the wave energy industry. The Government has now unveiled its support mechanism for marine renewables and, together with the Wave Hub, we can start to create a new and exciting industry."

The case for 'green coal' as part of Britain's future

Much of the current debate on the future for UK energy supply centres on the relative costs and merits of renewable and nuclear technology, with concern about the over-use of gas. But this is to miss out the essential and very major contribution that cleaner coal could and should make, argues the Director of Technology & Engineering at Mitsui Babcock, Les King. *This feature also looks at Mitsui Babcock's work on clean coal in China.*

If debate on the future of energy in the UK was rising before the general election, it has probably increased since. While some ministers are openly embracing both nuclear and clean fossil fuel technologies, the Government, industry and the general public are far from unanimous about which direction to take.

Greenhouse gas emissions in the UK are still rising. In the near-term, global trading will quickly put pressure on coal power plant generators to switch to less carbon-intensive fuels to reduce emissions. Indeed the EU has led the world in introducing its greenhouse gas reduction system; the EU Emissions Trading Scheme Directive and the Kyoto Protocol itself came into force in February of this year.

The challenge now for all governments is balancing those environmental pressures with the requirement for security of energy supply and a global rising demand for more power in a world where oil and gas reserves are fast depleting. The prices for oil and gas are also volatile, whereas there are considerable reserves of coal and the market remains relatively stable.

The UK government has committed to playing a leading role in reducing worldwide carbon emissions. It has given significant attention and support to renewable power in the UK (an important element of the energy mix) but is yet to provide sufficient direction or support to the UK energy industry, in particular to owners of coal-fired power stations.

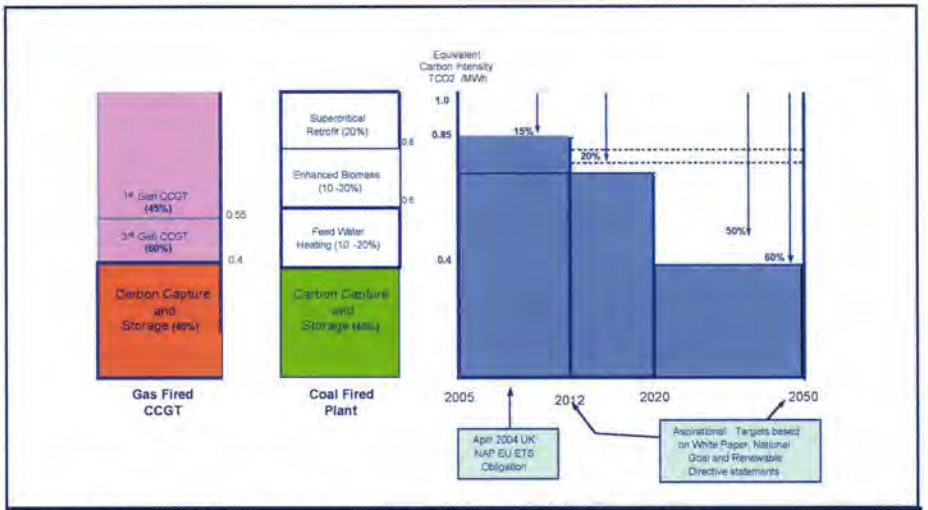


Figure 1. Green coal technology: supercritical, biomass and feedwater heating

On the face of it coal-fired powered generation may appear less attractive in environmental terms. The large existing coal fired power plant introduced in the UK in the 1960s each produce approximately 1 tonne of carbon dioxide per MWh of electricity produced. The latest combined cycle gas turbine (CCGT) powerplants emit approximately 40% of this. However, while 150 years of global coal reserves are available, reserves of gas and oil are far more limited with gas reserves estimated at 50 years.

A balanced energy policy

Gas currently provides 39% of the total power supplied in the UK. Our demand for gas under carbon trading will increase significantly just as we are in the process of becoming a net gas importer. Possible over-reliance on gas and the task of delivering a new gas supply infrastructure, coupled with expectations on renewable generation, is causing real concern over how power demands will be met as the projected reductions in coal and nuclear generating capacity are realised.

Mitsui Babcock believes that a balanced fuel mix is required to meet security of supply requirements while reducing emissions. For coal-fired generation to remain a part of this balance, this means employing the cleanest coal firing technologies possible.

Mitsui Babcock's 'Green Coal' technology provides power generators and governments with a sustainable solution. Continued use of coal is possible, maintaining security of supply whilst achieving the longer-term emissions reduction and renewables targets in the most cost effective and efficient manner.

Full use can be made of the existing infrastructure for coal fired generation which currently has a total capacity of 28 GW (36% of the UK's total installed capacity). This valuable legacy – consisting of everything from complete infrastructure, physical buildings, coal supply, ash handling and grid connections through to the people and skills of the operators, can be utilised very cost effectively by the 'brownfield' retrofit of Green Coal technologies.

Green Coal technology

Our Green Coal technology utilises a combination of technologies to achieve up to 60% reduction of carbon dioxide emissions from a coal-fired power plant. Further reductions (to 95%) will be possible in future by implementation of carbon dioxide capture and storage, with a plant retrofitted with Green Coal technology being designed to be 'capture-ready'.

The 60% reduction in carbon dioxide emissions can be achieved by the introduction of boiler and steam turbine efficiency improvements, biomass co-firing and improved feedwater heating technology. As shown in **Figure 1**, these technologies can all deliver substantial reductions in carbon dioxide emissions – bring-

ing coal fired power plant emissions down to typical levels for gas-fired power plant.

Stage one of the Green Coal technology portfolio is the application of supercritical technology: upgrading the boiler and steam turbine plant from subcritical conditions (eg 180 bar pressure, 540°C final steam temperature) to supercritical conditions (eg 300 Bar pressure, 600°C final steam temperature). In doing so, plant efficiency will increase from around 36% for most UK plants to around 43.5%. For the same electrical output this equates to a carbon dioxide reduction of 20%. For older, less efficient units this saving in carbon dioxide emissions can be greater, approaching 30%.

The boiler improvements are achieved by replacing the current natural circulation boiler design with a supercritical design, resulting in a lighter overall boiler design capable of being retrofitted within the existing boilerhouse structure. Recent Mitsui Babcock advances in supercritical boiler design enables application of our own 'Posiflow' system of internally ribbed boiler tube technology. This design of tubing allows a vertical furnace tube arrangement to be used, which is easier to retrofit, has lower cost and is more efficient than the conventional spiral wound arrangement of tubing.

The second stage of Green Coal technology is biomass co-firing: as a renewable fuel biomass does not attract a carbon dioxide cost under the EU Emissions Trading Scheme. Utilising biomass in small-scale electricity production struggles to achieve cycle efficiencies above 30%. However, enhanced co-firing levels can be achieved with minimal generation risk on a plant that is retrofitted with supercritical technology. The replacement furnace would be designed with this intent. Mitsui Babcock is confident that the supercritical retrofit design with an enhanced biomass co-firing system will deliver up to a 40% reduction in carbon dioxide emissions.

Stage three is feedwater heating improvement: most existing plants bleed steam from the turbine to heat the boiler feedwater. Two technologies exist which can contribute to reducing carbon dioxide: gas turbine feedwater heating and independent biomass direct fired feedwater heating.

Gas turbine feedwater heating has already been proven in other coal plant applications. The technology involves a partial re-powering of the coal plant cycle, recovering the waste heat from the gas turbine's exhaust gas in a purpose-built feed heater. The gas turbines are packaged with their own generators, which add to the output from the main unit. This delivers up to a 20% carbon dioxide reduction by replacing coal with gas as the feedwater heating fuel and lifting the overall cycle efficiency by applying CCGT efficiency levels to part of the main coal plant cycle.

The Changshu supercritical coal-fired power plant under construction in China

Export opportunities

Electrical power production in China is growing rapidly, at roughly 15% year-on-year. A dramatic increase in orders for new power plants has followed. In 2003, well in excess of 100 GW of pulverised coal-fired power plant was ordered – equivalent to almost two times the total installed generating capacity within the UK. Roughly 75% of power in China is generated from coal. The US government has predicted that coal's contribution to global energy consumption will double to 50% by 2015 as developing countries such as China and India increase generation and draw on their huge reserves of coal.

The dual demands of meeting environmental and power supply challenges make China an interesting case study for the use of clean coal technologies. For current new coal-fired plants in China, 90% of orders are for supercritical equipment. This focus is driving much of Mitsui Babcock's work in the area on plant retrofitting and upgrading.

Mitsui Babcock has a technology transfer agreement with Harbin Boiler Company (HBC), China's largest utility boiler manufacturer. This partnership is key to the company's work in the region, and has resulted in Mitsui Babcock/Harbin being the world's largest supplier of new supercritical boiler plant in 2004, with over 600 MWe of plant.

Prior to this formal agreement, Harbin and Mitsui Babcock have been working on several successful projects. At Yaomeng, in China, for example, they have recently upgraded a 300 MW universal pressure once-through boiler to a low water mass flux vertical tube furnace. Output was raised from 270 to 323 MWe, boiler efficiency increased by 1.1%, heat rate reduced by 975 kJ/kWh, coal consumption by 10% and availability improved to 100% for 17 months out of 18. The outage during which the boiler was replaced was six months in duration.

The advantages of incorporating this particular technology at Yaomeng have enabled the existing boiler dimensions and foundations for the support structure to be unchanged, with no need for additional steelwork to be added. For a relatively modest outlay, the operator now has a valuable asset, with a further 20 year design life instead of a boiler destined for imminent closure. The peak output of the unit has been increased by 20% and it has exhibited a significantly improved load-following capability.

More recently Mitsui Babcock designed the first in the new generation of supercritical power plant boilers at the Changshu power plant in China, close to Shanghai. The technology recently achieved the hydraulic test milestone in record time – which involved the water in the boiler being pumped to 1.5 times working pressure, thus proving the manufacturing and construction of pressure parts. More recently the plant is now being commissioned to the full 600 MW load.

Applying the supercritical technology in China is a major milestone for Mitsui Babcock as China represents a major world market. With this modern reference point the company is well positioned to win significant new contracts in the region. This means the aging coal fleet in China could be replaced by new, efficient boilers which are kinder to the environment. ●

Mitsui Babcock's internally ribbed boiler tube technology can help to increase boiler efficiency

UK opportunities

To complement the introduction of renewables and to minimise the security of supply risk associated with excessive reliance on gas, there is, in the Mitsui Babcock view, a number of crucial steps that the UK Government must take:

- increase investment in cleaner coal research, development and demonstration;
- provide active support for clean coal technologies to complement renewable energy plans;
- introduce mechanisms similar to the Renewables Obligation for carbon abatement of coal plants; and
- maximise environmental trade opportunities through support for export of UK clean coal expertise.

Governments should be looking to secure a balanced fuel mix for their electricity supplies, including nuclear, gas, renewables and coal. The reality is that coal is currently a crucial contributor to electricity generation in the UK, China and internationally. Governments must take the lead on delivering balanced energy policies which recognise the importance of coal in achieving security of energy supply and in reducing carbon emissions to meet current targets. Solutions are available now that will achieve these aims, but industry will not commit to carbon abatement improvements without active leadership from Government and a commitment to coal in the long term.

The costs for implementing a supercritical retrofit stand at £116 million for replacement of a 600 MWe subcritical coal fired unit, compared to an equivalent new build of £350–375 million. The retrofit programme would take 24 months, including 12 months for site works. The scale of investment appears large, but comparison to wind power costs puts the carbon dioxide savings into context. A 600 MW unit retrofitted with supercritical technology will save at least 0.47 million tonnes of carbon dioxide per year. This saving equates to 234 1 MW wind turbines (operating at a capacity factor of 25%) at a capital cost of £175 million (onshore) or £216 million (offshore).

Supercritical retrofits applied across the 28 GWe UK coal fleet (55 units) would save around 22 million tonnes of carbon dioxide per year (equivalent to savings from around 11,000 MW of wind turbines with 25% capacity factor). A full programme of supercritical retrofits would cost around £6 billion. The wind turbine alternative would cost £9–£13 billion. Introduction of only the first phase of green coal technology would achieve the same future-proofed carbon dioxide savings for less than half the investment.

Green Coal technology offers power generators and governments a new approach to the low carbon future. Coal-fired generation delivered in this way is the most practical, sustainable and 'future-proofed' solution to fossil fuel use for the 21st century. In essence, coal can become green.

Only through a balanced energy policy can we ensure the UK has security of supply in the future. But the government must address questions over finance and support for cleaner energy. As the Government settles in to its third term, it must address the uncertainties which surround energy policy and deliver on the support for carbon emissions reduction it has been so vocal about. ●

Les King is Director of Technology & Engineering at Mitsui Babcock.

Headquartered in the UK, Mitsui Babcock is a subsidiary of one of the world's largest engineering companies, Mitsui Engineering & Shipbuilding Co Ltd of Japan. The company provides services to the petrochemical, oil and gas and power industries worldwide. For further information, visit **www.mitsuibabcock.com**

DTI to support coal conversion project

Since the main article was written, Mitsui Babcock has announced that the DTI will be providing 65% of the £1.2 million investment behind a design study that the company is spearheading to look at the feasibility of retrofitting the entire UK coal fleet with advanced supercritical boiler and turbine technology, and carbon dioxide capture and storage technology.

This project is the precursor to full demonstrations of these clean coal technologies in the UK, and follows an earlier feasibility study on the Scottish Power Longannet coal plant in Scotland supported by Scottish Enterprise. Project partners collaborating in the new study include E.ON UK, Drax Power Ltd, EDF Energy, Alstom, Air Products, Fluor Ltd and Imperial College London.

Green coal technology involves increasing the plant cycle efficiency by the introduction of modern supercritical boiler/turbine technology which reduces emissions by 20%, followed by the introduction of biomass fuels which can reduce emissions by a further 20%. The supercritical technology utilises higher temperature and pressure steam leading to increased plant cycle efficiency, making more electricity from less coal and more electricity for less carbon dioxide emitted. The technology behind capture and storage is less mature but will mean that 90–95% of the carbon dioxide emissions can be captured and their emission to the atmosphere avoided.

Iain Miller, chief operating officer of Mitsui Babcock, said: "Having DTI support for this study is a major step toward reducing emissions from coal. No previous study has looked at the feasibility of retrofitting the entire UK fleet with supercritical technology. Capture and storage technology has come a long way and now needs to be studied for its economic viability. The UK gets roughly a third of its energy from coal, but in countries like China it is relied upon even more. The export potential of this technology for the UK is significant and it would be a great benefit to the environment if the technology was rolled out internationally." ●

Nottingham researches ultra-clean coal

A team at The University of Nottingham is one of only two in the world working on ground-breaking techniques to purify one of the world's main energy sources – coal.

Engineers are developing ultra-clean coal that could make power generation 50% more efficient and reduce carbon dioxide emissions by a third. They have been awarded a grant of £120,000 by the Engineering and Physical Sciences Research Council to help them develop the ultra-clean fuel.

Dr Karen Steel, of the School of Chemical, Environmental and Mining Engineering, said: "Ultra-clean coal is seen as something of a 'Holy Grail' in energy generation. It's a very efficient way of producing electricity, and it's also much less harmful for the environment. This is an exciting project in the sense that ultra-clean coal has world-wide applicability."

When coal is dug from the ground, it contains about 15% mineral matter – including sulphates, oxides, clays, quartz and carbonates – which greatly restricts its use. A chemical leaching process being developed by Dr Steel and her team promises to reduce this figure to less than 0.1% – meaning much greater efficiency per tonne of coal and up to 33% less carbon dioxide pollution from the power station.

Most conventional coal-fired power stations burn coal to produce steam, which turns turbines linked to a generator. Although efficiencies have gradually risen over the years, they are typically around 37%. But, because ultra-clean coal can be burned directly in gas turbines, it has a potential efficiency of around 55% – a relative increase of 50% from current levels.

Dr Steel added: "There has been an assumption that it would be too expensive to produce ultra-clean coal. But our aim is to do it cheaply, so the coal will sell for not much more than it would otherwise. There are potential markets for ultra-clean coal technology all over the world – and not only for power generation. Ultra-clean coal could also be converted to carbon-rich products such as carbon electrodes used in aluminium smelting."

The only other body working on ultra-clean coal technology is the Commonwealth Scientific and Industrial Research Association in Australia. They are investigating a different technique in pursuit of the same goal. ●

US accelerates future coal fleet programme

Several US coal-fired power generators and the US Electric Power Research Institute (EPRI) have announced a new initiative, 'CoalFleet for Tomorrow', to accelerate the deployment of clean, efficient, advanced coal technology and to develop options for managing the carbon dioxide emitted from power plants.

Coal-based power plants have long been the workhorse of the US electricity system, producing more than half the power generated there. Globally, a number of leading economic powers also have large coal reserves. Power generating companies and government agencies concerned with maintaining long-term energy security and keeping electricity affordable look to coal as a fuel source worth sustaining.

Hank Courtright, EPRI's vice president of generation and distributed resources said, "The goal of this initiative is to preserve this abundant source of fuel as a vital component in the electricity generation mix. Work must begin now to ensure that the advanced coal technologies can establish a solid track record before large numbers of coal plant replacements become necessary. We see the need to get plants built and operating soon to gain experience with and reduce the cost of advanced coal plant technology."

"During the first year of this programme, we will concentrate much of our effort on accelerating integrated gasification combined cycle (IGCC) technology into the market in the 2005 to 2015 timeframe."

IGCC combines the high efficiency of gas turbine power systems with the ability to run on coal and other low-cost solid or heavy-liquid fuels. In addition, IGCC units have demonstrated extremely low emissions of sulphur, mercury, and nitrogen oxides.

Courtright added, "Over the programme's lifetime we will address a balanced portfolio of advanced coal technologies including ultrasupercritical pulverised coal and supercritical circulating fluidised bed combustion, and examine how these technologies will perform with different types of coal. We will also be increasing our understanding of the options for capturing and sequestering carbon dioxide, and determining potential beneficial uses for it. We plan to ensure the commercial availability and operation of all these technologies by 2015 to 2020." ●

Transatlantic partnerships for cleaner power

Two new collaborations in cleaner fossil power generation have been initiated through the UK's industry-led Advanced Power Generation Technology Forum (APGTF), the DTI Cleaner Fossil Fuels Programme, the US Department of Energy (USDOE), and the US National Energy Technology Laboratory.

Back in March 2003, as part of a ten-year memorandum of understanding on energy R&D, the UK and US governments signed a 'Fossil Energy Implementing Arrangement' to facilitate effective technology partnering in this area. The arrangement has given real impetus to research in both countries by acknowledging that only by sharing costs and stretching R&D budgets will progress be made at the required pace.

Two initiatives have already been developed under the arrangement – 'Advanced Materials for Low Emission Power Plants', and 'Virtual Plant Simulation' – both fields identified as top priorities in the UK and US.

Work on advanced materials focuses on achieving significant, cost-effective improvements through the availability of new materials for use in power stations. The key UK power industry players, Alstom Power, Mitsui Babcock, NPL, Siemens, Corus, Howmet, E.ON UK, RWE npower, Liverpool University and Cranfield University are partnered by a range of US power industry manufacturers, utility companies and research organisations led by the USDOE's Oak Ridge National Laboratory in Tennessee.

The virtual plant simulation collaboration has its origins in two ongoing projects, one in the UK and the other in the US, which share many of the same objectives. Both aim to improve the computer modelling techniques used to assess technical, commercial and economic issues involved in power station design and development.

The nine UK partners, Alstom Power, Engineous, Fluent, K-S Tech, ME Engineering, Mitsui Babcock, Process Systems Enterprise, RWE npower and the University of Ulster, are working with US partners led by the USDOE's National Energy Technology Laboratory in Pittsburgh.

Additional technology areas where possible collaboration under the arrangement has already been reviewed include near-to-zero-emissions power plants, co-firing biomass with fossil fuels, plant life extension, carbon dioxide capture and storage, and novel power plant cycles. ●

***Contact Philip Sharman, DTI International Technology Promoter for sustainable energy technologies for North America, e:* philip.sharman@pera.com**

The imperative for clean coal in Australia

Coal provides 85% of Australia's electricity, so it is not surprising to see a good deal of activity there aimed at accelerating the arrival of cleaner coal technology, including the establishment of COAL21 – an coal industry initiative aimed specifically at reducing carbon emissions from coal-fired power generation. The keynote address at COAL21's recent conference was given by Eileen Claussen, *President of the US-based Pew Center on Global Climate Change. We present edited extracts from her speech – which Ms Claussen started with two bold predictions.*

I want to start by laying out what I believe are two predictions for the future in which I have great confidence. The first is that we will soon be living in a carbon-constrained world. And the second is that coal will continue as a primary source of energy throughout the globe. How we reconcile these two predictions is, I believe, the crucial question facing this industry in the months and years ahead.

I do not need to tell you about the vital role that coal plays, and will continue to play, in meeting the world's energy needs. But I do want to offer a few statistics to put it in perspective.

In the United States today, coal provides 51% of all electricity, more than double the amount of any other fuel source and five times more than gas, oil, or hydroelectric power. Here in Australia, of course, coal is even more dominant in the energy mix, providing 85% of the nation's electricity. And then there are the developing countries like China and India. China alone now accounts for 31% of worldwide coal consumption, and the developing world is going to be bringing huge amounts of new coal burning capacity online in the years ahead.

The bottom line: coal is the most abundant energy source today, it is dispersed throughout the world, and it is available at a relatively low cost. There is no way that the world can continue to quench its growing thirst for energy without it.

So those are the facts: carbon constraints are coming, as they should be, and coal is here for the long haul. Now the question is how do we reconcile these future scenarios? How can the future include both carbon constraints and coal?

In the US today, coal is responsible for 33% of carbon dioxide emissions. The comparable figure for Australia is 58%. Worldwide, the proportion of carbon dioxide emissions from coal is 26%. As we say in America, something's got to give.

To the extent that the coal industry fails to take seriously its obligation to substantially reduce emissions, then the controls imposed from outside are likely to be both more severe and less business-friendly. This is why the COAL21 National Action Plan is so important.

By laying out a pathway for developing new technologies to reduce coal-related emissions, you are planting your flag on the side of solutions. But the most important point I want to leave you with today is that a technology strategy alone is not enough. It is absolutely essential. But we also need broader climate policies that will draw the new technologies into the marketplace – policies that reflect the urgency of this issue and the need for real reductions in emissions.

Technology and policy. We need to do both and we can do both. So let me go back to the 2005 World Economic Forum meeting at Davos, where there are two thoughts that are particularly relevant. First, "there is no single 'magic bullet' or technology to address climate change. A diverse portfolio of low and zero carbon technologies will be required." And second, "but it is essential that business be guided by clear price signals and a predictable regulatory path."

Technology is essential

First, technology. You are the experts on the technologies that can reduce greenhouse gas emissions from coal. And the agenda for this conference reflects that. Over the next two days, you will be talking about carbon dioxide capture and storage, IGCC, oxy-fuel combustion, lignite dewatering and drying, ultra-clean coal and more. The potential for combining IGCC with carbon capture and storage is, of course, where a lot of the attention is right now – and for obvious reasons: whatever we do, we have to do it as efficiently as possible. But each of the technologies on your agenda holds great promise. And we need them now.

Worldwide, in developing and developed nations, the International Energy Agency anticipates that about 250 GW of new coal capacity will be built in this decade. We will build almost double that (480 GW) between 2011 and 2020. We have already missed our chance to influence the choice of technology for most of the capacity that will come online before 2010. But the longer we wait, the more likely it is that we will fail in the next decade as well. We simply cannot afford to do this.

So where are we today in developing the technologies we need? Well, let's look at IGCC as an example. Right now, there are only two real IGCC plants in operation in the US, but neither is operating fully on coal. Of 106 proposed new coal plants for the US, nine are IGCC. There is also the Bush administration's $1 billion 'FutureGEN' project. But no specific plans have yet been announced. So, in reality, we haven't figured out if this is even viable yet.

With carbon capture and the other technologies, it is the same story. Lots of great ideas, some demonstrations here and there, but we are nowhere near where we need to be. And governments and industry are going to have to work together to jump-start these technologies and get them to a point where they can actually make a difference.

The COAL21 National Action Plan is absolutely correct in saying that international collaboration in this work is essential. We need to reduce duplication of effort – and that means planning, funding and deploying trial projects with publicly shared results. Any R&D we do on these technologies should be focused squarely on the remaining technical hurdles to their deployment, with special attention to reducing the costs involved. There is enormous potential here – but, as all of you know, we have a lot of work to do before these technologies can even begin to make a real contribution to protecting the climate. And the clock is ticking.

Policy is just as important

But again, an R&D focus alone is not enough. We need to combine technology and policy. A recent Pew Center study looked at three future energy scenarios for the US – one where oil and gas are abundant and relatively inexpensive; one where energy supply disruptions and terrorism concerns lead to more interest in both alternative energy and coal; and one

Coal gasifier being trialled in Queensland, Australia as part of work on integrated gasification combined cycle (IGCC) power generation.

where government and industry partner to get climate-friendly technologies to the marketplace.

Even in this last scenario, where technology triumphs and where we presumably would get a fairly good handle on technologies such as carbon storage and coal gasification, the study projected no net reduction in US carbon emissions by 2030 without a broader climate policy. Even if we get these technologies to a point where they can be deployed in cost-effective ways, we still need broader policies to enable change. Industry needs to know that government is serious about this issue, that there are clear and certain goals driving our policies, and that all sectors will be held accountable for reducing their emissions.

What types of policies am I talking about? At the international level, we need an agreement that engages all major emitters of greenhouse gases, from both the developed and the developing world. It is the only fair way to do this. It is the only way to bring the US – and Australia too – back into the process. And it is the only way to fully engage the major emitters in the developing world.

But I am not saying that all countries – or all companies – need to play by the same rules. Flexibility is key. Different countries are at different stages in their development, and they have different resources to invest in climate solutions. And different countries are endowed with different kinds and quantities of natural resources. So we need a framework where everyone is involved in ways that they and their competitors view as fair. 'Fair and effective' should be our mantra as we move forward. Fair because we need broad engagement in this effort, and effective because we need to create pathways that get us to a low-carbon global economy.

Moving from the international stage to policies at the national level, we need to look at an assortment of policies that can contribute to reduced emissions. One of these is cap-and-trade. As you know, this is a policy that sets targets for greenhouse gas emissions and allows companies the flexibility to trade emission credits in order to achieve their targets. This is the policy in New South Wales, and a number of US states are considering a cap-and-trade initiative as well.

The US Senate for the first time voted on a national cap-and-trade measure last year. It attracted the support of 43 senators, and its sponsors have vowed to bring it up for consideration again. Cap-and-trade policies can be important because they encourage economy-wide reductions in emissions. And the work we have done shows this is the least expensive way to do it – reductions happen where it is cheap and where it makes the most economic sense.

However, cap-and-trade is far from the only policy option at the national level. And for some countries, it may not be the preferred approach. Government standards and codes, public infrastructure investments, public-private partnerships and government procurement all have a role to play in reducing emissions and forcing change. We also may need to think sector by sector, either on a national or a global basis. Are there specific sectors where a particular approach makes the most sense, and if there are, how should we go about getting new technologies and new processes into the market for that sector.

In the electricity sector specifically, we need policies and incentives that will result in companies building the best, most efficient plants they can; retiring old, inefficient plants as expeditiously as possible; and capturing and storing the carbon stream.

We also need national energy policies like the British example – policies that balance our desire for security, growth and affordability with the need to build a diverse portfolio of climate-friendly technologies.

Last but not least, we need to pay attention to adaptation. Because, even with an ambitious strategy to reduce emissions, we're already committed to future changes in the global climate that will pose serious challenges to our natural ecosystems and resources, our economies, and human health. The recent report from the Arctic Climate Impact Assessment made it crystal clear: climate change is happening now. And the nations of the world need to be ready to adapt. ●

Australia's COAL21

COAL21 is an initiative of the Australian Coal Association aimed at reducing greenhouse gas emissions arising from the use of coal in electricity generation in Australia. It is a collaborative, consensus-building programme involving participants from federal and state governments, the coal and electricity industries, and research organisations. A full list of participants can be found at the COAL21 website at **www.coal21.com.au**

Peak oil – 'bottom-up' approach suggests problems begin in 2008

No-one is seriously suggesting that the world is 'running out of oil' just yet – there's quite a bit left in the ground. But what many observers have been saying for some time now is that the point of historical global peak production is probably very close, possibly within a very few years. And the significance of the peak point is that global oil supplies will be in progressive decline from then onwards, with less oil available each year to supply what, until now, has been growing demand. The potential ramifications are enormous and, say believers, imminent.

Energy World *has reported from the 'peak oil' debate several times and here we present two angles on the debate: first, a 'bottom-up' analysis of likely oil production and demand and second, a note on understanding depletion, both by* Petroleum Review *editor* Chris Skrebowski. *On subsequent pages we reproduce material from recent speeches by executives from BP, which take a different tack.*

For background reading on peak oil, see Energy World, *January 2005, April and February 2004, and the website of the Oil Depletion Analysis Centre (ODAC) at* www.odac-info.org

Various approaches have been used in the attempt to determine when 'peak oil' will occur: peak oil being the point when total oil production cannot be expanded further because the losses from depletion more than offset the gains from new fields and new production sources.

The approach used by Chris Skrebowski, editor of *Petroleum Review*, and presented at recent conferences in Edinburgh and Lisbon is to treat visible depletion (when a country produces less oil than the year before, also termed Type 3 – see box) as new demand to be offset against new production flows before demand growth can be met.

According to Skrebowski, the 'visible depletion' can simply be established from any of the sources of oil production data – BP statistical review, the IEA data, production data in the *Oil & Gas Journal*. According to him this is currently running at around 1.1 million barrels/day.

He says that future production flows can be established from a listing of all the larger new projects. Because new projects are quite slow moving (these larger projects are currently averaging 5–6 years from first reported discovery to first oil production) and because they are also well publicised, he maintains we can have confidence that the listing of megaprojects he regularly publishes in *Petroleum Review* is comprehensive.

The final part of the equation is oil demand. The long term average increase is around 2% per year but over the last few years this has speeded up, reaching 3.3% in 2004. The usual explanation being that the industrialisation and rapid economic growth in China and India is now large enough to raise oil demand growth above its long term trend.

By plotting demand, depletion and new capacity (see **Figure 1**) Skrebowski claims to show that peak oil occurs in 2008, an outcome that can not easily be ameliorated because any project large enough to change the outcome, even if started tomorrow would be unlikely to be onstream before 2011. In **Figure 1**, 2008 is the year where 'unmet demand' begins to grow significantly.

In terms of recent changes to the megaprojects listing, the principal differences to the version printed in *Petroleum Review*'s August 2004 issue is the number of projects where start-up times have slipped. Four projects due onstream in 2004 have slipped in to 2005. However, of these, Clair South has already come onstream and the Nowrouz and Soroush expansions are due onstream imminently. The Roncador II project has been delayed to 2006. Project slippage is a recurrent theme that is tending to smear out the forward production profile. Nevertheless, it remains true that relatively few projects are listed beyond 2007/2008.

Analysis of the database shows that the average time delay between discovery and first oil is nearly six years. Onshore projects are rather faster – a major redevelopment of known and existing onshore fields such as the Abu Hadriya, Khursaniyah, Fadhili (AKF) fields project in Saudi Arabia taking two-and-a-half to three years, while a major onshore devel-

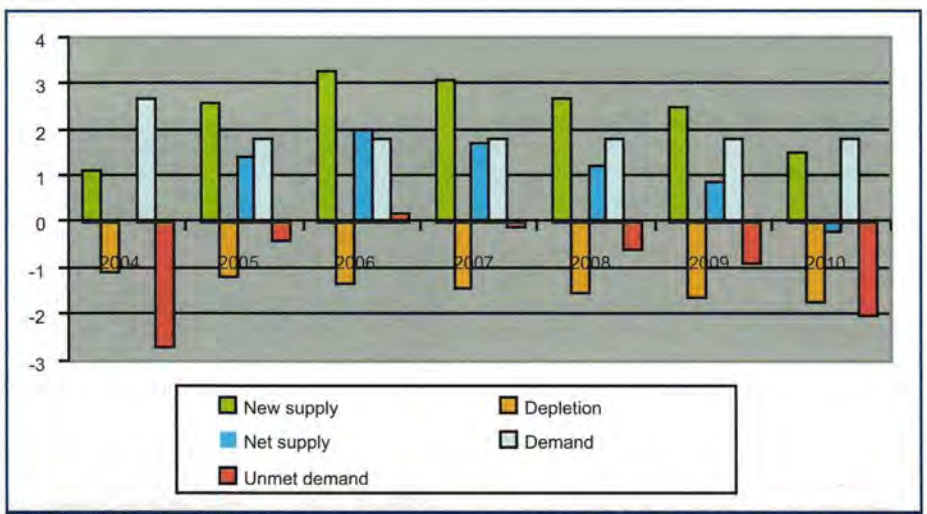


Figure 1. The new supply/demand balances accounting for Type 3 depletion (in million b/d)

opment requiring infrastructure and field delineation, such as the El Merk fields in block 208 in Algeria will take at least four years from the start of the project to first oil. There are, however, few of these fairly rapid projects.

Notably long delays are occurring in West Africa, particularly offshore Nigeria with project times up to seven years (Erha) or even nine (Agbami), while start-up of the ill-starred Bonga project has been delayed again to September/October 2005 – some nine years after its discovery.

A few projects in the database have come in early, but usually only by a few months. The one truly dramatic acceleration is Kizomba B, now due onstream in 3Q2005 rather than in 2006. This is seen as a vindication of ExxonMobil's 'design one, build two' philosophy for this project.

The conclusion, however, is that with most projects taking at least five years to come onstream, likely developments and production flows are unlikely to change much in the period to 2010 and additional projects are unlikely to be onstream before that date.

The listing of 14 possible developments in Opec countries and 28 possible developments in non-Opec countries shows the potential for future production – however, the long project lead times means virtually all of these projects and potential projects will only come onstream after 2010, and most probably after 2012. Projects that are virtually certain to materialise include two, possibly three, deepwater projects offshore Angola; several deepwater Gulf of Mexico projects; and further large-scale development of Canadian tar sands. Similarly, a second phase of Orinoco heavy oil developments may be about to start, with Sincor II reported as being close to sanction. The projects that have a realistic chance of coming onstream before 2010/2012 are those that will utilise some existing infrastructure offshore Vietnam, Brazil and Australia.

The conclusion of the analysis is that, by 2008, there is a significant excess of demand over supply which implies high prices and demand uncertainties. The only way in which such an outcome can be avoided is if demand was significantly lower than simple extrapolation suggests. Significant increases in new capacity or reduced depletion rates, while not impossible, are unlikely. However, significant reductions in demand would imply economic recession or worse affecting a high proportion of the world's consumers. The timescale is simply too short for significant uplifts in efficiency in use to have any impact.

The other conclusion is that the longer 'peak oil' is delayed the more time there is for companies and individuals to adapt and reduce their fuel usage or to utilise alternative fuels and technologies. How disruptive peak oil will be in terms of economic activity and individual's way of life depends entirely on how well it is anticipated and how adaptable we all prove to be. ●

Understanding depletion

Currently, world oil depletion is running at 4–6%, according to ExxonMobil. Taking 5% of 2004 production of 82.5 million barrels per day (b/d) gives a depletion rate of 4.1 million b/d per year. This sounds huge but is in fact correct.

It accords with a presentation given by Klaus Rehaag of the International Energy Agency (IEA) in Rio last year. Another way of looking at it is that 70% of global production is already in decline and is declining at 7% per year. Simple maths: 70% x 82.5 x 0.07 = 4.04 million b/d – close enough.

So, overall depletion is running at a little over 4 million b/d each year at the present time. However, there are three types of depletion.

Type 1 Depletion: is the normal situation in a field where production from some wells is declining and this is being offset by production from other wells or new wells. This sort of depletion has been going on since the first oil field development.

The homely analogy would be that you go into your favourite pub or bar and find that the beer you order is being dispensed from a different tap or beer engine from the last time you were in. Perhaps they're using a different keg or barrel; perhaps they switched pipes in the cellar. You don't really care; you don't have any reason to care. It is the management's business and you're still getting the beer you wanted.

Type 2 Depletion: occurs when a whole field, area or region is depleting but compensating supplies are available from within the same country. An example would be declining conventional oil supplies in western Canada being more than compensated for by rising supplies from offshore eastern Canada and from heavy oil production. This sort of depletion has also been going on since early in the oil industry's history.

The homely analogy here would be that you go into your favourite pub or bar and find that the beer you like is being dispensed from a different bar from the last time you were in. This may be a small inconvenience but you don't really care that much. It is the management's business and you're still getting the beer you wanted.

Type 3 Depletion: occurs when a whole country is in decline, there are no compensating supplies within the country and customers can no longer get all the supplies they require. This means that customers now have to go to an alternative supplier for some or all of their requirement.

This is radically different from Type 1 and 2 depletion because for the alternative supplier this is new and to some degree unexpected demand. In the history of the oil industry it is also a fairly recent development. As late as 1990, only the US and Romania were in Type 3 depletion. Currently, about 18 major producers are in Type 3 depletion, and over 50 if all the small producers are added.

Over the last two years (2003/04) Type 3 depletion was running at around 1 million b/d. However, in the next 2–3 years several major producers are likely to enter Type 3 depletion. These include Denmark, Malaysia, Brunei, China, Mexico and India. This could raise Type 3 depletion rates to around 1.3–1.4 million b/d per year.

The homely analogy for Type 3 would be that you go into your favourite pub or bar and find that the beer you like is no longer available. If you want your beer you need to find a new pub or bar that has supplies. The bar that hasn't got what you want will be reluctant to tell you they've run out, hoping you'll settle for something they have got. They won't be too keen to tell you who might have some either. They're losing a customer.

Your new supplier, when you find one, will be pleased to see you because you're a new customer (new business), but only providing they have adequate supplies for their existing customers and for you.

This leads us to a number of conclusions:

- producers moving into Type 3 depletion will be reluctant to admit it;
- countries moving into Type 3 depletion will be reluctant to admit it;
- Type 3 depletion acts like *new demand* and is probably the underlying reason for much of the recent underestimation of demand;
- Type 3 production decline must be offset each year before any incremental demand can be met; and
- once Type 3 depletion reaches a level that cannot be offset by new supplies, global production decline sets in.

It is not at all clear how well new demand estimates include the demand from Type 3 depletion.

Two immediate problems. You can always brew more beer but, as far as I know, no-one is brewing oil. The other problem is that, according to industry consultants IHS Energy, 90% of all known reserves are now in production. This is another indication that there's little more to come.

So, at some not too distant point the ability to offset Type 1 and Type 2 depletion will be greatly restricted and Type 3 will spiral upwards. At this point supply will really be falling quite quickly, with Type 3 depletion possibly running at over 3 million b/d each year.

Now, a nearly 3% per year decline in supply would be pretty awesome as I can't conceive of any technology or alternative that could offset that for more than a few years. ●

Oil supplies – the view from BP

What is the mainstream oil industry view of oil supplies and the potential for depletion? Several executives from BP have been speaking publicly on the subject recently – below are edited extracts from two speeches, first from Tony Hayward, *Chief Executive, Exploration and Production, and second from* John Manzoni, *Chief Executive, Refining & Marketing. Both were speaking at international events in April this year.*

Sustainable growth in a volatile world – *Tony Hayward*

As we all now know, last year was exceptional in terms of energy demand. The world economy grew at one of its fastest rates for 30 years and oil consumption followed suit. Growth in oil consumption was around three million barrels a day in 2004 as opposed to under one in 2002 and under two in 2003. China was the largest source of this demand growth, accounting for a third of the total.

Supply in 2004 grew by over three million barrels a day, meeting the demand with a little room to spare. Last year spare capacity reduced to around a million barrels a day, less than the level of exports from Iraq or Nigeria. Russia was the largest source of supply growth, increasing its production by 700,000 barrels a day over the year. Important further growth came from Kazakhstan, Equatorial Guinea, Angola and Ecuador. OPEC also responded strongly, especially late in the year as prices surged above $50 a barrel.

Our view is that high prices have been chiefly driven by the strength of demand. The fear of a geopolitical shock, such as war or terrorism, causing a major upheaval in the market should be receding. This is because producers have shown that they can keep energy supplies flowing through crises such as the Iraq war or the aftermath of a major natural disruption such as Hurricane Ivan. The fear that the world is running short of oil and gas resources for the longer term has also been answered by the world's continuing ability to replace reserves. The global replacement ratio has consistently run at over 100% for two decades now. Technology is of course the key to this. Our analysis suggests that the world has enough proved reserves to provide oil for over 40 years and gas for over 60 at current consumption levels.

The real challenge is that of turning reserves into production at a pace and a price that is acceptable to shareholders as well as meeting the needs of customers.

Demand for energy will continue to grow because the world's population is growing - by almost 10,000 people an hour in fact. All of those people need light, heat and mobility – and more and more of them can afford it. The International Energy Agency (IEA) estimates global demand for all forms of commercial energy will rise from the 2002 level of around 205 million barrels of oil equivalent per day to some 290 by 2020, a rise of 40%.

Available evidence now suggests that the immediate pressure is easing. Economic growth in 2005 is likely to be slower than 2004. China's growth in particular appears to have eased a little.

Meanwhile supply is expanding as investments made over the past few years bear fruit. Third party estimates indicate that industry exploration and production spending rose from $100 billion in 2000 to around $170 billion in 2004. 2004 saw an increase of 12% over 2003 – a trend that looks set to continue this year.

In aggregate, non-OPEC production is expected to grow by around 4.5 million barrels a day by 2008. Growth from Russia – the largest contributor to growth of supply in 2004 – is expected to slow somewhat but it will continue to be important as will growth from the Caspian region, the deepwater Gulf of Mexico and Angola. Each of these four areas is expected to add one million barrels a day to production by 2008. OPEC has also shown willingness to supply demand to balance markets and fulfil the needs of its growing populations, and is adding capacity to meet expected demand growth.

In addition it is reasonable to expect that over time government policy in consuming nations will continue to be directed at mitigating demand – driven by both energy security concerns and environmental considerations. ●

Options to build energy security – *John Manzoni*

As well as growing demand, the last two years have seen an increasing concern about the security of energy supplies.

For most of the last two decades the market has operated with around 3 million barrels per day (b/d) of spare capacity. Last year that spare capacity fell to around 1 million b/d – an amount less than is produced in a number of areas where continuity of supply has been threatened by disruptions – including Iraq, Nigeria and Venezuela. There has been no physical shortage, but there has been a fear that a shortage could develop.

It was this reduction in spare capacity which precipitated the increase in the price during last year – and has held it there since. Supply is still growing – but so too is demand. China will need at least another half a million barrels of oil per day this year and India perhaps an additional 100,000 b/d or more.

So although it is impossible to predict what will happen to prices, the tension of supply and demand will remain in the short to medium term and there is very little immediate prospect of a return to the calm of the 1990s.

So short term – the high prices are one cause of insecurity. But there are other longer term factors at work.

If you look ahead over the next decade it is clear that the demand for oil will increase further. On the most recent forecast from the International Energy Agency (IEA) oil demand is set to grow by almost 150% between the year 2000 and 2020. Natural gas demand could grow by 300%.

In the transport sector in particular there are as yet no obvious, commercial viable substitutes for oil. Vehicle numbers are increasing – estimates start at 250 million over the next ten years.

There is no shortage of oil. The best estimates say that there are at least 40 years of supply remaining at current rates of consumption – and that is just conventional oil. There are also heavy oil supplies in places such as Canada and Venezuela and at least 65 years of natural gas supplies.

We believe that non-OPEC supplies of oil will continue to grow as industry continues to explore existing and new basins, and applies new technology to existing fields and new exploration. Over time, and depending of course on other factors including demand and OPEC production policy – this should lead to a more comfortable level of spare capacity and moderation of today's very high prices. ●

Response to Monbiot – less ideology in energy debates

Sir,
I too am fond of Cumbria but, on the balance of evidence and risks, remain deeply opposed to wind farm developments justified by Kyoto 'obligations' and saving the planet – see *Energy World* June 2005.

Having researched climate politics, the associated science debates and highly lucrative research agendas, and the institutional politics of the IPCC since the late 1980s, I see the political driving force of 'decarbonisation' less as the climate threat – a social construct using selected science – than as the recommended solutions. Subsidies and regulations to develop or protect low carbon energy sources provide incentives for political activity. To legitimate such a major shift in public resources, science is misused, especially by environmentalists and parties likely to benefit.

European governments fear having to rely on imports of energy and use climate alarmism, and planetary ethics as propounded by Monbiot, as political tools. While R&D on renewables, energy efficiency, clean coal technology and cleaner and less dangerous nuclear power are indeed needed, the growing reliance of taxpayers' money, regulation and exaggerated climate threats require a serious public debate that is being stifled. Energy supplies made 'profitable' by protective regulation are not likely to be sustainable. A more serious effort to distinguish between science and belief is urgently needed. Wishful thinking is now deeply embodied in computer models that claim to 'predict' future climate. Being based on selected science and controversial empirical evidence, these general circulation models make unreliable policy guides. What has happened to our collective memory about past false forecasts by environmentalists?

We do not face a 'global emergence of climate change'. Climate has always changed. The assumptions that climate is stable is not supported by evidence. One popular and overly simple theory is supported by some evidence, the concentration of some 'greenhouse gases' has been increasing. This is the theory of radiative forcing by greenhouse gases – that these gases control the energy balance of the earth-space system, 'trap ' heat and hence warm the surface, remains contested outside the political statements by 'big science' institutions. At most, this theory is likely to provide a partial explanation and need not be taken too seriously by the energy world. The claim that 'global warming' is dangerous as well as preventable has by now attracted many 'no-regret' and 'win-win' policies. The number of interested parties with a stake in 'global warming' being true and preventable has silenced scientific doubts.

Meteorologists at the UK Hadley Centre make 'predictions' from computer models based on weather forecasting. In this process, some relevant sciences have been sidelined, including geology, biology and solar physics. Major debates which the IPCC is trying to stifle, are also taking place about the assumptions on which future emission scenarios and their social scientific 'story-lines' are based. Climate models run on atmospheric doubling of carbon dioxide concentration, another debatable assumption. The observed trend itself is too short to be statistically significant. We live in a post-glacial era. Glaciers respond to many factors, not just temperature and are subject to retreat as well as advances. If only retreats are reported in the media, a false impression is given. Truth is not a matter of consensus, but emerges over time from debate.

Alternative explanations for the recent warming trend (1998 remains the warmest year) are ignored. They are not the province of the dominant meteorological institutions but emphasise extra-terrestrial influences, especially solar flares and magnetic variations, or the role of water vapour and land-use changes in controlling earth climate. The benefits of warming also tend to be ignored by advocates of 'solutions' and because the climate treaty itself assumes dangerous, anthropogenic warming. An empirically supported science of climate should be able to explain the ice ages and the large climatic changes as recorded in history. Its lack makes climate 'predictions' subject to political bias working via official funding systems and personal belief systems. Two questions remain: what are the causes of climatic change and is humanity able to control climate without increasing the risks to itself, including risks arising from competition over trade and investment opportunities?

'Global warming' has generated a form of political rhetoric which the IPCC, closely linked to the UN, EU and major research agendas, has encouraged and disseminated for a number of reasons, many of which promise competitive advantages to non-fossil fuel interests. Will these promises be kept? Who are the losers? Preparation for adaptation may well be the least risky and most innovative response. It would allow us to test allegedly climate related state interventions in energy markets and innovation systems more carefully for their priority relative to other human needs.

Yours,
Dr Sonja A Boehmer-Christiansen, Reader in Geography, Hull University

A forum for nuclear debate

Sir,
I understand that the Prime Minister and the new Energy Secretary, Alan Johnson, have declared that they will reopen the nuclear debate. Far from being a deviation from our UK energy policy, it is suggested as the only way of meeting our carbon dioxide reduction targets.

I can see no better forum for a definitive debate on the source of energy for power than this publication. I urge readers to supply the information and opinion, for vetting by their peers, in this journal. I would hope that we, The Energy Institute, can then present summary unbiased conclusions for the benefit of the politicians, press and public, after reviewing the arguments for and against each energy form, submitted by our experts.

I write this letter from the middle of the Sahara Desert representing the fossil fuel and combustion industries. Alternatively, as a Liverpudlian, I would be delighted to see a Mersey tidal barrage, (which would render political and employment benefits as well as a long term return on investment). As a Dorset resident (5 miles from Winfrith) I lost the fight with the Council for Pollution of Rural England, who scuppered our local windfarm plans. As a European, one of my recent projects was the municipal solid waste energy-from-waste plant at Valdemingomez near Madrid. It was interesting to compare the pollution levels from internal combustion engines in the city centre (shown on the public information displays), with the gas analysis inside our chimney downstream of the FGC plant. As a rural home owner, I am now embarking on solar panel installation to complement my biomass heating system.

Although each of us may draw our income from one branch of the industry, as a body of energy engineers we are the most informed source of information from all disciplines and should present the pros and cons of all energy sources.

Yours,
Mike Menzies MEI, MD, Kinson Power Ltd, Dorset

Why are energy costs rising?

UK energy costs are increasingly tied to international oil, gas and coal prices, to say nothing of the effects of EU initiatives. E.ON Energy's Peter Haigh *reports on the causes of rising prices, and how customers can react.*

Almost half a century ago, the then Prime Minister Harold Macmillan told the British electorate that they'd never had it so good. Pretty much the same sentiment could have been applied to the post-privatisation UK power market when we were self-sufficient for gas and electricity, and prices were low. Things are now changing and they are changing for a variety of reasons that are beyond the control of individual countries, let alone individual companies. And we at E.ON Energy – part of the world's largest investor-owned energy company and the leading energy retailer to UK industry and commerce – are in a unique position to see and react to those changes.

Until very recently, the UK was in the enviable position of being almost completely self-sufficient for gas and electricity. We had enough North Sea oil and gas to sell on to other countries let alone to cater for our own needs, we had a fleet of coal, nuclear and gas-fired power stations and we had a market that ensured competitive retail prices.

Today, however, we see a very different picture. North Sea oil and gas is running out, many of our coal-fired and nuclear power stations are expected to close in the next decade and retail prices are rising, and rising rapidly. The UK commodity markets are amongst the most volatile in the world and what we are experiencing at the moment are highly volatile gas and electricity markets driven by world commodity prices.

Oil prices affect gas and power prices

Much has been written about the price of oil – which has hit record levels on a number of occasions in recent months. What is important to appreciate is the extent to which oil and gas prices are linked. One obvious example of how oil has impacted gas prices is Iraq, where the war and later insurgency has helped to drive oil prices up. In previous decades the UK might have been able to remain relatively unaffected but now, with less oil and gas coming out of North Sea fields and the UK importing significant amounts of gas from continental Europe, there is a strong correlation between oil and gas prices. This arises because European gas prices are indexed to oil price.

The situation is even more evident on UK prompt (or short-term) markets, where gas is currently the marginal generation fuel. That means that the UK base load of electricity comes from large coal-fired stations and from nuclear stations, with the supply spikes encountered at peak times usually being dealt with by gas-fired stations. That means that spikes – which could, for example, be exacerbated by a very cold winter morning – inevitably lead to very high power prices on the spot market, which is the immediately traded market.

Even coal, traditionally a much more stable commodity, has seen massive changes in recent years. Clearly coal is now sourced worldwide, from countries as far away as Australia and Colombia, as well as from the UK. But the price of coal has been increasing rapidly in recent years, so affecting power prices as well. Demand for coal has risen rapidly, largely driven by Chinese industrial expansion, and that has pushed prices up. In addition, the cost of transporting coal has increased – with the same vessels that transport coal from the other side of the world to European markets being used to transport

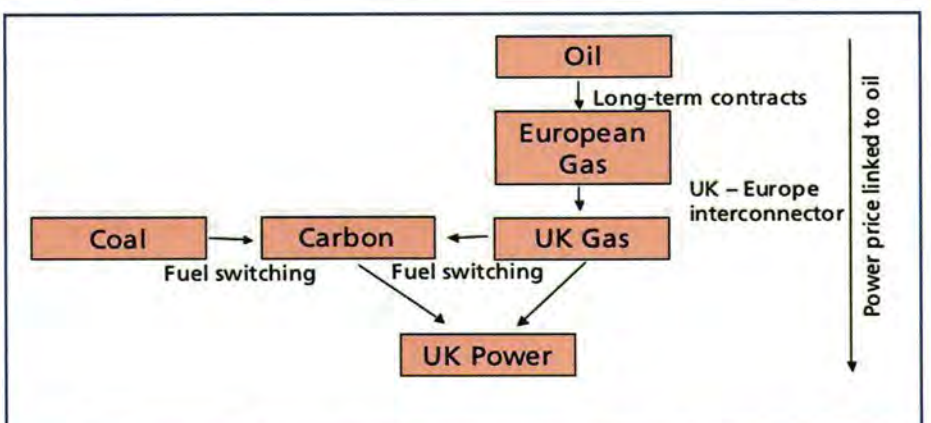


Figure 1: Energy commodity prices are linked – movement in one knocks on to the others

E.ON UK buys Enfield CCGT

E.ON UK has completed the purchase of 100% of the Enfield combined cycle gas turbine (CCGT) power plant. At 392MW, the station will be E.ON UK's fifth gas-fired power station.

The station was bought for £109 million on a debt free, cash free basis, with the long-term gas contract associated with the station already sold to Deutsche Bank.

Dr Paul Golby, Chief Executive of E.ON UK, said: "This is an excellent acquisition for us – Enfield is a modern, efficient CCGT in a strategic location near London. With European directives aimed at reducing greenhouse gases coming in, gas-fired generation is becoming increasingly attractive and this is another step in a long journey to E.ON lowering our carbon emissions. Investment in gas-fired generation, combined with our extensive renewables business, means that we're reducing our emissions as well as planning for the future to ensure we help keep our customers' lights on."

Enfield, which was commissioned in December 2002, employs 30 staff, who have transferred with the station to become part of the E.ON Group. ●

other commodities, such as bauxite, further pushing prices up. It has now even become difficult to source transport vessels for international coal, and that is before cost comes into the equation.

Emissions trading, plant retirement

A new factor in the cost of electricity is the new EU emissions trading scheme, which came into force on January 1 this year. The scheme aims to reduce carbon emissions by giving companies allocations for the amount of carbon dioxide they can emit, with those allocations being below the volume currently emitted. That means that a coal-fired power station that ran for several thousand hours in 2004 will either have to cut its running times in 2005, so potentially pushing power prices up as supply reduces, or it has to buy allocations from other companies, again applying upward pressure to prices.

So, the reasons for higher power and gas prices are clear but they also need to be put in context, especially when you consider that billions of pounds need to be spent by gas and electricity companies on essential infrastructure. We estimate that around 40% of the UK's power stations will be shut by 2015 through a combination of nuclear retirement and EU initiatives such as the EU Emissions Trading Scheme and the Large Combustion Plant Directive, which aims to reduce sulphur emissions. We also estimate that it will take up to £70 billion to build the new power stations and the new gas and electricity infrastructure we need to ensure the lights remain on.

As it stands today, it is clear that it is only through this massive investment that our energy infrastructure – our power stations and electricity cables, and our gas pipes – will cope for the coming decades. However, we are in the position where the current difference between gas and electricity prices is so small, that no-one is investing in new generation capacity other than wind farms (and only then because they have their own market under the Renewables Obligation).

Purchasing strategy

Having painted a relatively bleak picture of the reality of the energy market, it would be remiss of me to suggest that there is nothing anyone can do in a volatile market and a background of rising prices. Clearly any responsible company needs to work with its customers to help manage rising energy costs in what is a rapidly changing market.

E.ON Energy's B2B Business is uniquely structured into four targeted channels: major accounts, groups, strategic accounts and SME (under the Powergen brand). And, we are the only UK supplier that trades all commodities in one integrated trading hub.

E.ON, partners apply for wind farm consent

CORE Limited, E.ON UK Renewables and Shell WindEnergy Limited have said that their consortium, London Array Limited has submitted consents and planning applications for the London Array offshore wind farm project.

If built, the wind farm could generate up to 1,000 MW of renewable electricity, equivalent to the household demand of Kent and East Sussex combined, or a quarter of greater London homes, says the consortium. The wind farm will also avoid emissions of up to 1.9 million tonnes of carbon dioxide every year and could make up to 10% of the UK Government's 2010 renewables target.

London Array is the first of the Round 2 UK offshore wind farm projects, awarded leases by the Crown Estate in December 2003, to apply for consents. The applications come after an extensive consultation process as well as comprehensive technical and environmental studies.

The full development, costing up to £1.5 billion, will require up to 270 wind turbines to generate 1,000 MW and would connect into the National Grid's transmission system in Kent. The turbines would be located in the outer Thames Estuary, more than 20 km offshore and equidistant from the coasts of Essex and Kent. Due to the distance of the wind farm from the shore, there is expected to be little visual impact from the coastline.

If consents are granted (by national and local government officials), the construction programme envisages London Array being built in up to four phases. The first phase would be commissioned in 2008, and it is hoped that all phases would be complete by 2010/11. The consortium is hoping for consent to be granted in 2006 to achieve the proposed construction programme. ●

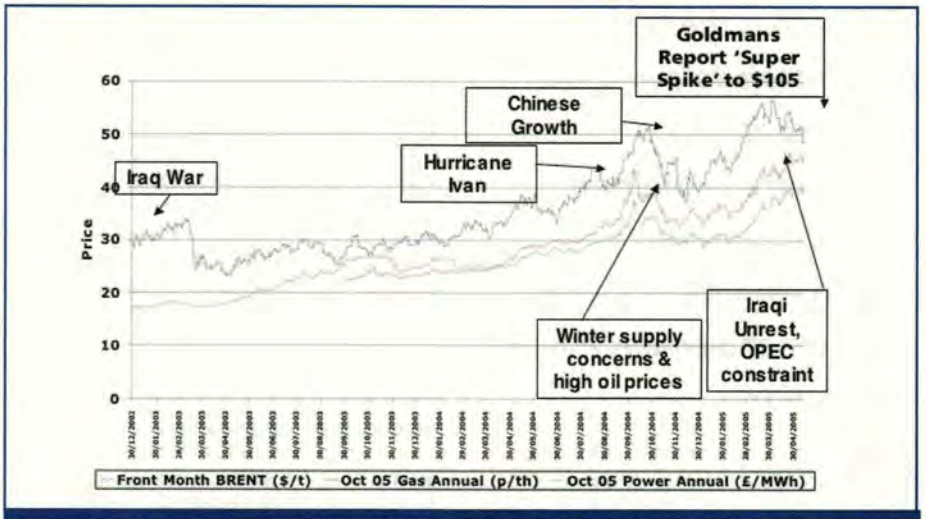


Figure 2: Tightening global supply/demand balance for oil has fed through to UK gas prices and therefore power prices

In addition, being part of the E.ON Group means our customers can benefit from added pan-European gas and electricity expertise, as well as by being part of a larger European supplier. For our pan-European customers, we can provide a global purchasing strategy helping them to reduce their energy procurement costs across European markets. Understanding European market drivers is becoming increasingly important in the UK.

Having said that, as the UK's largest conventional generator and one of the biggest electricity distributors and retailers, we also have an unrivalled expertise in UK energy markets and we can share that expertise with our customers. We are committed to building long-term relationships with our customers and offer a wide range of innovative and flexible energy solutions.

In a background of rising prices, we believe that energy buyers simply cannot sit and wait for prices to go down. Energy markets are changing quickly and the management of their energy risks is crucial. This requires buyers to develop an appropriate purchasing strategy for their business. However, changing buying approach is not always easy and customers need to work closely with their suppliers. A good price, combined with gas and electricity expertise and a working relationship with the right supplier, is key for businesses. ●

Peter Haigh is Director of B2B Business, E.ON Energy, **www.eon-energy.com**

Brave new emissions trading market

Power stations, such as the Arrubal power plant built by Siemens Power Generation in Spain, are important players in the EU Emissions Trading scheme

A proactive and systematic approach is the best way for emitters to avoid the real risks of non-compliance in the new world of EU carbon trading, argues Dr Geoff Harrison *of Siemens Power Generation.*

Operating within the EU Emissions Trading Scheme is likely to prove challenging for many carbon emitters. Although some installation operators, new to carbon trading, are adopting a 'wait and see' approach, we believe it makes much better business sense to be prepared.

Operators of installations that fall within the scheme must now have a permit to emit carbon. Moreover, they must ensure that these emissions are monitored strictly in accordance with their approved monitoring and reporting plan. Then the emissions must be independently verified and submitted to the national Registry (DEFRA in the case of the UK) by 31st March each year, starting in 2006. If emitters do not do so, then their carbon allowances 'account' will be frozen and ultimately they will be subject to determination of their emissions by the Regulator and other severe penalties.

To achieve the all-important verification, all source data and supporting material must be stored in a secure environment with a complete audit trail. Once verified, the data must be locked down to prevent any modifications and then must be archived for 10 years.

To achieve compliance, each emitter must surrender allowances sufficient to cover the verified emissions by the 30th April each year. If they don't, they face a penalty of €40/tonne in the first three years of the scheme, rising to €100/tonne in 2008.

To avoid these penalties, emitters who have insufficient carbon allowances to cover their emissions during the compliance period will need to buy additional allowances on the open market.

Taking risks

Some emitters have decided that if they exceed their allowances then they can simply purchase them on the open market at the end of the compliance period or even pay the fixed penalties, whichever is lower at that moment. They reckon this is a smaller price to pay than investing money and effort in continuous monitoring, reporting and verification. We firmly believe this is a short-sighted and risky strategy for the following reasons.

First, even though installation operators might decide to pay the penalties, this does not 'clear the debt' of their obligations – they are simply carried forward into the next compliance period.

Second, this is a new market and no-one knows what the open market price of allowances will be as the first compliance period draws to a close. As we write, the price is about €20/tonne, an increase of €13/tonne on the previous three months, and could well end up even higher by March 2006. Or it might be much less. But what we can safely predict is that there will be a marked price change at the end of the first phase of the scheme – December 2007 – as allowances cannot be banked into the next phase, whilst any undischarged obligations will be carried over. All this means that companies who find they need to purchase allowances could have to do so when the price is highest.

That is why they should set up proper emissions monitoring and forecasting systems to minimize their risks and liabilities as they would for any other aspect of their business. The need to do this becomes obvious when we consider that now, about 45% of the cost to produce one MWh of power by burning coal is derived from the price of emitting carbon. Although gas is cleaner, the carbon dioxide cost still amounts to around 22% of the total cost of producing one MWh.

Third, there are more risks in failing to obtain verification than many emitters suppose. As we have said, failure to submit a verified emissions report by 31st of March 2006 will result in blocking of transfers on a company's emissions account. If the problem is not resolved before the compliance deadline of 30th April, the national Registry will impose the penalties. As a result, the operator's compliance position may not be finalised, possibly resulting in qualified company accounts – a very serious position for any company.

Fourth, as well as a financial penalty, the Registry will be obliged to publish a list of defaulting companies. This would damage the environmental credentials of those companies named and could undermine investor confidence because of the proven link between corporate reputation and share price.

Develop a strategy

Having addressed the challenges of compliance, the financial impact and the risks, emitters should develop a corporate strategy to improve their compliance

prospects. Here are some guidelines.

- Install business processes and IT solutions to monitor carbon emissions and track allowance holdings continually. Tools now exist to predict future emissions, based on the emitter's production forecasts and combustion processes. This means that organisations can better plan if they need to purchase allowances to make up any predicted shortfall.
- Actively manage existing plant to optimise overall production costs including fuel, material and carbon costs.
- Invest in cleaner technologies. Gas is an obvious example but emitters should also consider using renewable fuels and biomass for combustion. Done effectively, organisations will be able to increase production output without exceeding their carbon allowances. There is another benefit to be exploited: corporate reputation is enhanced if an emitter switches to cleaner fuel.

Organisations can gauge their level of readiness for the EU ETS by answering these questions.

- Have you a mechanism in place to continually assess the market price of allowances, so you are minimising your cost of compliance?
- Do you know your overall carbon emissions level at all times? To do this you need procedures in place to gather the material and fuel data to make these calculations.
- Is your data secure and verifiable, containing all evidential material to support each of your production sites' annual submission to the Registry? This means much more than logging your gas or electricity bills, it means all production documentation including calibration certificates.
- Are you able to transform your production and business planning data into a future liability in your compliance plan? You must be able to re-assess your compliance position if your business or production plans change.
- Are individuals responsible for executing and supporting these business process changes?
- Do you have the skills in your organisation to meet the rigorous demands of compliance? If not, will you outsource to external compliance consultants or will you use an external software solution? You must focus on a complete, 'joined-up' solution.

Who is most prepared?

The power generators, oil processors and any organisation involved in energy trading are already familiar with the concepts of the scheme and are prepared to take a proactive role in a new commodity marketplace. Other organisations are taking a 'wait and see' approach. In some cases there are good reasons for this, for example because they hope that the existing Climate Change Agreements (CCAs) between the UK government and their representative trade associations will enable them to opt out of the EU wide scheme.

DEFRA has made an application to the EU on behalf of those companies that wish to opt-out on the basis of their CCAs. However, the industry consensus is that the new ETS is a much tougher trading regime in which every installation is individually liable for its own emissions and allowances. This contrasts with CCAs, under which emitters may only have to meet sector targets and where much of the administration is carried out by the trade association. For this reason, an opt-out may not be offered.

Our advice, therefore, is to not rely on the possibility of opt-out and to get ready anyway. It's true that preparations for the new EU ETS will certainly be costly and complex, but the cost – and not just financial – of non compliance will be much greater. ●

***For more information, contact Helen Plowman, Marketing Manager, Siemens Power Generation, Instrumentation Control and Information Systems, e:* helenplowman@icistechnology.com**

Siemens emissions compliance management system

Siemens Power Generation has developed a unique, end-to-end service for emissions monitoring, reporting and allowance management of carbon dioxide emissions. At its core is a powerful but easy to use software package 'Emissions QuickStart', which meets the requirements of the EU Emissions Trading Scheme for carbon dioxide emissions and can handle all Kyoto unit types.

The software is available to users either as part of a real-time managed bureau service, accessed via a PC and internet browser, or as a self-managed package available under licence. The bureau facility, the first of its kind in the UK according to Siemens, is particularly suitable for organisations, for example in the manufacturing or processing industries, that have limited expertise in-house or who do not wish to make a major capital investment at this point. All the users have to do is to enter the plant's fuel data and rest is done for them. This means the burden of maintenance, service and upgrade costs are a thing of the past. Instead the solution is offered on a fixed monthly fee basis.

Siemens expects major emitters such as power generators to favour the licensing option because of their greater experience in carbon trading. Either way, users can enter raw fuel and materials consumption data manually or automatically and from there Emissions QuickStart calculates its carbon emissions.

Reporting and forecasting

It also performs the reporting and compliance procedures required under the EU scheme. This includes forecasting the user's allowance position to the end of the compliance period, enabling the user to make an informed decision on the best moment to purchase any necessary allowances, because their price is likely to vary over time. Moreover, Emissions QuickStart tracks their ownership as they are traded and can communicate with any national emissions Registry in order to complete the allowance trading reporting cycle, says the company. The software package will present a subscriber's reconciled data in exactly the right format for each national Registry, making report generation an automated task.

The package holds an exact copy, in real time, of the user's Registry account(s). It tracks all the user's allowance transactions and will automatically notify the Registry as they take place. Likewise Emissions QuickStart will inform the user when the certificates have been transferred into their account at the Registry and update its own balance accordingly.

The software can make trading between plants owned by the same company very easy too; it will perform the banker role as usual and report the transactions to the Registry when complete.

Easier verification

There are two main features of the EU ETS independent verification process. The first is the checking of the monitoring and calculation methodology and reporting emissions on time to the Registry (to avoid penalties), and the second is to ensure that the organisation has enough certificates to cover its current and future obligations under the scheme. Emissions QuickStart simplifies both parts of the process. It provides an audit trail, noting every update in data entered so that the independent verifier has a complete log to review the emissions monitoring procedures. It then gives the organisation its current account balance in terms of emissions allowances to check if they cover the volume of carbon dioxide emissions actually made.

Emissions QuickStart can be fully integrated with other systems like trading and risk management products or with accounting packages, says Siemens. Certificates are expected to be valued like any other company asset and will appear on balance sheets.

A new version, due later in 2005, will monitor emissions from any process-based unit of production, rather than just combustion. ●

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Energy Services Coordinator Required

Up to circa £35,000 p.a. salary, plus company car.
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CVs to & further information from – Steve Howe.
Email : line6@energy121.com [Agency.]

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to 15.5°C base temperature

	Region	Mar 2005	Apr 2005	May 2005
1	Thames Valley	232	159	104
2	South East England	262	184	130
3	South Coast	249	180	119
4	South West England	236	183	132
5	Severn Valley	247	175	119
6	Midlands	262	201	133
7	West Pennines	257	219	154
8	North West England	260	223	148
9	Borders	274	235	169
10	North East England	265	223	152
11	East Pennines	259	203	139
12	East Anglia	280	189	144
13	West Scotland	266	232	180
14	East Scotland	274	232	186
15	North East Scotland	240	243	195
16	Wales	292	203	155
17	Northern Ireland	248	224	172
18	North West Scotland	276	238	215

ei awards 2005

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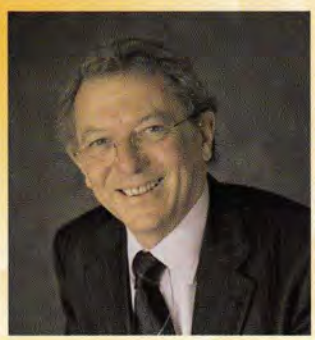
EI Summer Luncheon

Tuesday 12 July 2005, Royal Automobile Club, London
Drinks reception: 12.15, Lunch: 13.00

Guest of Honour and Speaker
***Sir David King*, Chief Scientific Adviser to HM Government and Head of the Office of Science and Technology**



Price: Members – £80.00 (+ VAT £94.00)
Non-members – £90.00 (+ VAT £105.75)

The EI Summer Luncheon is now an established date in the Energy Institute's calendar of events.

This event has been designed to provide guests with a fantastic opportunity to network with colleagues drawn from across the UK's energy spectrum.

In addition, the Summer Luncheon has developed a reputation for attracting leading industry figures to provide their analysis and commentary on current market conditions and the 2005 Luncheon is no exception!

To apply for tickets, please complete this form in BLOCK CAPITALS and return it to the address below, together with payment in full.
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t: + 44 (0) 20 7467 7106, f: + 44 (0) 20 7580 2230, e: arabella@energyinst.org.uk

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Credit card holder's name and address:

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For more information and table bookings please contact:
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Ticket price includes pre-luncheon drinks, and 3-course lunch with wine. Cigars and liqueurs are not included.

In the event of cancellation of attendance by ticket purchaser a refund, less 20% administration charge of the total monies due, will be made provided that notice of cancellation is received in writing on or before 13 June 2005. No refunds will be paid, or invoices cancelled after this date.

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