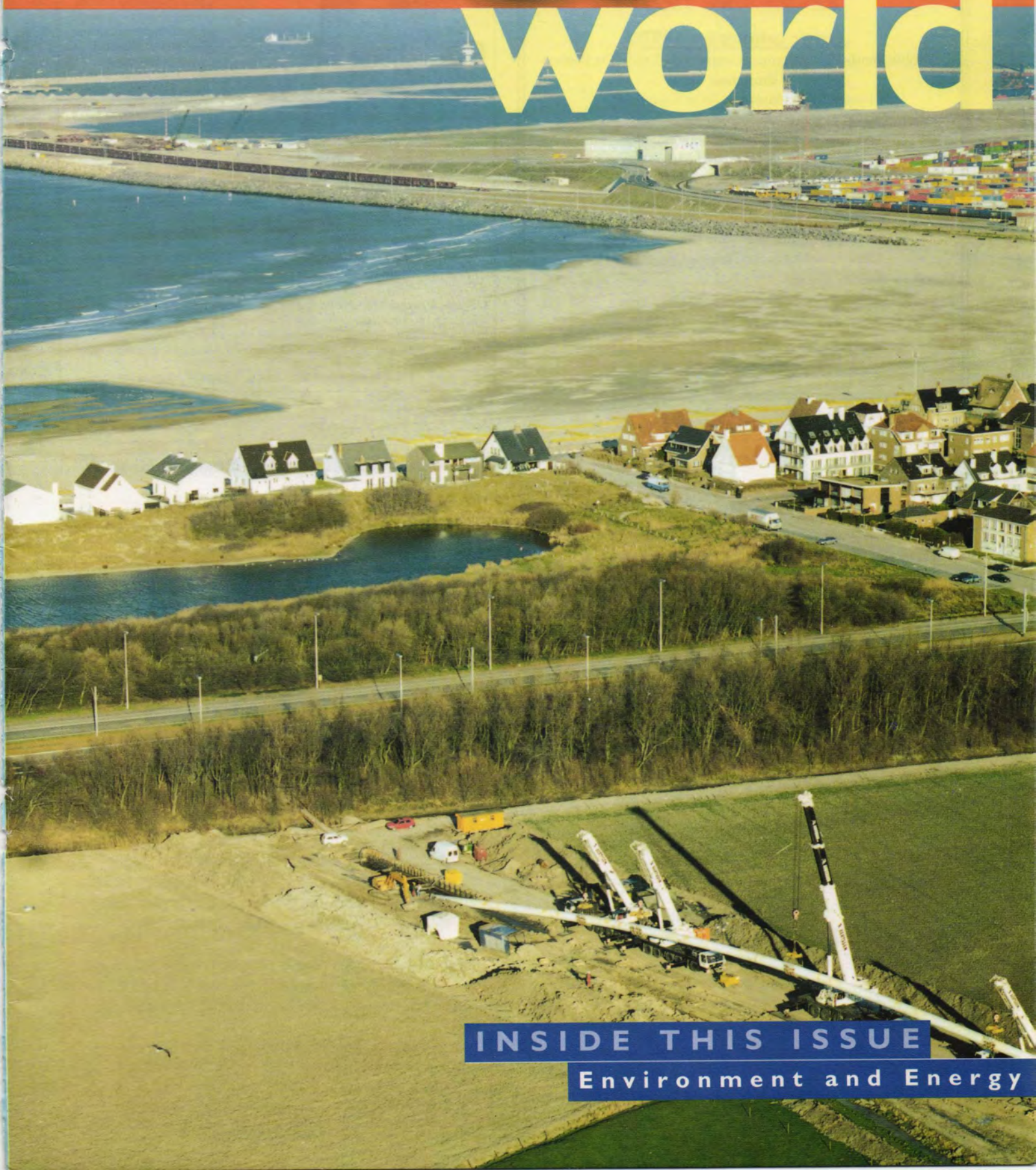
THE MAGAZINE OF THE INSTITUTE OF ENERGY

energy world

the institute of energy

No.246 February 1997



INSIDE THIS ISSUE

Environment and Energy

THE UNIVERSITY OF LEEDS
Department of Fuel and Energy

SHORT COURSE and EXHIBITION
CFD in Combustion Engineering
3 - 4 March 1997

Combined Heat and Power: Technology and the Environment
22 - 23 April 1997

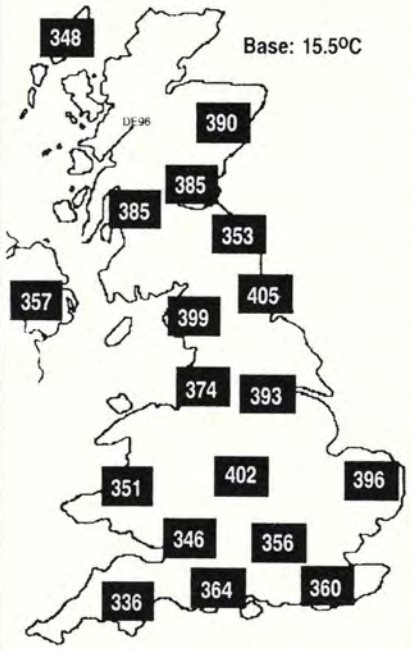
Other courses for 1997

Combustion Instrumentation, Control and Low NOx Burner Emissions
Diesel Particulates and NOx Emissions
Emissions Monitoring Exhibition
Engine Emissions Measurement
Explosion Prediction and Mitigation
Fire and Explosion
Incineration of Municipal Waste with Energy Recovery
Industrial Air Pollution Monitoring
Spark Ignition Engine Emissions
Ultra Low NOx Gas Turbine Combustion

Further details from:
Jamie Strachan, Dept Fuel & Energy, Univ Leeds, LS2 9JT
Tel: 0113 233 2494 *Fax:* 233 2511
Email: shortfuel@leeds.ac.uk
World Wide Web: http://www.leeds.ac.uk/fuel/shortc/sc.htm

DEGREE DAYS: DECEMBER 1996

Source: **Degree days direct**



These regional figures, calculated from daily outside air temperatures, provide an index of demand for space heating over the month and thus enable excessive consumption to be detected.

A well-controlled heating system should manifest a straight line relationship between monthly fuel used and the local degree-day value; any significant deviation from this 'target characteristic' is likely to signal the onset of avoidable waste (such as a stopped timeswitch or an open isolating valve).

Readers can get more information on the use of degree days from Vilnis Vesma, 8-10 Church St, Newent, Glos GL18 1PP (01531 821350)

 Note: the figures given here have been calculated to correspond as closely as possible with those published by government sources. However, because of differences in observing stations, close agreement cannot always be guaranteed.

http://vesma.com/ email: ddd@vesma.com

The Institute of Energy goes 'live' on the net

We now have a permanent website address, on The UK energy centre's site. We would like to thank Entech who are one of our group affiliates for the design of these pages.
www.instenergy.org.uk

If you want to contact us electronically please make a note of these email addresses:

Executive Secretary
jleach@ioe.org.uk
Deputy Executive Secretary
levans@ioe.org.uk
Projects & Marketing Dept
lcollins@ioe.org.uk
madams@ioe.org.uk
Accounts
djsmith@ioe.org.uk
Education & Training
cpavey@ioe.org.uk
Membership
ppowell@ioe.org.uk
General Enquiries
info@ioe.org.uk

We look forward to hearing from you

South Wales & West of England Branch

24th Idris Jones Memorial Lecture

CARDIFF CASTLE
FRIDAY, 21 MARCH 1997

"The Energy Market
The story so far and the road ahead"
Dr Brian Count PhD, MA (Cantab)
Operations & Technology Director,
National Power plc

The Lecture will be held at 11.00am (coffee & reception at 10.30am) and will be followed by the Branch Annual Luncheon at 12noon for 1.00pm.

Admission is free to the lecture but those wishing to attend should apply for tickets. Tickets to the luncheon are priced at £8.00 per head inclusive of coffee and pre-lunch drinks.

Apply in writing & enclose cheques made payable to The Institute of Energy, to Mr David Suthers, 2 Danybryn Close, Radyr, Cardiff, CF4 8DJ

Sponsored by: National Power plc, Aberthaw Power Station

THE MAGAZINE OF THE
INSTITUTE OF ENERGY

Contents

PUBLISHED BY
THE INSTITUTE OF ENERGY
18 Devonshire Street, London W1N 2AU.

Editor
Steve Hodgson
Tel/Fax: 01298 77601

ADMINISTRATION
0171-580 7124

MEMBERSHIP, AND JOURNAL SUBSCRIPTIONS
Tel: 0171-580 0077 Fax: 0171-580 4420

ART EDITOR
Louise Collins

DESIGN
Steven Stoner, X-Design
0181 948 2405

ADVERTISEMENT SALES
RGO Exhibitions & Publications Ltd
Pam Bourne Tel: 01424 883110

PRINTED BY
Headley Brothers Ltd, The Invicta Press,
Ashford, Kent

THE INSTITUTE OF ENERGY

PATRON
Her Majesty The Queen

PRESIDENT
P H Johnson CEng, FInstE, FIEE, FIMgt

Hon Secretary
Dr P J Mullinger

Hon Treasurer
M B Pittwood

TERMS OF CONTROL
Energy World is circulated free of charge to all paid up members of The Institute of Energy. To libraries, organisations and persons not in membership it is available on a single subscription of £70 (UK), £80 (overseas) for 10 issues.

ISSN 0307-7942

COVER

The UK - Continent Gas Interconnector - laying of the Zeebrugge section of the Interconnector was completed in December. The proposed pipeline, which will link the UK's gas distribution network with Europe for the first time, is due to deliver its first gas in 1998. The cover picture shows a section of 40 inch diameter polypropylene-coated pipeline being pulled into a hole drilled horizontally under the Fonteintjes nature conservation area (with lake) towards a tie-in point on the beach west of the port of Zeebrugge, Belgium.

See next month's issue for an update on the project.

Clean coal deserves support too

The UK is well placed to be able to help in the improvement of the use of coal in developing countries and by doing so will continue to keep alive a knowledge base which might otherwise not be available when the time comes to build plant with improved environmental performance.

In any balanced appreciation of the future global needs of resources to sustain human life at an acceptable standard, it is accepted that the supply of energy will need to be considerably greater than at present. Most analysts agree that even if energy consumption in industrialised countries can be contained at levels not much above the present, the increased demands of developing countries will continue to rise. By the second decade of the next century, energy consumption in the developing world will surpass consumption in the industrialised countries of the OECD.

Professor James Harrison
Past President

There is no doubt that in most countries presently becoming industrialised, especially those struggling with the problems of development and those tackling problems associated with the misery, ill-health and poverty of increasing numbers of people, the prime concern for energy is to increase its supply and its reliable distribution at lowest cost while making the maximum use of indigenous resources. Electricity production is central to these requirements and in the next 25 years is expected to rise by 6% per annum in developing countries. A recent commentator has expressed this as a new 250 MW power station being built every 33 hours and most of these will be fuelled from coal.

In fulfilling these future needs for electricity coal will have to be used in ways which satisfy the improved environmental criteria which are being evolved by governments and funding agencies. This will also be a requirement for coal used for other energy needs, such as steel-making and industrial heat supply. The present methods of using coal in inefficient domestic and industrial furnaces are responsible for levels of pollution in some developing countries which would not have been tolerated here in the worst days of industrialisation. There is an urgent need for these practices to be corrected and improved, clean coal, equipment to be installed and properly maintained.

The 'invisible' fuel

In industrialised countries coal is in many ways the invisible fuel, because much of it is used for electricity generation away from centres of population. In the UK, for example, it is commonly thought that we no longer have a coal industry and no longer use coal, although in fact as well as that used to make steel and cement considerable tonnages are still used for electricity production (some 60 million tonnes in 1995), and coal will continue to contribute to a diversified supply, albeit at a lower level. In the world at large, coal presently supplies over 40% of the electricity produced and will supply many of the new stations required, especially in countries such as India and China and countries of central Asia and Indonesia

Alongside the 'invisible' coal industry there is also in the UK an invisible body of scientific and technological expertise on coal and on a range of clean coal processes, including domestic and industrial processes and two advanced processes for power generation, one developed by British Gas the other by British Coal. This expertise is kept alive by enthusiasts in industry and the universities and is supported by a modest level of funding from industry, the Government, the European Commission and from international sources co-ordinated by the International Energy Agency.

UK clean coal research

The UK is unique in having established a Coal Research Forum, jointly supported by industry and academia, which has brought about a close interaction over a wide range of research projects. The UK hosts two coal-related projects for the IEA. One of these serves the world in supplying and appraising technical information on coal and the other concentrates on the development of technologies specifically to deal with the perceived problem of carbon dioxide emissions. The support from the European Commission has enabled work to continue until recently on the proving of equipment related to the advanced clean coal electricity process based on the air-blown gasifier of British Coal.

These activities in the UK help to support those in industry and consultancy who are deploying their expertise in helping developing countries to bring the benefits of increased coal use to their peoples while reducing the environmental, and sometimes social, impacts to levels acceptable in developed nations. It is to be hoped that the benefits of Governmental support at the research level will continue to be recognised, but consideration should also be given to supporting a further stage of the development of the Air Blown Gasifier, now being led by private industry. This would be a spur for overseas activities but would also be an insurance policy for the UK itself when the time comes for new coal-fired power stations to be built and more stringent environmental standards met.

In the medium term the practical environmental benefits from clean coal technology could well be greater than from renewable energy. It would be a welcome first step if the favourable treatment presently given to renewables projects for power production, including financial assistance to aid their introduction into the market, could be extended to the newer clean coal processes so that experience can be gained in this country, as it is in other industrialised countries.

Wind developer wins EU joint venture cash

A British energy company has been granted EU funds to develop a wind farm in the Czech Republic. Border Wind Ltd intends to expand production facilities and new market opportunities for its wind, solar and hydro renewable energy equipment and expertise through a bridgehead operation. The EU funds - in this case a six figure allocation, one of the highest possible - were made accessible by the Cranfield Joint Venture Programme.

EU funding of up to ECU 1 million (around £800,000) is available for firms planning to set up or expand joint ventures, in Eastern Europe as well as Asia, Latin America, the Mediterranean region, the Middle East and South Africa. The Joint Venture Programme helps companies cut through the red tape involved in applying for aid to develop partnerships abroad.

The programme offers:

- free assessment of eligibility for aid,
- help in the search for a suitable partner,
- completion of the application form,
- any assistance qualifying firms may need to set up or expand their joint ventures.

"One phone call enabled me to decide whether it was worth applying," said David Still, Border's MD. "It is evident that a great deal of judgement is involved in securing funding, even for a worthy business like ours. Cranfield helped to clarify our thinking and then articulated it, on our behalf, in a way that clearly found favour with the bureaucrats in Brussels."

Companies wishing to take advantage of the programme should contact Elaine Beal, Joint Venture Programme, Cranfield School of Management, Cranfield, Bedford MK43 0AL, Tel 01234 751122 or Fax 01234 750350.

"Caspian's old black gold needs British alchemy" *Lord Fraser*

"The new oil 'Middle East' - the Caspian region of the Former Soviet Union - must be top of the agenda for companies in the oil and gas industry who seriously want to make their mark internationally," according to Energy Minister Lord Fraser of Carmyllie.

Speaking at the Caspian Oil and Gas Conference, Lord Fraser continued: "Estimates of reserves in the Caspian region - up to 200 billion barrels of oil and 7.5 trillion cubic metres of gas - put it on the same scale as the Middle East as one of the most prolific oil and gas development areas of the world. It is also among the oldest.

"Tradition has it that the first oilwell was dug in Baku in 1594 and the first modern well was drilled there in 1884, 11 years before the first American oilwell was drilled in Pennsylvania. But modern development is needed now, particularly to rehabilitate existing production facilities.

"Fortunately, the UK has the expertise and leading edge technologies to meet this need, so I was very pleased that the UK group at the Caspian Oil and Gas Exhibition in Baku earlier this year was the largest with around 50 of the 180 companies exhibiting there.

Lord Fraser has since embarked on a visit to Baku, Azerbaijan, with a team of British oil and gas industry specialists.

"UK suppliers have had considerable successes already: winning about 80% of the contracts from Chevron's Tengiz project in Kazakhstan; British Gas is jointly developing the giant Karachaganak gas condensate field there; McDermotts are studying the development of the North East Caspian: and BP is involved in the exploitation of Shakh Deniz in Azerbaijan.

"Another example is the role of BP in the Azerbaijan International Operating Company which was established to operate the agreement for the development, over a thirty year period, of the Chirag, Azeri and the deep water portion of the Guneshli oil fields, estimated to contain four billion barrels of light crude. Clearly, development of the Caspian region offers immense opportunities for the UK and is a place where we can and must do business."

Peru and Bolivia are opening up new opportunities for British companies, added Lord Fraser before leaving on a five day visit to the region. A recent agreement has been signed between Shell and Mobil to co-operate on the US $4 billion Camisea natural gas project in Peru. In Bolivia, work is going ahead on a number of gas pipeline projects to Brazil and Paraguay, and the privatisation of the state oil company, YPBP, is due next month. Also, Peru and Bolivia have both waged successful battles against hyper-inflation in recent years, and enjoy healthy increases of economic growth, foreign investment and trade.

ABB wins $500m oil refinery contract for India

International engineering company ABB has won a contract valued at over $500 million to build one of India's first private sector oil refineries. The contract was placed by Essar Oil Limited, and covers the supply of equipment and materials for the Essar Refinery presently under construction at Jamnagar, in the western part of India in Gujarat State. Under a separate contract, ABB is also responsible for the overall project management in the construction of the entire refinery complex.

The refinery is being built on a greenfield site and is designed to produce 9 million tonnes of refined oil per year. The customer, Essar Oil Ltd, is a member of the Essar Group, one of India's largest business houses with assets exceeding $ 3 billion and with wide engineering interests, including power, oil and gas.

'Trigeneration' cooling system for downtown Kansas City

Buildings in downtown Kansas City are to be served with centrally-generated heating and cooling from a "trigeneration" plant to be built in the city.

The US-based Trigen Energy Corporation has announced that its subsidiary, Trigen-Kansas City, has received letters of intent from the City of Kansas City, Jackson County, Missouri, and the General Services Administration (GSA) to purchase chilled water for eleven buildings in downtown Kansas City, Missouri which are owned by these government entities. Trigen is proceeding with the detailed design of the system while working with the three government entities to finalise terms of the contract. Contract signing is expected this month.

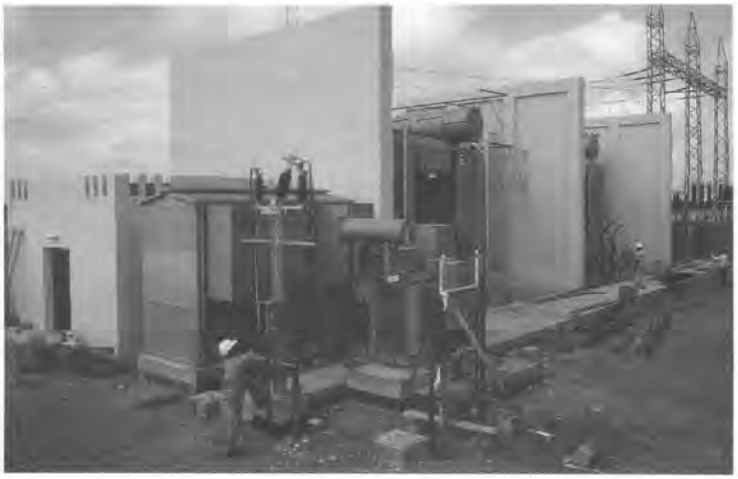
Trigen plans to break ground in early spring and begin serving the cooling needs of the government buildings in the second quarter of 1998. In addition to these anchor buildings, government and private buildings are expected to be connected in the short term, with additional buildings added during the ensuing two to three years. Trigen's total investment in the system is expected to reach $25 million by the year 2000.

Trigen-Kansas City emerged as the winner in a bidding process that began with the submission of qualification statements from Trigen and four other firms last February. The City, County, and the GSA have been advocates for the development of a central chilled water infrastructure in downtown Kansas City since Trigen first introduced the idea in 1990, when it acquired the downtown district steam system from the local electric utility. The City, County, State and Federal GSA joined forces to select a qualified developer, offering their cooling loads as the anchor for a new system to serve the entire central business district and to further the process of economic development of the downtown area.

District heating and cooling services allow new buildings to save construction and operating costs. District energy allows older buildings to avoid the expense of replacing ageing cooling equipment, most of which contain chlorofluorocarbons (CFCs), which have been banned from further production in the US by the Clean Air Act. The higher efficiencies inherent in a centralised energy system will result in substantial reduction of the air pollutant emissions caused by individual building cooling systems. This will help Kansas City to maintain its status as the largest city in the country within the clean air requirements of the Environmental Protection Agency.

Trigen is the leading commercial owner and operator of district energy systems in North America. It currently serves more than 1,500 customers at 13 locations including industrial plants, electric utilities, commercial and office buildings, government buildings, colleges and universities and hospitals.

Leicester based Cressall Resistors has designed and built neutral earthing resistors to protect a substation in the Sultanate of Oman from damage caused by earth faults. Two 33 kV neutral earthing resistors (NERs) have been installed at Sohar, a 132-33 kV substation located on the coast of the Indian Ocean about 150 miles north-east of the capital, Muscat. The installation, with a contract value of £55,000, was carried out on behalf of the Omani Ministry of Electricity and Water. Should an earth fault occur, an NER will limit the current flowing through a transformer to a safe level while ensuring that sufficient current remains to activate shut-down circuits. The resistors used at Sohar are rated for a current of 1500 A over 30 seconds.



Celtic Energy invests for solid fuel market

One of the first gravity feed boilers to be developed for thirty years is currently undergoing trials in readiness for its launch onto the UK market. Celtic Energy, the country's largest anthracite producer, is behind the new "Celtic" boiler, which is being developed and marketed in partnership with Cornwall Heat of Bury St Edmunds.

The 45,000 BTU boiler will be trialled over the coming months and will be priced competitively with comparable products on the market.

Celtic Energy's Chris Banks said the decision to back the development of a new generation of gravity feed boilers was a deliberate move to boost the number of boilers on the market: "As a major supplier of quality anthracite to the domestic market, we were concerned about estimates that showed that over the next two years, up to 50% of the 100,000 or so boilers currently in use could need replacing. There is a very real fear that, unless a competitive solid fuel boiler is available, these customers could switch to other forms of heating when they need to replace their existing equipment".

The new boiler will incorporate a number of modern design features to bring gravity feed right up-to-date.

Rolls-Royce Power and Northern Electric to develop 50 MW power station

Rolls-Royce Power Ventures Ltd has signed a joint venture agreement with Northern Electric Generation Limited to develop, own and operate a 50 MW natural gas fired power station at Seal Sands on Teesside. Viking Power, the new joint venture, is owned on a 50/50 basis by Rolls-Royce Power Ventures and Northern Electric Generation.

The commercial operation date for the project is November 1997. The capital cost is £17 million and it is intended that the plant will be project financed taking advantage of non-recourse loans.

The project is the first of at least three that Rolls-Royce Power Ventures and Northern intend to develop in the UK. All of the projects contemplated are similar in technical configuration and operations, but will be located at different sites to be chosen by the joint venture company.

The power station will be constructed by Rolls-Royce Industrial Power Systems under a turnkey contract and will utilise the Rolls-Royce Trent gas turbine generator. The Teesside plant will be the second power generating facility in the UK to utilise the Trent, and is the first to use it in an open cycle configuration. The station is expected to operate during times of peak power demand. The industrial Trent is said to be the world's most powerful aero-derivative gas turbine and delivers 42% efficiency in simple cycle operation.

Tony Hadfield, Chief Executive of Northern Electric plc commented: "We will supply gas to the power station which will be connected within Northern's distribution system, thus avoiding any National Grid transmission charges. Our intention is that the normal operation of the plant will be about 15 hours a day during the peak periods. It will allow us to manage our gas and electricity supply businesses more flexibly which will be particularly important following the introduction of full competition in 1998."

Lighting up Fiddler's Ferry

The lighting at PowerGen's Fiddler's Ferry Power Station is maintained on a programmed maintenance schedule by Parkersell (Lighting & Electrical) Services. This ensures that at all times lighting is operating at an optimum level of efficiency resulting in both energy savings and helping to ensure that the site conforms to requisite safety standards. Lighting throughout the site is at a level of efficiency not achieved for many years.

Fiddler's Ferry power station

The Fiddler's Ferry site near Warrington, Cheshire, is a large coal fired power station with over 11,000 lampways. Lighting is located in many contrasting areas including quiet, clean offices, as well as areas which present particular maintenance difficulties. In the boiler house, for example, fumes and dust created present a hazard whilst lighting in the coal handling conveyor areas is subject to high levels of dirt ingress.

Energy services - CHPA launches new initiative

The Combined Heat and Power Association has launched a new industry grouping to promote the development of integrated energy services. The new Energy Services Association (ESA) is designed to deliver a broader range of services to energy consumers using new approaches to the efficient production and use of energy. The initial priorities of the ESA will be:

- The development of local authority-based energy services companies, building on a number of pioneering joint public/private sector initiatives that are already underway.
- Ensuring that the launch of the Government's new guidelines for the provision of energy services in the public sector result in practical action.
- Promoting the new opportunities for the development of integrated energy services and energy efficiency that are opening up as a result of current and planned changes.

The new group will be Chaired by David Sigsworth, commercial Director of Scottish Hydro-Electric who said at the launch: "It is increasingly clear that customers aren't just interested in buying units of electricity or therms of gas. What they really seek is a warm home and a good environment in which to work. A public sector customer wants a good energy solution, just as much as a business, commercial or industrial customer. The launch of the ESA is an important first step towards developing new ways of delivering the benefits of energy efficiency for all consumers."

CHPA Director David Green, who will lead the ESA, added: "To ensure that the goals of sustainable development are achieved the developing energy services industry need to offer competitive and energy efficient solutions in a progressively liberalised energy market. A key challenge will be to ensure that the process of liberalisation does not cause new blockages - and where they emerge, they are effectively tackled. The experience of the CHPA will be vital to this process.".

Hovair Systems ***has supplied a £20,000 air film transporter to Nuclear Electric's Heysham 1 power station. The new transporter has improved the safety and ease with which 12-tonne motor windings are moved around workshops while removed from the reactor for maintenance checks. Nuclear Electric chose the air transporter because manoeuvrability of the loads in confined spaces made it difficult for its own cranes to carry out the work. They are now free for other equally important functions within the Gas Circulator Maintenance Facility.***

ABB acquires GEC Meters

ABB has announced the acquisition of GEC Meters of Stone, Staffordshire, the UK's largest manufacturer of domestic and industrial electricity meters. The company will be renamed ABB Metering Systems Ltd, and will form part of ABB's UK Power Transmission and Distribution segment, which has its headquarters at Telford.

GEC Meters is the UK's largest manufacturer of electricity meters. Its products, sold in the UK and to countries where IEC standards apply, include single-phase and polyphase electro-mechanical meters, single- and polyphase electronic meters, precision meters, programmable polyphase meters, meter reading systems, and the Watercard "smart-card" budget payment system.

Northern Electric to read gas meters

Northern Electric's metering subsidiary, Northern Metering Services Limited has won a £1 million contract for reading gas meters. The contract with British Gas TransCo is for reading the meters of over 11,000 primarily commercial and industrial sites within Northern Electric's area and in neighbouring parts of Cumbria, over two years planned to commence from 1st February.

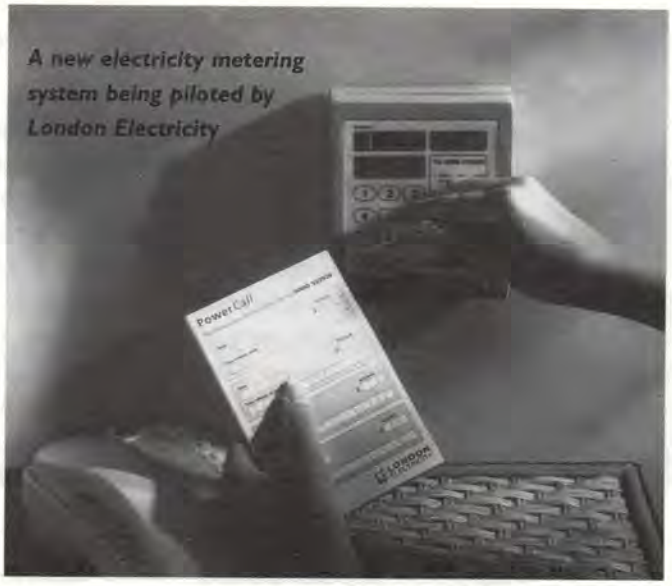
The contract, won against competition from regional electricity companies and other private sector service providers, is the first to be let by TransCo in the UK for meter reading as part of the process of introducing competition into the industry.

Pay-as-you-go pilot uses Siemens meter technology

New metering technology from Siemens has been combined with an advanced keypad and phone pre-payment system to create a pay-as-you-go charging facility currently being piloted by London Electricity Plc for customers on single rate tariffs.

Siemens Measurements Ltd is supplying 1300 keypad customer interface units (CIU) and meter units to London Electricity, which canvassed its customers to select households willing to trial its new PowerCall system.

The CIU, which is located close to the meter at a convenient eye level position within the premises, enables the customer to check how much 'paid for' power they have left to use. Additional units of electricity can be purchased by simply calling London Electricity's freephone 24 hour hotline. Once the payment is made over the phone by credit card or bank account debit card, the enquiry agent gives the householder a release code number which is entered on the CIU to make the electricity units available.



A new electricity metering system being piloted by London Electricity

According to Siemens, the system benefits the power provider because it offers a competitively priced installation which removes the need for token purchase systems. In London Electricity's case, it also provides an alternative to its existing keycharge system, and thereby continuing to ensure pre-payment for all power supplied. The customer benefits because PowerCall provides a more user friendly alternative to pre-paid tokens by offering 24 hour access to purchasing power from home.

The system's CIU incorporates an LCD display and uses simple to understand graphics to ensure the release code is keyed in correctly, and the 16 digit code offers a sophisticated level of security to remove the risk of fraud. Safety features include an audible warning when the number of units drops below a certain level, to avoid sudden loss of power. The CIU, can also supply additional information on power use for the customer via the LCD display, revealing the amount of electricity used in the past 24 hours, and the amount of power last purchased.

UK industry edges up power price league

The UK electricity industry continues to out-perform the majority of its European neighbours in offering customers good value power prices, according to the Electricity Association in its new edition of the world-wide comparative prices data survey, International Electricity Prices.

In the domestic market, the UK ranks fifth cheapest out of the 15 EU member countries, says the survey. In an industrial prices table, UK electricity prices under contract as fourth cheapest within the same group.

In world terms, UK electricity prices remain competitive falling midway in both domestic and industrial price comparisons. The typical UK price for customers on a domestic standard tariff is 9.23 p/kWh, against 15.01 p/kWh for Belgium, the most expensive nation in the domestic table. For UK industrial customers with a typical 2.5 MW 40% load factor supply, the average price under contract is 4.53 p/kWh, compared with 8.3 p/kWh for Japan, the most expensive.

Another Galleon joins the expro fleet

The £135 million second phase development of the Galleon gas field in the southern North Sea has been given the go-ahead by the Department of Trade and Industry.

Shell UK Exploration and Production (Shell Expro) is the operator for the development on behalf of Shell and Esso Exploration and Production UK Limited, each with initial shares of 40%, and Conoco (UK) Limited and PowerGen (North Sea) Limited, each currently with a 10% share.

The project will involve the installation of a new wellhead platform - Galleon PG - and the drilling of 11 development wells to drain the north western area of the field which straddles four Blocks in the southern North Sea some 80 km north of Lowestoft.

Installation of the platform is planned for the end of 1997. First gas from an initial three development wells is due on stream in October 1998 and Galleon PG is expected to recover at least 770 billion standard cubic feet of gas..

Gas will be exported to shore at Bacton.

Committed to

by Dr Chris Fay, chairman & chief executive, Shell UK Limited

Shell UK is currently making much of the public consultation process it has entered into to find a solution to the Brent Spar disposal problem. The company says it is now listening to the environmentalists and others, and is willing to take their suggestions on board. An independently-facilitated seminar on Brent Spar held in London last year has been followed by publication of the eleven 'best' proposals to dispose of the giant oil storage and loading buoy. But what is the overall Shell approach to the environment? Here, its chairman and chief executive Chris Fay describes the company's environment performance and its reporting, in a talk originally given to industry regulators, environment groups, political representatives and the media last November.

I will cover three areas in this article:

- first, the challenge of responding to public concerns about the environment,
- second, some of our achievements we hope will inspire public trust, and
- third, how we pursue our commitment to continuous improvement in environmental performance.

Responding to public concerns about the environment is not easy. The issues are complex. It is difficult to gauge - let alone reconcile - diverse perspectives, views and interests. Nevertheless, we have always understood that our business depends on retaining public trust. Brent Spar reminded us just how much effort this requires in a world increasingly less trusting of governmental and commercial institutions.

Environmental issues are difficult because they are all embracing. Everything we do affects the environment and bears risks - within complex, inter-related natural and human systems. Our knowledge is still very limited in many areas.

That doesn't mean we can avoid taking action. Whatever the difficulties, we have no option but to pursue the goal of sustainable development. But it does mean that we need to appreciate that:

- there are no easy environmental answers or absolute standards,
- decisions require balancing many factors and recognising inevitable trade-offs, and
- taking action without thinking through all the implications may result in greater environmental problems later.

The values and goals of society must set the environmental agenda - acting through our democratic institutions and in the context of the many challenges we face. But public opinion provides imperfect guidance for the complexity of individual decisions. Those require a strong regulatory process.

This process must ensure that decisions are made on the basis of thorough, wide-ranging, scientific evaluation. It must also encourage the continuing innovation which drives long-term environmental progress. It will do this most effectively by setting goals - which companies can pursue in their own ways - and by agreeing priorities, rather than by blanket, inflexible, prescriptive rules.

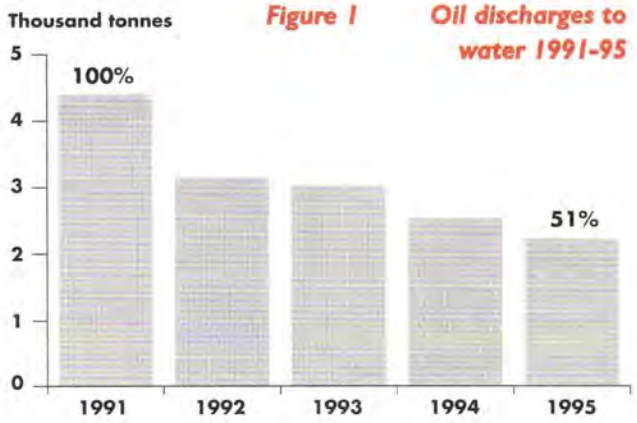
But this process can only work if it is trusted. It must be seen to be rigorous, fair and responsive to public concerns. There can be no perception of cosy deals behind closed doors. Regulators will certainly be subject to constant challenge by interested groups and the media.

Their task will be much easier if the companies they regulate demonstrate that they are not self-interested defenders of profit above all. That they are responsible enterprises which deliver benefits to society and are genuinely trying to balance their economic, social and environmental responsibilities. In short, if companies earn public trust.

I believe that a company's ability to earn trust must depend on two things: how it conducts its business and how well it communicates. Let me offer three areas where, I hope Shell UK's efforts can help to develop this trust:

- the conduct and openness of our operations, and
- our contribution to dealing with environmental problems associated with

Figure 1 ***Oil discharges to water 1991-95***



improvement

How Shell UK approaches the environment

the use of our products, and
- our community relations.

Performance and communication are linked through environmental reporting. For several years, Shell UK has published aspects of its environmental performance. This year we produced - for the first time - a detailed report of the environmental approach and record of our businesses over the past five years. We also produced three local site reports. We are committed to improving and extending our reporting.

In particular, I would draw attention to the 49% reduction in oil discharges (Figure 1) and the 45% reduction in gas flaring and venting (Figure 2) over the period. Most discharges and flaring come from our upstream operations - which, I remind you, produce a fifth of the country's oil and gas. The oil discharged into the sea, mainly in water produced from the reservoirs, amounts to a tiny percentage (0.008%) of oil production (Figure 3). The average concentration is now half the legal limit. Gas flaring now amounts to 1% of the oil and gas produced.

Emissions of volatile organic compounds, methane (Figure 4), and sulphur and nitrogen oxides (Figure 5) were also reduced. So were carbon dioxide emissions (Figure 6) - despite increased refinery processing to meet changing patterns of demand and more stringent environmental standards for products.

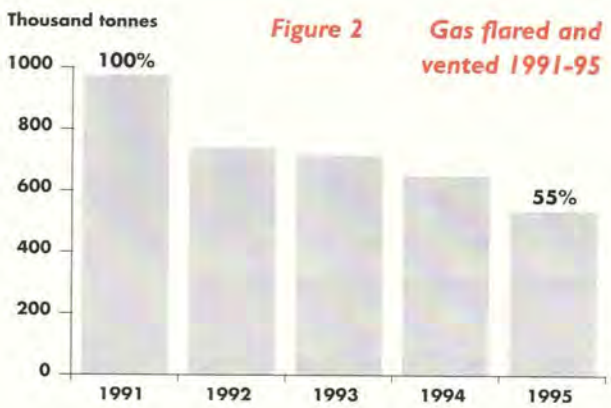


Figure 2 ***Gas flared and vented 1991-95***

There were, of course, things we did less well.

The case for offshore disposal of Brent Spar was prepared with professional skill and judgement - and secured all necessary regulatory approvals - but we were clearly insufficiently sensitive to public concerns and the need for wider discussions. We have learned much from that experience - not least that we tended to communicate at a technical level rather than in ways that people could understand. The widespread discussions which are integral to the process for developing new disposal proposals for the Spar is just one reflection of this.

Although offshore oil spills have been reduced to very low levels, we reported an increase in spills during refining and product distribution. I should stress that these are mostly very small - a few litres - and generally within contained areas. I have no doubt that the rise is the result of much greater emphasis on internal reporting - and says much for the honesty of our operators and drivers. Our Downstream business is giving a very high priority to tackling this problem.

Many people responded to our request for feedback on the report. Several raised the question of external verification. Our reporting process is now being verified by an independent assessor and the results will be given in next year's report. This is in line with our commitment to continue developing our reporting.

As well as own operations, we must also consider the impact of our products. We acknowledge that there is much concern about the affect on global climate and local air quality of the increasing use of fossil fuels, particularly for transport.

I recognise that it does seem increasingly probable that man-made carbon dioxide, largely from fossil fuels, may affect climate - albeit much less than in previous projections based on an unrealistic view of how energy markets could develop next century (Figure 7). The international community is right to consider prudent precautionary measures, and the oil industry should play a constructive role in that debate.

However, there are good reasons for expecting significant improvements in

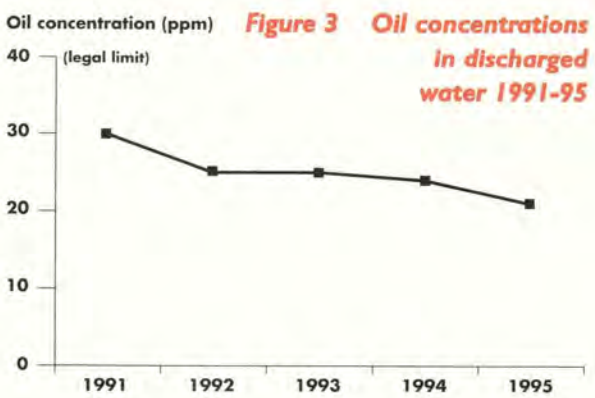


Figure 3 ***Oil concentrations in discharged water 1991-95***

energy efficiency as a result of technological development, greater market efficiency and changing lifestyles. Renewable energy sources are becoming increasingly competitive. Any measures must encourage the continued economic development which drives these processes.

Concern about the impact on air quality of increasing road transport is both widespread and understandable. But there is growing awareness of the improvements that are already in train as a result of advances in vehicle and fuel technology, and tighter regulation. This subject suffers from much unsubstantiated assertion - which is a poor basis for considering measures that would cost consumers a great deal. This is why the European Auto-Oil programme was so important.

This three-year research programme - involving the European Commission, the European automobile and oil industries, and independent consultants - systematically investigated what further action was needed to meet stringent, health-based air quality targets in the most cost-effective way. Shell companies contributed significantly to this work - particularly through the extensive research into vehicle emissions and fuel quality carried out over many years at the Thornton Research Centre in Cheshire.

The Auto-Oil study confirmed that all major transport emissions are now falling and will go on falling as a result of measures already in place. However, some further action is needed - particularly to deal with nitrogen oxides, ozone and particulates.

The package of proposed new European measures for implementation by the year 2000, drawn up on the basis of Auto-Oil, would deliver:

- better vehicle inspection and maintenance,
- tighter exhaust limits, and
- more stringent fuel specifications.

I believe that it is essential that environmental policy is based on scientific research, defined targets and cost-effectiveness. That is why it is so important that these measures are implemented without delay.

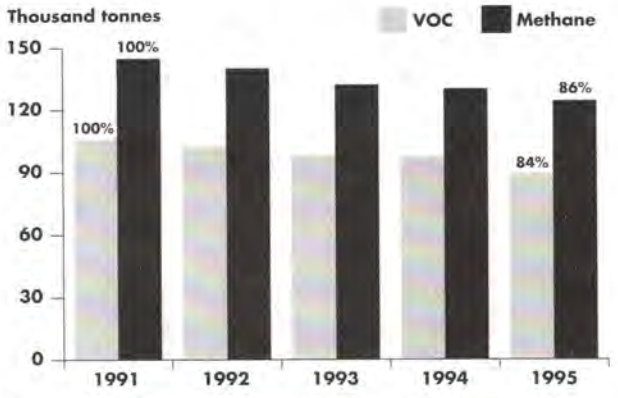


Figure 4 VOCs and methane emissions 1991-95

Finally on our conduct, let me mention Shell UK's community relations. We have always endeavoured to act as good neighbours to the communities around our plants. But we are now putting much greater emphasis on ensuring effective, two-way communications. The three site

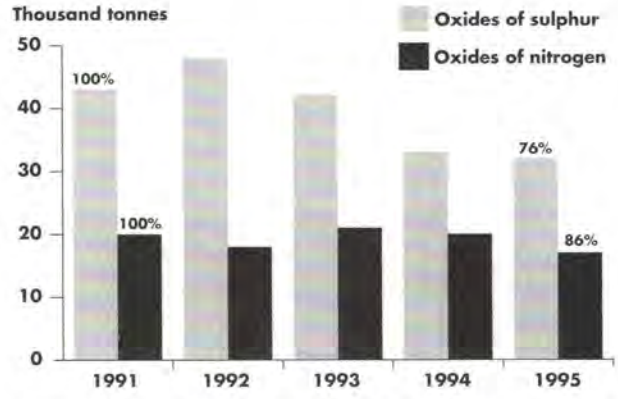


Figure 5 Oxides of sulphur and nitrogen emissions 1991-95

environmental reports I mentioned are part of this effort. More will follow next year.

Let me make just two points about community investment. First, that we believe in long-term commitment in these programmes as much as in the rest of our business. The Shell Better Britain Campaign has been contributing to local environmental improvement for 26 years. Livewire has been helping young business people for 14 years. STEP has been bringing undergraduates and small companies together for 10 years. Second, that a very important benefit for us from these programmes is the chance to exchange views with people from the many partner voluntary agencies. This is something greatly appreciated by our staff.

That brings me back to the question of communications. This is not just a matter of properly explaining policies, performance and plans - although that is essential - but also of listening to the views of others and responding to their concerns.

We have to consider why trust in companies is declining. I think that the roots of this mistrust lie in the fact that people

- fail to see the relationship between business success and their own quality of life,
- regard technological advance as a threat rather than an opportunity,
- are suspicious that business standards do not protect people and the environment,
- question the rational, scientific approach which is at the heart of business, and
- don't understand how business can contribute to achieving a sustainable future.

I think that regaining trust presents all business people with a vital communications challenge - which requires communicating in a way that people understand and can relate to, rather than in a technical or business jargon which alienates them.

Let me turn to my third topic - how we pursue our commitment to achieve continual improvement in environmental performance. I believe this requires three things:

- systematic management,
- technology development, and
- the enthusiasm, skill and judgement of all involved in our operations.

Business is about systematic management. Flair, imagination and creativity are all vital -

but are ultimately useless if they don't rest on a bedrock of system. This is as true of environmental management as of any other aspect of business - though business people have sometimes been slow to recognise this.

In Shell UK, we increasingly manage health, safety and the environment as an integrated system because they involve similar goals:

- to prevent the incidents which may injure people or harm the environment,
- to reduce the effects of activities which may cause long-term damage to people's health or to the environment.

Our health, safety and environment management systems have four key stages:

- assessing the probability and potential severity of hazards or long-term effects,
- prioritising effort,
- taking preventative or remedial action,
- monitoring the results to inform further steps.

The first two stages are the essential foundation for action. We cannot avoid all risks and prevent all effects - that is impossible. Deciding which risks require what action, with what priority, must be done on the basis of thorough, scientific assessment. But the choices depend on human judgement and values.

The fourth, feedback, stage is also essential. Continuous improvement depends on learning from experience. Goal-based regulation meshes with this iterative, systematic learning process - which is why it is much more effective in ensuring long-term progress than prescriptive rules.

Many people don't understand that extent to which environmental progress depends on good operational management. But long-term progress also requires technological advance. This must also be managed properly. My long career as an engineer has taught me how often uncritical excitement about new technology can waste effort and expenditure. Worse, it may increase risks by adding to complexity.

Let me make three points about developing technology. First, it must done in close co-operation with those who will use it - so that it meets real needs and suits real conditions.

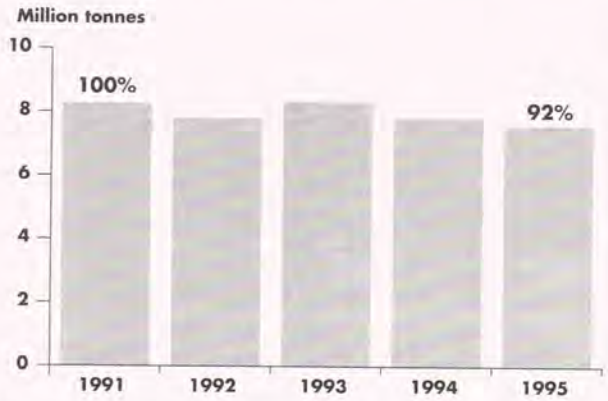


Figure 6 Carbon dioxide emissions 1991-95

Second, it is very difficult to 'pick winners' - to identify those technologies of the future which deserve support. These only emerge through a process of widespread experimentation, competition and optimisation - provided by the free market. Third, the speed with which advances are adopted depends on companies having the profitability and confidence to invest.

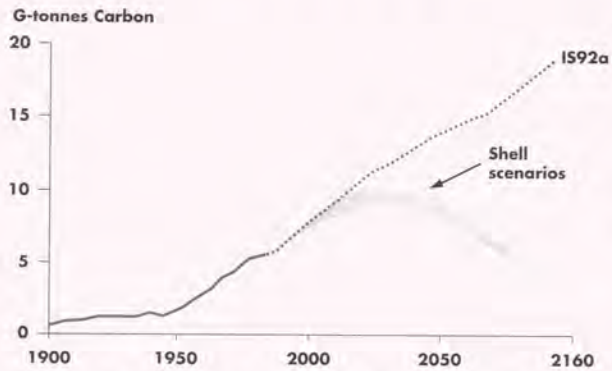


Figure 7 Global carbon dioxide emissions (from fossil fuels) 1900-2160

Finally, let me turn to the question of people - on whom everything depends. There is much that senior managers can do to pursue better environmental standards. They can establish and monitor effective management systems. They can support investment in better technology. They can ensure that all staff are properly trained and equipped for their tasks. They can provide the necessary guidance, advice and encouragement - most effectively by always demonstrating the reality of their own commitment in their own actions.

But, as with safety, those standards ultimately depend on the individual operational judgements of thousands of staff and contractors. Safety awareness is, of course, driven by the powerful motivation of preventing injury to ourselves and our colleagues. Environmental awareness depends on our individual commitment to protecting the natural environment.

However, contrary to what some may think, those of us who work in business - including in the oil industry - are not indifferent to the issues and concerns of the society of which we are part. Like everybody else, we have values, environmental awareness, and concerns for the future. And we don't leave these at home when we come to work.

Like most people, we have come to understand the environmental challenge much better. And, we all owe a debt to those who brought this truth home to society. The increasing environmental awareness of staff at all levels is the most powerful driver of Shell UK's environmental commitment.

However, we also appreciate the company's economic contribution, the fragility of competitive success in face of increasing global pressures, and the complexity of the environmental issues we face. I believe that spurs us to use our skills and creativity to find solutions which will enable us to continue meeting society's economic needs while protecting our environment - that is to achieve sustainable development.

But in order to do this we must retain public trust. The American philosopher Francis Fukuyama has argued that trust is essential for economic prosperity. I believe it is equally necessary for environmental progress.

Coal for Development: The World Bank's

by Karl Jechoutek, Division Chief for Power Development, Efficiency & Household Fuels, The World Bank, Washington, USA

The World Bank's Karl Jechoutek delivered the 1996 Coal Science Lecture to a London audience last October. Mr Jechoutek stresses the pressing need for clean coal technologies to reach developing countries, particularly India and China, where increased use of coal in the next two decades will make them dominant contributors to greenhouse gas emissions. Through its Clean Coal Initiative, the World Bank intends to catalyse action throughout the coal-to-energy chain.

Emerging economies represent an increasing portion of world coal demand. The energy sector generally, and the coal sector specifically, are critical components of sustainable economic development. Coal is, and will remain for the foreseeable future, an important and primary source of fuel for both power generation as well as for industrial and domestic applications. Over the next 15 years, world coal use is expected to increase about 2.1% annually, keeping pace with overall energy growth. The projected increase in coal use reflects its abundance, its potentially low and predictable costs, and its value as a fuel for power generation, where about 80% of the world's thermal coal is used.

Nevertheless, the pattern of growth differs among countries. OECD countries are expected to average less than 1% growth in coal demand, while Asia experiences annual growth rates that exceed 3%. In particular, China and India account for almost 60% of the projected global incremental demand and about 40% of total world coal use in 2010 - see Figure 1. They, along with Indonesia, Kazakhstan, Mongolia, Poland, Russia, Thailand, Ukraine and Vietnam represent countries where coal will be a significant energy source, either by virtue of the country's dependence on coal as a portion of total energy and/or because of the size or regional importance of the industry.

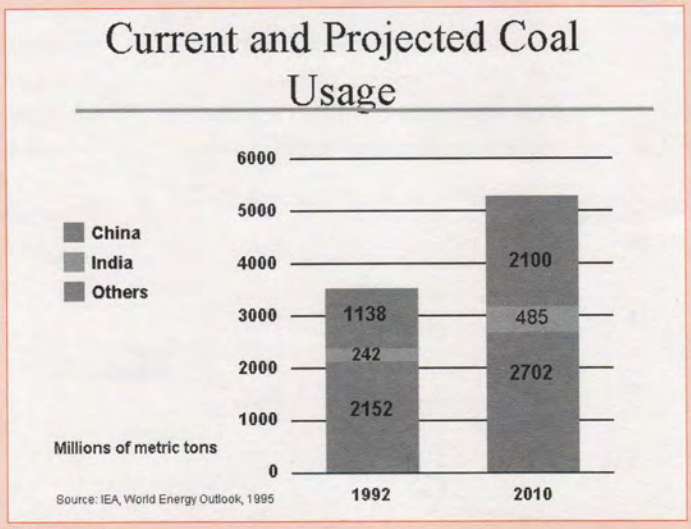


Figure 1

Environmental impacts

Coal use in developing countries has negative environmental impacts and projected growth could exacerbate these effects. Projected increases in the use of coal as a major energy source have raised serious concerns about additional negative environmental impacts. Principal environmental concerns are:

- local effects that include extensive harm to water and land resulting from mining and waste disposal and adverse health effects resulting from high levels of particulate matter and dust;
- local health and regional materials and ecosystem effects resulting from increased levels of sulphur oxides and nitrogen oxides; and
- global effects resulting from the potential for a 50% increase in carbon dioxide emissions (from combustion) and methane emissions (from mining) that contribute to global climate change.

Conversion efficiency

Energy conversion efficiency is low in coal dependent developing countries and thus carbon dioxide emissions are higher than they need to be. Power plants and industrial coal boilers in emerging economies typically consume 15-30% ore fuel per unit of energy produced than those in the industrialised world. Even when new units are installed, thermal efficiencies that are comparable to levels in industrialised countries cannot be guaranteed and opportunities to adopt advanced technologies that have thermal efficiencies that exceed 40% are limited by costs and institutional barriers.

Financial resources

Developing countries are emphasising policies to promote economic growth and have limited economic and financial resources to invest in environmental improvements. Yet, improving the environmental performance of coal while controlling costs is not new. Throughout this century, industrialised countries have made

clean coal initiative

evolutionary advances in reducing emissions and effluents associated with coal while improving efficiency and containing costs. As part of their strategy, they have widely deployed environmental control technologies and, in the process, driven down their costs.

In general, industrialised countries started improving environmental performance with management and operational changes and simple low cost technologies. Their approaches frequently incorporated concepts of diminishing returns, often referred to as the "80/20 rule - 80% of the pollution control could be obtained for approximately 20% of the cost of obtaining 100% emissions reductions". As industrialised countries developed and deployed more sophisticated technologies, they have learned to match the technologies to local conditions and optimise across the coal-energy chain to control costs.

Frameworks

Many emerging economies lack the legal, regulatory, fiscal and institutional framework necessary to reduce costs in the coal-energy chain and improve its environmental performance. Frameworks are characterised by pricing and/or allocation controls; 'parastatal' organisations with monopoly power resulting from investment and licensing constraints; other entry/exit barriers; subsidies and/or cross-subsidies; weak environmental laws and regulations and/or enforcement; and limited capital for investment in clean coal technologies. These frameworks provide little to no incentive to capture the low cost/no cost management and operational performance improvements across the coal-energy chain. Without these incentives, basic principles of promoting environmental improvement are not achievable.

The harmful effects are systemic. Sizing coal for industrial facilities can increase thermal efficiency, but pricing mechanisms often do not encourage this practice. At power plants, inconsistent and/or poor coal quality often prevents efficient and environmentally acceptable plant operations; coal quality may not meet design specifications because the coal quality has declined since the plant was built. Selective mining and coal preparation could alleviate this problem, but administered pricing systems and monopolistic producers and transporters create major barriers to these options, leaving customers to buy tonnes of material, not kilocalories of energy. Furthermore, increased coal preparation would not only improve fuel quality, it would also reduce the volume of material to be transported by 10-20%; lower volumes would reduce rail car and locomotive requirements and help to alleviate transportation system congestion.

Across the chain, enterprises have little incentive to close unprofitable mines and rail links, increase productivity and lower costs. The result is high mining costs, poor or inconsistent coal quality, high transportation costs and rates, transportation congestion and sometimes inability to meet coal production and delivery schedules. For existing plants, these inefficiencies lead to higher electricity and heat production costs; if the costs cannot be recovered through higher electricity and heat rates, the power or heat production authority will have financial losses.

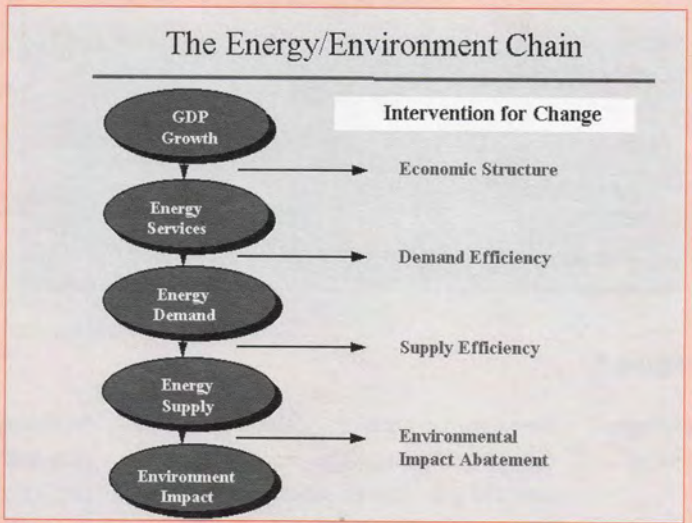


Figure 2

The solutions

The World Bank response to this need is the Clean Coal Initiative, a forum to catalyse appropriate actions and build upon ongoing activities.

The World Bank has generally supported its borrowers in energy sector development and specifically in power generation, coal mine and coal preparation, and related transportation infrastructure development. Historically, the Bank's investment operations, technical assistance projects, and general dialogue with its borrowers have tended to be sector-specific, focusing on specific power, coal or transportation projects. The Bank's increasing environmental focus has also tended to be sector- and project-specific, although an increasing number of stand-alone environmental initiatives have been developed and are being implemented. Within the energy/ environmental chain there are a number of points in different sectors at which interventions to achieve improvements can be made, shown in Figure 2.

The Clean Coal Initiative

The Clean Coal Initiative is a cross-sector initiative to address the integrated coal-energy chain (mining-preparation-transportation-power/heat conversion and clean coal technologies) for both new investments and existing facilities. Its objectives are:

- to improve environmental performance; and
- to increase coal production, coal preparation and transportation efficiencies to realise least cost and cleaner power generation and heat production.

From an institutional perspective, the Clean Coal Initiative provides a framework to coordinate and optimise policy, technical assistance, and environmental programs across the coal-energy chain and build partnerships with countries and among other stakeholders.

The Clean Coal Initiative is based on the principle that achieving optimal solutions to environmental and efficiency problem requires an integrated approach across the coal-energy chain. By adopting an integrated approach to the coal-energy chain, cross-sector issues of environmental degradation and efficiency can be addressed in a rational and cost-effective manner. Sector focused designs fail to optimise across the chain and fail to recognise that the efficiency and environmental performance of the system are determined by a series of interdependent decisions. These decisions, when carefully balanced, can lead to the production of least cost energy in economic and environmental terms. In a coal-energy system that is optimally designed for efficiency and environmental performance, the selection of conversion technology and site for its installation are based on the delivered cost and quality of the fuels available to the plant. The cost and quality of the fuel option is in turn based on the efficiency of the transportation system and the ability to mine and prepare a suitable quality product.

The Strategy

The Clean Coal Initiative strategy has two parts. The first is to assist client counties to:

- reform and restructure coal, transportation and conversion sectors;
- develop and enforce appropriate environmental standards; and
- deploy clean coal technologies.

The second is to assist countries to implement reform and clean coal demonstration projects that optimise the efficiency and environmental performance of the coal-energy chain.

Client Country Assistance

Legal, regulatory and institutional reforms are essential to promote cost-effective environmental policy and clean coal technology utilisation. The experience of the industrialised countries indicates that an efficient legislative, regulatory and institutional framework covering the entire coal-energy chain is a pre-condition to cost-effective environmental policy. An effective commercial and environmental framework:

1. provides incentives to consolidate mining, transportation and conversion operations that enable efficient investment in clean coal production and conversion technologies;
2. provides incentives to identify and implement the lowest cost efficiency and environmental options first, and more effectively evaluate the costs and benefits of clean coal technology;
3. directly reduces adverse environmental impacts by providing incentives to reduce energy use; and
4. is a necessary condition to enabling private investment, a major source of the capital needed to provide additional energy supplies and improved environmental performance.

Effective environmental standards and enforcement are critical elements to improve environmental performance. Markets alone will not reduce emissions to levels that adequately protect health and ecosystems. Carefully designed environmental regulations that balance costs and benefits are critical to improving environmental performance. The Bank encourages its borrowers to develop:

- appropriate permitting procedures to encourage pollution prevention; and
- sound and enforceable standards.

It supports strengthening appropriate institutions and training staff to identify pollution prevention and cleaner production options and to monitor and enforce compliance with permit conditions and environmental standards.

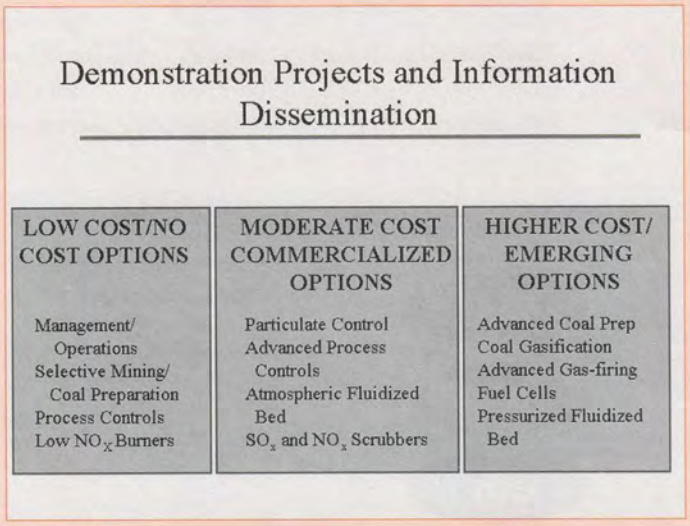


Figure 3

Clean Coal Technologies

Deployment of clean coal technologies is an integral part of the proposed strategy. Adequate environmental protection technologies are critical to improving the environmental performance of coal and the efficiency of its conversion. In industrialised countries, clean coal technologies are applied throughout the coal-energy chain.

There are ranges of low and moderate cost commercialised, and higher cost emerging clean coal technology options - see Figure 3. The lowest cost options are typically derived from the incentives created by reform and restructuring: improved management and operations, selective mining and coal preparation, and process controls. These contribute to lower maintenance costs, higher availability, lower

ash, sulphur and possibly carbon dioxide emissions, and lower volumes of solid waste for disposal. Minemouth generation, combined with long distance electricity transmission may also be a low cost option.

The moderate cost options can be induced by environmental regulation and are drawn typically from the portfolio of commercialised and widely deployed technologies: particulate controls, sulphur dioxide and nitrogen dioxide removal systems, advanced process controls, circulating fluidised bed combustion and chemical feedstock plants based on coal. The higher cost options include emerging technologies: advanced coal preparation, pressurised fluidised bed, coal gasification, and technologies that can use synthetic fuels, such as advanced gas-firing units and fuel cells. These technologies typically have higher combustion efficiencies and lower emissions than commonly available techniques.

In emerging economies, higher capital costs, lack of information and proper evaluation of the benefits of clean coal technologies, and inadequate incentives to use them have inhibited their adoption.

Market reforms

The second part of the Clean Coal Initiative strategy is to assist countries to implement reforms and clean coal demonstration projects that optimise the efficiency and environmental performance of the coal-energy chain. The key is to develop new market structures and incentives to improve efficiency and environmental awareness, to adopt environmental regulations and to deploy appropriate clean coal technology. Under the proposed initiative, legal and regulatory frameworks and institutional arrangements, environmental regulation and clean coal technologies would be reviewed with country partners and other interested stakeholders, both public and private.

Such market structures will encourage improvements in financial, economic and environmental performance by:

- encouraging essential corporatisation/commercialisation with financial accountability to government and other shareholders;
- focusing on competition rather than market protection; and
- permitting closing of unprofitable operations.

Important elements are competitive access to coal reserves for new entrants, internationally competitive exploration and licensing procedures and commercial transport arrangements that move away from pre-conceived producer-consumer transport linkages. Negotiated or market pricing of inputs, outputs and services (particularly deregulation of price and allocation controls and elimination of subsidies and cross-subsidies) is also critical.

Such new market structures and incentives for efficiency/environmental improvement would facilitate and stimulate the identification and implementation of low cost, profitable operations and application of modem management and technology. They would enable implementation of cost-effective and environmentally superior options and investments in clean coal technology based on reasonable expectations for profitability.

Implementation

The World Bank is taking a phased approach to identify the fundamental issues, which began with the Clean Coal Initiative Roundtable to assemble representatives of client country, international industry (including coal producers, coal preparation specialists, electricity and heat producers and experts in clean coal technologies), bilateral and multilateral lending agencies and non-governmental organisations. Together, they reviewed present legal, regulatory, and institutional arrangements across the coal-energy chain and discussed options for revised policy and institutional improvements to permit increased coal energy chain efficiencies and environmental performance. Improved conditions for existing state enterprises and for the participation of interested new private sector entrants was an important focus.

Following the Roundtable, the World Bank plans to initiate country partnerships and, through these, to undertake detailed coal-energy chain case studies in selected countries. 'Bench-marking' is being considered to identify opportunities for efficiency and environmental improvements and needed reforms. In parallel, technology assessments will be undertaken to assess the status of and opportunities for clean coal technologies. These initiatives will lead to the development of action plans incorporating opportunities and recommendations for policy framework revision, technology status and options for their improvement, and follow-up coal-energy chain proposals. The World Bank Group instruments are:

- traditional lending operations to support project investment through the International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA);
- equity participation in projects through the International Finance Corporation (IFC);
- guarantee operations through the Multilateral Investment Guarantee Agency (MIGA), IBRD and IDA to support private sector projects;
- support through the Global Environment Facility (GEF) for the demonstration of highly efficient new technologies to reduce greenhouse gas emissions;
- policy advice and technical assistance on macroeconomic and sectoral reform issues;
- assistance in developing country specific environmental guidelines for coal production and use;
- networking/knowledge brokering; and
- global environment facility.

The World Bank's initiative will not be a research-style program but rather an analysis and dialogue designed to develop realistic options for implementing policy, legal and regulatory reforms in the coal-energy chain, in parallel with or leading to specific demonstration or pilot projects.

The role of biomass energy

by M J van der Burgt, Energy Consultancy BV

The following article is the keynote presentation given as part of a 'think tank' meeting organised by the Institute's International Committee last November. The Committee's previous think tank tackled the question of the likely future for oil, and several articles have appeared in the June 1996 and subsequent issues of Energy World as a result. The consensus was that oil production would peak around the year 2030, although minority views had this peak somewhat earlier. The latest meeting looked at the ability of renewable sources of energy, and biomass in particular, to take the place of declining oil production. The main conclusions from the meeting are also recorded.

Although biomass is not a major industrial fuel it supplies 15-20% of the total fuel use in the world. Mostly it is used in non-industrialised economies and to a minor extent in industrialised countries where the fuel use is mostly limited to the use of by-products from forestry and the paper and sugar industry.

There are many people in the world who believe that all transportation fuels and organic chemicals can in the future be produced from biomass. This would call for an immense acreage of biomass plantations of a few million square kilometres. This seems unrealistic for various reasons:

- The sheer size of such projects.
- It is far from certain that large scale plantations of more or less conventional crops as Eucalyptus, miscanthus, euphorbia, etc are so green as the advocates of these plantations claim them to be. The large scale biomass production in Minas Gerais in Brazil for making charcoal used for their blast furnaces is a well known environmental disaster. Fertilisers, herbicides and pesticides will be required, ash may have to be recycled in order to recycle alkali, etc. Irrigation may be a problem and so may be soil erosion. Moreover monocultures are very sensitive to pests. Last but not least how can such developments be reconciled with the wish for more biodiversity?
- Biomass is easy to transport when it comes to gathering firewood for domestic use. However, it is expensive to transport in large quantities over any appreciable distance. The energy density of biomass is one-tenth that of liquid hydrocarbons and further it is a solid which cannot be pumped. In order to make wood, etc more amenable to transport it can be chipped but then the energy density will even further decrease.
- The energy required to get bulk biomass to the markets is appreciable. It could well be that it will require a sizeable percentage of the liquid transport fuel market it wants to replace.

A possible solution could be plantations of salt water algae in desert areas which are located close to the sea. The advantage of this approach is that problems associated with fertilisers, irrigation, etc are virtually absent. Moreover an advantage of aquatic crops is that they are probably easier to harvest.

Such farms should of course be located there where there is a lot of sunshine. These are also locations where solar power and hence hydrogen are advantageously generated. This in turn means that the conversion of the biomass into true hydrocarbons for transport fuels could be carried out close to the biomass production thus grossly diminishing the transport problems.

For countries in the Middle-East which are now heavily dependent on crude oil exports for their income this could imply that they can continue to supply the world with hydrocarbon fuels.

There are of course some hydrocarbons sources available for which no additional biomass plantations are required, such as recycled plastics and waste biomass from forestry, paper mills and sugar mills.

Liquefaction

What nature has done with biomass over millions of years is not so easy to carry out in a processing plant. More specifically this is to convert a very wet material which on a dry basis contains about 50% oxygen into a solid hydrocarbon such as coal with about 10% oxygen or even better into liquid hydrocarbons such as crude oil with virtually no oxygen at all.

For converting biomass into liquid hydrocarbons in principle three routes are available:

- Hydro Thermal Upgrading (HTU) as developed by Shell Research. This process comprises a sort of pressure cooking of the biomass. The advantage is that about 75% of the oxygen can be removed from the biomass without the use of hydrogen, resulting in a product with about 15% oxygen. Scouting type hydrogenation tests of this product have resulted in good quality liquid hydrocarbons as required for motor fuels. However the hydrogen consumption is high and amounts to 4% on fuel. Further, catalyst stability may be a problem. The overall energy efficiency of making liquid hydrocarbons from biomass via the HTU process is at best 50%.
- Production of bio-crude from biomass by (flash) pyrolysis can be accomplished with an energy efficiency of about 67%. Unlike the HTU oil the bio-crude has about the same composition as the dry biomass. The big advantage is though that the transportability is much easier as, contrary to the HTU, liquid it is not a very viscous material. The energy density is about half that of crude oil. Because of the low sulphur content the bio-crude can be used as such as heating oil. It is

as an carrier of the future

possible that eventually it can also be used as a fuel for medium and slow speed diesel engines and for gas turbines. However, it cannot be used as such in high speed automotive diesel engines or in jet engines for aircraft. Catalytic conversion of bio-crude into good quality motor fuels is prohibitive because of the very high hydrogen consumption which would result in an efficiency of less than 10%.

- Gasification of the biomass with oxygen followed by either Fischer-Tropsch (FT) synthesis or methanol synthesis. The energy efficiency of the gasification plus synthesis is about 50% for the FT route and 60% for the methanol route. The FT route yields excellent quality jet fuel and automotive diesel fuel and a good quality motor gasoline. The methanol cannot be used as jet fuel but may be used as a clean automotive fuel. By using low level heat to catalytically decompose the methanol before combustion in the engine the effective efficiency of the methanol route can be increased to 70%.

Although also the efficiency of gasification-synthesis route may seem low it is not much lower than the efficiency with which coal can be directly converted into automotive fuels be means of hydrogenation. Moreover gasification-synthesis is the only route for which all processes are proven and available. It seems unlikely that the alternative routes via the HTU process or via bio-crude will give better results. In this respect it is interesting to look at the processes developed for coal liquefaction (after all biomass can be considered as a very young coal!).

Direct conversion of biomass proper into liquid products (so-called direct liquefaction via the HTU and pyrolysis routes) followed by upgrading into specification products has as a corollary to coal liquefaction - the problem that aromatic products are often formed. These can result in highly aromatic gasoline and deteriorate the properties of diesel (low cetane) and jet fuel (low smoke point). Further direct liquefaction has the disadvantage that the process is dependent on the type of feedstock. Finally in the absence of a ready source of hydrogen it will be found that the efficiency of these routes is certainly not better than that of the gasification-synthesis route.

Gasification

Almost all biomass gasification processes suffer from the fact that always some tar is produced which causes problems in the downstream processing of the gas. An exception is the Battelle biomass gasification process which produces a relatively clean synthesis gas without tar.

Gasification is also advocated by many people in relation to combined cycle power generation from biomass. In this respect it should be realised that gasification in power generation normally serves two purposes: to make the power station more environmentally friendly and to convert the solid fuel into gas which can be fired in a gas turbine.

The first point is of little relevance to biomass because of its low sulphur content. Of course no solids can be fired in a gas turbine. But this problem can also be coped with by complete combustion of the biomass with preheated moisturised air at an elevated pressure of say 8-10 bar followed by particulate and alkali removal at 900°C. The hot gas can then be expanded through a low tech gas expander without blade cooling. Other elements of the so-called TOPHAT cycle could also be added, such as:

- quasi-isothermal compression of the air comprising two compressor stages where after each stage the air is cooled by direct injection of water which evaporates in the air,
- heating this compressed moisturised air with the sensible heat in the exhaust gas leaving the turbine, and
- finally using the excess of low level heat in the exhaust gas for drying of the biomass.

An efficient power station is obtained in which the biomass is converted into electricity with an efficiency of about 50% - higher than that claimed for any gasification based biomass fired power station and much lower in capital cost.

The attractiveness of this scheme is that there is no steam cycle and hence it can be built economically for capacities of say 3-10 MWe. This is a major advantage as the biomass has not to be transported over large distances. Anybody who maintains that Integrated Gasification Combined Cycle (IGCC) based power stations for biomass will eventually become competitive should look at the coal based IGCC developments. With this much better feedstock and for capacities of 250-750 MWe, IGCC is still not economically viable. Much will depend just as with other developments on what solar and nuclear energy will do.

Anaerobic digestion of biomass

Presently anaerobic digestion is only applied in small scale units of below 5 MW to convert agricultural waste. The use of thermophilic micro-organisms has made this conversion more attractive but for a reasonable conversion of the biomass a period of 2-3 weeks is still required which makes this process less suitable for larger scale plants. It could be that with hyper-thermophilic micro-organisms this period can be reduced such that it can also be applied for larger scale plants. Moreover by using hyper-thermophiles no sterilisation stage is required which is needed in case the digestion waste will be recycled to farms and/or forests. The gas produced is essentially a mixture of methane and CO_2 and can only be advantageously used for heating purposes and as a gas turbine fuel.

The tale of the Foxes and their Stray Cat Part 2

by Chris Laming, CPL Electrical Engineering

Last April's issue of Energy World carried the story of ex-Cambridgeshire farmers Geoff and Gillian Fox and their catamaran incorporating specially-designed energy systems. The Fox's round-the-world voyage has now come to a temporary halt in Portugal as they embark on a new project. Meanwhile, Stray Cat's energy efficient systems continue to perform well.

Since leaving the UK in August 1995, in their Prout catamaran Stray Cat, Geoff and Gillian Fox called into Jersey before sailing across the Bay of Biscay to Santander in Northern Spain.

Last year they cruised the Algarve and spent most of the summer in the Villa Real de Santo Antonio area at the mouth of the Rio Guadiana, as well as sailing up the river.

While in the area they spent several weeks at anchor without having to go into a marina for fresh water or to recharge the batteries. The engine was used only when the fresh water tanks required filling. The water maker is belt driven from a pulley attached to a shaft from the non-drive end of the engine and makes 20 litres an hour of fresh water from salt water or 15 litres an hour from the clean river water of the Rio Guadiana. The belt drive drives a high pressure pump which pumps the sea/river water through special filters which extract the impurities producing fresh water as a result. Suspended silt in the river water clogs the filters more than salt in sea water.

The engine was not only driving the water maker, but the internal cooling water was used to heat the water in the hot water cylinder, so that clothes washing etc can be done at the same time. Battery charging also takes place during this period, when the engine is running. With the kestrel alternator controller, the alternator output is boosted to give a continuous steady output instead of the normal taper charge characteristics of the alternator's own regulator, thus replacing more charge into the batteries.

The engine therefore performs three important tasks when the yacht is at anchor, ie driving the water maker, heating the hot water cylinder and charging the batteries. When the engine is not running the three Siemens PM55 solar panels provide continuous output, and therefore charging the batteries, during daylight hours.

The demand from the batteries is generally quite low, one of the largest single demands being the refrigerator. This is a custom-built unit cooled by water. The cold plate is placed inside one of the two purpose-built compartments which are located beneath the starboard aft berth. The space between the hull and the compartments is filled with expanding foam making the installation thermally very efficient, and also providing buoyancy should the hull be damaged in this area. The compressor cuts in for about two minutes every two to three hours when the thermostat is set at +3 °C. Being water cooled, the compressor quickly dissipates heat to the cooling water making it very energy efficient.

Total current consumption of the compressor and cooling pump is about 4 amps and running for an average of one minute per hour gives an average amphour consumption of 1/15 the of one amphour. Normal boat refrigerators, which are basically caravan units, are cooled by natural convection and consume several amphours of battery capacity.

The demand on the batteries is kept to a minimum, as Geoff and Gillian are both aware of the limitations of a yacht's electrical supplies. However, even using the microwave oven through the onboard inverter, does not consume much battery capacity. The solar panels produce an average of 70 amphours of charge per day and can cope with the normal demands of lights, fridge etc when at anchor. At sea the demand is higher because of the use of navigation equipment 24 hours a day and navigation lights at night and this is when the reserve capacity and reliability of the batteries is very important.

Since installation the Alcad batteries have required no maintenance and have been 100% reliable. The Foxes encounters with other cruising yachts have revealed that virtually every yacht has electrical problems, mainly concerning the reliability, or lack of it, of the batteries, and requiring frequent running of the engine to charge them. The higher cost of the nickel cadmium batteries, when compared with lead-acid, has been offset by their reliability and peace of mind that the Foxes have regarding their batteries. With a lifespan of twenty years it is unlikely they will have to buy batteries again.

Anyone requiring further information on energy efficient electrical systems for yachts/houses can contact Chris Laming, CPL Electrical Engineering on 01634 254056, or write to 12 Broadwood Road, Chattenden, Rochester, Kent, ME3 8LU.

The Stray Cat

Solar powered metering by radio

by Colin Boughton-Smith

Metering of energy *supplies and effective meter reading techniques are crucial to modern energy management. Here, Colin Boughton-Smith describes a solution incorporating solar powered, low power radio.*

The classical management technique of breaking a problem into manageable components and keeping close control of each component is applicable to energy and water management on large estates. Monitoring consumption in each small area is the key, but the costs of submetering, meter reading and data analysis resources have limited the application of this management technique.

Recently, the cost of metering has reduced considerably, particularly for the most expensive utility - electricity. This is due to new technology, greater competition and easier methods of installation.

Many meters have been installed at considerable cost only to then be forgotten about and not used. On several large hospitals and Ministry of Defence bases, my company has conducted surveys of the existing meters and found many meters which were not known about by the staff on site. This is because manual reading and analysis of more than, say, 15 meters is simply too time consuming.

Furthermore, and perhaps more important for consumption management, manual meter reading cannot utilise the full potential of metering. By reading the meters every half hour to produce profiles of consumption, metering can be used as a diagnostic tool to analyse consumption and identify and check wastage very rapidly. Such frequent meter reading is simply not possible by manual means. A method of automatically reading the meters and bringing the readings into a computer is needed.

By 1994, several methods of automatic meter data acquisition had become popular with large energy users. These were mainly associated with some form of hard wiring, whether by direct 'daisy chain' loops, telephone lines, or microprocessor-based building and energy management systems.

All of these methods have drawbacks when applied on large multi-building sites - either the wiring is too expensive to install and involves too much disruption on site, or the methods use mixed comms systems which often lead to responsibility demarcation problems whenever faults occur. Some consumers do not go ahead with plans to install automatic metering systems when these costs become apparent.

Typical transmitter installation

The Energy Efficiency Office (now the Energy and Environment Management Directorate of the DoE) recognised that there was a need to develop a lower cost system to overcome these problems and bring automatic metering within the means of smaller energy users. The Building Research Energy Conservation Support Unit (BRECSU) saw that my company was investigating the idea of low power radio to provide a low cost, simple to install solution to automatic meter reading, and awarded a Future Practice grant to assist this.

Low power radio was beginning to be used for meter reading in 'wireless point' systems. Pulses from the meter were fed into a transmitter and reproduced by a receiver which then fed them into a conventional hard wired meter reading system. The cost of such systems was high, and they were normally only used for isolated, remote meters on sites which already had a well-established meter reading system.

The result of the BRECSU-funded project was the DATA BIRD system, a complete, stand alone system using solar powered, low power radio. The meter pulses are counted by the transmitter to generate a meter reading which continually accumulates throughout the lifetime of the system. This reading is then transmitted at user-definable intervals to a central receiver located up to 10 km away. The receiver listens to up to 256 transmitters, and includes a data logger which stores up to 400,000 meter readings. At any time the data logger can be downloaded by a PC, either directly connected or via a modem.

The photograph shows a typical transmitter installation. Solar power was initially developed for remote locations, but we have since found that even in buildings where mains power is available it is often cheaper to install a solar panel than a 240V fused spur. It also makes the system extremely quick to install, with minimum disruption on site.

DATA BIRD systems are now installed in schools, universities, hospitals, MoD bases and several industrial sites. The system is also ideal for bureau service activities.

Automatic meter reading systems will produce a significant amount of data and it is essential that an automatic data analysis system is installed. There are several automatic energy monitoring and targeting (M&T) packages on the market, including the our DYNAMAT AUTO program. Such packages can import data from popular automatic meter reading systems and alert the user whenever excessive consumption occurs.

Regulatory incentives for

C G Thomas,
Principal Electrical Engineer,
Office of Electricity Regulation

There is much discussion of the benefits of "embedded generation" within the renewable energy and CHP communities. But just what is embedded generation, who benefits and under what circumstances. The following is an edited version of a paper given to a recent ETSU conference on the subject.

It is the purpose of this paper to put forward some of the potential benefits - and potential pitfalls - of embedded generation. It is my intention to demonstrate that these benefits can accrue both to the generating company and to the distribution system operator.

Embedded generation may be conventional thermal generation, in which I include combined cycle gas turbine (CCGT) units, operating as baseload or dayload generation, or peak-lopping sets. It may be an industrial generation plant, exporting surplus generation to the REC or PES network; this is known as 'on-site' generation and I shall return to this later. Further possibilities include CHP plant, or renewable generation.

Licensing and other agreements

Generating plant for operation in Great Britain generally requires to be licensed, though smaller plants may be licensed by exemption from this requirement. Compliance with the Grid Code is required; smaller plants will be subject to G59/1 (for plants less than 5 MW) or the forthcoming G75 for embedded generation between 5 and 50 MW.

If a generator holds a generation licence, Pool membership is mandatory, and the generator's exports onto the REC system must go into the Pool. Unless centrally despatched, a generator is free to export onto the public system whenever he wants to, and the Pool will pay Pool Purchase Price for those exports. Many embedded generators are too small to be compelled to be centrally despatched, but they can elect to be so if they wish. This gives them access to a greater range of payments from the Pool, but requires them to bid in and to accept despatch instructions form the grid operator. Note that centrally despatched embedded generation pays NGC Use-of-System charges (or receives payment in 'negative' charging zones) but confers no Triad benefit, to which I shall refer later. Generation not centrally despatched pays no Use-of System charges, but it is an absolute requirement that any generation over 100 MW shall be centrally despatched.

Embedded generators need connection agreements with the host REC, and may also need a REC Use-of System (UoS) agreement. The connection agreement has to be there in all cases and may, therefore, be the most convenient contractual vehicle in which to recognise not only the need to pay for connection but also any benefits which the generator may confer on the REC.

Embedded generators, whether licensed or exempt, may in certain circumstances be asked to enter an agreement with the National Grid Company (NGC). for reasons which NGC would explain. Generally, this would enable NGC to delay connection of the generator in exceptional circumstances. Embedded generators could challenge this by arguing that they need no agreement with NGC; if this cannot be settled then OFFER can adjudicate. In any event, the REC is prohibited from energising the connection until NGC gives clearance, so if NGC thinks an agreement with NGC is needed, it can prevent the connection to the REC's system being energised until the matter has been settled. As a result, it is important that prospective embedded generators contact NGC at the earliest opportunity to discuss these matters.

If the embedded generator is a Pool member, then exports are pooled, and are not sold direct to any identifiable supplier. The generator can, though, hedge the risk of the fluctuations in the Pool price by entering a contract for differences with any willing party.

If the embedded generator is non-Pooled he simply finds a supplier trading behind the same grid supply point, who is willing to buy exported units. They then strike a deal. This supplier could be the host REC. Title to the electricity passes to the supplier at the power station gate. It follows that, in these circumstances, the generator is not the person using the distribution system, as he does not own any electricity which is passing along that system, and is thus not liable to REC UoS charges.

OFFER cannot force any supplier to buy the generator's surplus electricity; it is up to him to go out and find a buyer. PESs have to buy electricity economically, though, so they cannot reject 'cheap' electricity without risking breaching that requirement.

On-site generation

Perhaps the most common form of embedded generation is the on-site generator. This is a plant owned by a company whose principal business is not generation, but where the generation of electricity and, often, heat, is an integral part of the main business. Examples of such generation can be found in pulp mills and paper manufacture, chemical works, food manufacture and heavy industry, while small-scale equivalents may frequently be found in hotels and leisure centres.

Such generation is often heat-led; that is that it is the demand for heat that dictates the electrical output of the generator(s). Where electrical output exceeds the demand of the owner's system, then the surplus may be exported to the REC. The exemption regulations to which I have referred are designed to allow such export with a minimum of bureaucracy; under the right conditions, up to 50 MW can be exported before the need for a generation licence or Pool membership arises.

Many of these plants run continuously, and can provide valuable support to the host REC, in addition to earning useful revenue for the owners.

The common feature of all embedded generation is that it generates electricity which is fed into REC systems other than by means of grid supply points, and often quite deeply into a REC system at 33 kV, 11 kV or even 415 volts.

All such generators will benefit from an

income stream; in the case of on-site generators this can be useful addition to their main business, while 'pure' generators will hope to make a profit from the process. Nevertheless, there has long been a view held by independent generators that RECs often do not seem to be too keen on embedded generation because it may reduce their UoS revenue. I propose to show the benefits that can accrue to a REC from the connection of embedded generation, benefits that can, of course, pass on to both customer and shareholder.

System benefits and disbenefits

There are several benefits that accrue to a REC from the presence of reliable and predictable embedded generation. As with many loads, there are parts of a REC network well-placed to receive generated output, while other circuits could not take a generator's output without substantial reinforcement works. Ability of the distribution system to receive load always has an upper limit, and it is as well to establish at an early stage the capacity of generation plant that could be accommodated without the need for expensive system reinforcement.

First, when embedded generation is running, it reduces the amount of electricity which has to be imported by the REC from the transmission system at the relevant grid supply point (GSP). NGC levies demand-related UoS charges on suppliers by reference to their demand at the GSP at the time of the three peak demands on the transmission system: the "Triad". If the generator is running at Triad, the NGC UoS charge payable in respect of the GSP is lower than it would otherwise have been: the embedded generator has conferred a "Triad benefit" on somebody. That somebody will automatically be the REC, unless the generator nominates one or more second tier suppliers trading behind the same GSP to be the beneficiary/beneficiaries. The Triad benefit arises irrespective of how, and to whom, the generator is selling the electricity: it is a function of the physical flow of electricity. For example, the generator might sell his electricity to the Pool, but sell the Triad benefit to a second-tier Supplier.

Of course, if the generator is not running at Triad, he confers no Triad benefit. (Similarly, unless he can guarantee to be available at the appropriate times, he does not permit the REC to avoid reinforcement expenditure). In other words, the generator has to be available when needed and will need to have half-hourly metering in order to demonstrate this.

The Triad benefit is only conferred by non-centrally despatched generation (the import at the GSP is grossed up by *centrally despatched* embedded generation, and NGC charges levied on the gross).

Second, generation close to the point of demand can reduce loadings on intermediate parts of the REC network, ie between the GSP and the nearer of the generator or the load. As we all know, dynamic losses in a distribution system are proportional to the square of the current; savings can accordingly be worthwhile. The Distribution Price Control Review, published in 1994, recognised that there was insufficient incentive on a REC to reduce system losses, and yet, at present, around 7% of electricity delivered to RECs at GSPs is lost before it arrives at the customer's installation. Under the previous control, the reduction of losses by 1 GWh increased the maximum allowed distribution revenue by £15,000 in the first year it was achieved. As this was widely felt to be insufficient to justify investment in greater energy efficiency, the control was amended to double the allowed revenue. We should also remember that RECs have a duty to operate and maintain an efficient, co-ordinated and economical system; I submit that embedded generation has a valuable role to play here, and would encourage dialogue between RECs and would-be generators.

Third, the existence of embedded generation can release capacity in a distribution system, thus permitting reinforcement to be deferred, or allowing new customer load to be connected. This not only results in savings to the RECs, it can also result in useful savings to their customers by way of reduced connection charges.

Fourth, and of particular interest to those RECs with lengthy rural circuits, embedded generation can provide valuable voltage support.

Of course, it has to be acknowledged that an embedded generator in the 'wrong' place can increase losses and reduce spare capacity; this merely underlines the need for early liaison between a generator and the REC, which may lead to identification of advantageous sites for both parties. On-site generation will, generally, have no such choice, as the site is usually fixed. Here, early discussions with the host REC will identify both benefits and problems, which may influence the designed export capacity, be reflected in the connection charges, or both.

There are, of course, a number of other contributions made by embedded generation; by no means all are advantageous.

Operation of additional generating plant will increase the short-circuit currents flowing in the event of a fault. Depending upon the levels already present, it may be that fault currents will exceed switchgear capacity, thus needing new switchgear and/or system reconfiguration. Harmonics on the system can be a problem - although, in many cases, it is consumers rather than generators who cause the greater problems here.

We must also bear in mind that the operation of embedded generation will affect voltage profiles on circuits close to the plant; where the generation is non-continuous (such as a windfarm), voltage variation on these lines could become a nuisance to other customers. Equally, it must be said that the presence of reliable generation within a distribution system can enhance its security, especially at peak demand levels and during system failures. All the above factors can be taken into consideration during a system study, and hence emphasises once again the need for the generator and the REC to discuss proposals at an early stage.

Distribution systems should now be open to the introduction of embedded generation. The rest is up to the market.

Name that genius

The purpose of this letter is twofold. One is to see if members of the Institute - or others - can tell me more about secondary air. The other is to suggest that obscurity is no suitable place for someone of combustion genius.

In a personal opinion and experience it would seem we have neglected in the history of innovation in this field to honour an inventor of the status of Newcomen and Watt. The introduction of secondary air has in its age done more for steam raising and use, and for basic emissions control than any other. We do not seem to have given honour where honour appears to be long overdue.

According to recollection dating back fifty years or more the introduction of secondary air has been said to result from World War II when North Sea colliers and others attracted enemy aircraft by their smoke. Oliver Lyle, well remembered for his text books on energy, steam and heat-use was, again from recollection, knighted for his wartime services to energy - particularly for the simplest possible move to thwart the enemy. He saw to it that boiler fire doors were drilled through with a pattern of holes.

Since boiler rooms were of necessity pressurised to provide forced draught, as primary air these holes, crude as they now seem, served to introduce the essential secondary air to burn bituminous coal more or less smokelessly.

At this point I have to introduce a personal note. When editor of The Master Builder (1955/1965) at an exhibition I came across an introduction from the USA. This was the Stokermatic; the impression remains - a coal-fired warm air heater with full automatic coal feed and control. With nutty slack then available at £4 per old ton this became for me the nucleus of the low energy house I began to plan.

The NCB chief of research readily agreed to provide the successor, a Triancomatic, Redfyre having taken over the original design.

What I found fascinating was the overfire supply of secondary air - and the difference this made to the heat produced and the flue gases. From disastrously smoky effluent to near-clean fumes from a fierce white flame.

The second time the feed worm failed I tried hand stoking and learnt the hard way - from complaining neighbours. That was the end. I was pressured initially to forget nutty slack and buy singles at something like £40 per ton. This went up by leaps and bounds to over £100. At that point, and compared with the cost of a new worm, Trianco no longer stocking spares, drove me to oil. Otherwise this domain would still be based on coal - but for one drawback.

Originally coal was delivered - from Leicestershire - by pneumatic tanker. The operator was skilled, dribbling in nine tons of the singles gently into the bunker. The last two deliveries were blown in brutally, eroding the sheet metal bunker end and, worse, smothering the adjacent garage and workshop with coal dust. That really was the end - but not of the dust. We still have that legacy.

To revert to my main purpose: who was the genius who first discovered secondary air? Just as simple and perhaps just as accidental as the first thoughts of Newcomen and Watt - but what an influence on the use of steam and the use of bituminous coals to supplement scarce and expensive anthracite.

Coal has not had its day; secondary (and tertiary) air still remains essential and ubiquitous. Who was that genius? We owe him at least a named place in the history of industrial development. Who would agree to give him (or her?) equal status with Newcomen and Watt?

Time is passing; secondary air is now so commonplace it is taken for granted but someone must have had the idea first; unlike other basic innovations the benefits must have been so obvious as to be widely adopted from first sight. Although very probably patentable too many must have got into the act initially. Who can name that genius?

Norman Jenkins

Environmentally intrusive?

There have been a considerable number of articles in *Energy World* in the last year or two explaining the advantages and general desirability of wind-based power systems. The article by Gaynor Hartnell from the British Wind Energy Association in the October/November was very interesting and contained a great deal of valuable information. There is a role for this power source in certain circumstances. I have only one point to make about this and similar articles.

It is appropriate to describe this type of electricity generation as sustainable, but I, and many others I am sure, will object to the term 'environmentally friendly' being used to describe it. As the photograph on page 4 shows, these machines are grossly invasive in the natural landscape and their visual impact is a high price to pay for the modest amount of electricity that they generate.

P H Spare (F)

The Editor welcomes concise letters on articles which have appeared in Energy World and on wider energy issues.

Letters may be edited.

Please address your letters to the Editor, Energy World at The Institute of Energy, 18 Devonshire St, London, W1N 2AU or fax them to: 0171 580 4420.

The Institution of Fire Engineers - Bi-Lateral Agreement

On Tuesday, 21 January 1997, a Bi-Lateral Agreement between The Institute of Energy and The Institution of Fire Engineers was signed by the respective Secretaries at a meeting of the two bodies at 18 Devonshire Street.

This marked a milestone in the history of both Institutions and represents an important step forward in raising the profile of both bodies.

As background to this agreement, on 21 January 1994, the Institution of Fire Engineers (IFE) and the Institution of Fire Safety (IFS) signed a Memorandum of Understanding, under which a Joint Working Panel (JWP) was established to identify areas of mutual interest. One such area was an application by the IFE to the Engineering Council (EngC) for Nominated Body status.

Subsequently the IFE has been awarded Conditional Nominated Body status and until such time as Nominated Body status is granted, the IFE have created an Engineering Council Division (ECD) to look after the interests of those of their members who seek EngC registration and to progress the application for Nominated status. Membership of the Shadow Board of the ECD is composed of representatives from the IFE, IFS, EngC, IoE and others as required.

One of the conditions expressed by the EngC requires the IFE to enter into a bi-lateral agreement with another institution and in view of our accreditation of Fire Engineering courses, and our previous discussions with the IFE going back beyond 1993, it was perhaps a natural extension that the IFE should turn to the IoE.

In essence the current agreement means that the IoE will register suitable applicants from IFE with the EngC, and that there is a concomitant requirement for such applicants to be members of the IoE. At the same time we will retain our representation on the Shadow Board ECD of the IFE to assist in their application for Nominated Body status.

Annual General Meeting

Notice is hereby given that the Annual General Meeting of The Institute of Energy will be held at 18 Devonshire St, London, W1N 2AU on Thursday, 8th May 1997, commencing at 10.30am.

The Institute would welcome anyone who is a member to attend. This is an ideal opportunity to come and visit the Institute, meet the staff, contribute your ideas on the way forward for the Institute and mingle with your colleagues.

To be followed immediately by the Annual General Meeting of the Benevolent Fund.

We look forward to seeing you.

New Members

MEMBERS

Tony Eric Grainger,
A E Robb & Associates, Newcastle-upon-tyne
James Joseph Kingsmore,
James Clarke & Partners, Belfast
Steven Milne, Dundee City Council, Dundee
Peter Leonard Stephenson,
National Power Plc, Wiltshire
Paul Arthur Wainwright,
Inenco Group, Lancashire

ASSOCIATE MEMBERS

Stephen Eugene Butler,
D D Butler Ltd, N Ireland

ASSOCIATE

Margret Nicola Noone,
University of Wales
Amanda Jane Gamble,
University of Wales
John James Hart,
University of Leeds

GRADUATES

Michael Anthony Blosse,
Saacke Ltd, Hampshire
Daniel John Lesser,
Merz & McLelland Ltd, Newcastle-upon-Tyne
Michael Elton Smith

GROUP AFFILIATE

Magnox Electric Plc,
Gloucestershire

STUDENTS

Michael Eton Cartwright,
University of Paisley
Katherine Elizabeth Chance,
University of Newcastle-upon-Tyne
Nicola Louise Cunningham
University of Newcastle-upon-Tyne
Joy Davies,
University of Newcastle-upon-Tyne
Paul Nigel Dunn,
University of Newcastle-upon-Tyne
Alfred Oritshuwa Erike-Etchie,
University of Loughborough
Mohinder Pal Singh Gill,
University of Greenwich
Emma Louise Hall,
University of Leeds
Kathryn Mary Harris,
University of Leeds
Andrew Peter Hedges,
University of Leeds
Yung Kan Ku,
UMIST
Mark William Lewis,
University of Newcastle-upon-Tyne
Christopher Meek,
University of Portsmouth
John Peter Eric Muller,
University of Newcastle-upon-Tyne
Colin Thomas Salt,
University of Leeds
Stephen Bolver Smith,
Napier University
David John Willis,
Napier University

Calling all members...

Join us to celebrate our 70th Birthday!

This is a personal invitation to each member of The Institute of Energy to make an appointment in your diary and join us on the **29 April '97** to celebrate the 70th Anniversary of the actual foundation day of The Institute of Energy in 1927.

Sir Bob Reid, Chairman of London Electricity will be our principal guest and speaker. Use the occasion to wine and dine your clients or simply reminisce with fellow members. With a thought provoking speaker, excellent food and wine, coupled with the relaxing ambience of the Langham Hilton, our birthday is not one to be missed.

Thanks to the generous sponsorship of National Grid plc, British Gas plc and Unilever **the ticket price this year is only £18.00 plus VAT.** Please use the booking form enclosed.

Or contact Mrs C Pavey tel: 0171 580 7124, fax: 0171 580 4420 or email cpavey@ioe.org.uk to reserve your place.

Diary of Institute Events

February 1997

NORTH WEST BRANCH
Thursday 20, Friday 21 February "Invent Conference" University of Stuttgart. Contact Mr E Curd, tel: (0151) 625 6744

NORTH WEST BRANCH
Monday, 24 February "Monitoring and Targeting to achieve Saving on Energy Cost". Risley Conference Centre, Warrington. Contact Mr E Curd tel: (0151)625 6744

YORKSHIRE BRANCH
Wednesday, 26 February, 6..30pm. Site visit to CCGT Power Station at Keadby, South Humberside, reservations by application form. Contact Mr A Mallalieu tel: (0113) 276 8888

ENERGY INDUSTRIES CLUB
Wednesday, 26 February "Energy Policy" James Wallace MP, Liberal Democrat. Contact Dr G G Thurlow, tel: (01684) 574481

NORTH WEST BRANCH
Friday, 28 February
Visit to Dinorwig Power Station. Contact Mr E Curd, tel: (0151) 625 6744

March 1997

SCOTTISH BRANCH
Tuesday, 4 March
"Young Engineers," to be held at Napier University, Edinburgh. Contact Mr R Loudon, tel: (0141) 332 4153

MIDLAND
Thursday, 6 March
"Performance Testing of Early Steam Engines" by Dr. J. H Andrew, Keeper of Industry & Collections, Birmingham Museum of Science & Industry. Contact Mr DEA Evans, tel: (01384) 374329

YORKSHIRE BRANCH
Tuesday, 11 March, 7.30pm
Meeting with the Institute of Petroleum. Cedar Court Hotel, Contact Mr A Mallalieu, tel: 01413 276 8888

NORTH WEST
Wednesday, 26 March, 6.00p.m. "Nuclear Issues", AEA, Thompson House, Risley. Contact Mr E Curd, tel: (0151) 625 6744

"Renewable Energy - its role in the future" *Dr Mary Archer*

Consider the whole history of the world to date compressed into a year, such that the formation of planet Earth commences at 00.00 on January 1st and 00.00 on December 31st marks the present time. April 1st then sees the origins of life and, on May1st, photosynthetic organisms first appear. On November 20th the Cambrian era begins and fossil fuels are deposited on December 1st. Homo Sapiens does not appear until 23.50 on December 31st and at 23:59:58 the Industrial Revolution takes place. Following this analogy (after Sagan), fossil fuels will be exhausted within "seconds".

Thus did Dr Mary Archer set the scene in delivering The Institute of Energy Northern Ireland Section's Prestige Lecture 1996, which was sponsored by NIGEN Ltd, B9 Energy and NIE, and marked the 50th anniversary of the Institute's incorporation by Royal Charter. Dr Archer, a noted scientist now influential at policy level, cut her research teeth in the field of photovoltaic cells, though she is now a recognised expert in all types of renewable energy.

Dr Archer expressed confidence that renewable energy would continue to play an increasingly important role in the future, as technologies improve and unit costs are reduced. Dr Archer also acknowledged that a significant increase in the uptake of renewables in the immediate term would only come from a sharp increase in fuel prices, such as might result from fears of fuel scarcity or sudden alarm regarding global warming and other environmental effects.

Report by:

Dr Patrick Waterfield
Honorary Secretary
Northern Ireland Section.

February 1997

Monitoring and targeting to achieve saving on energy cost.
Conference, 24 February, Warrington, £445 + VAT.
Details from AiC Conferences Ltd, tel: 0171 242 2324, fax: 0171 242 2320

Executive Development Week for the Utilities
Interactive seminars, in association with The Institute of Energy, 24-28 February, Bristol, £3300. Details from Learning in Business Ltd, tel: 0181 944 9030, fax: 0181 944 0434

Gasification technology in practice
Institution of Chemical Engineers conference, 26-27 February, Milan. Details from Tracey Lepkowska, IChemE, tel: 01788 578214, fax: 01788 560833, e-mail: tlepkowska@icheme.org.uk

Electricity Pool pricing, trading and settlement
IIR conference, 26-27 February, London, £899 + VAT.
Details from IIR, tel: 0171 915 5055, fax: 0171 915 5056

Offshore pipeline technology
Conference, 26-28 February, Amsterdam. Details from IBC, tel: 0171 637 4383, fax: 0171 631 3214

Managing costs, data and processes in metering & billing in utilities
Conference, 27 February, London, £695 + VAT
Details from AiC Conferences Ltd, tel: 0171 242 2324, fax: 0171 242 2320

Energy market liberalisation - what impact on the environment?
Half-day COGEN Europe seminar, 27 February, Brussels, ECU 50. Details from COGEN Europe, tel: +32 2 772 5044, fax: +32 2 772 8290

Spot & futures gas markets
Conference, 27-28 February, London, £799 + VAT. Details from SMi Ltd, tel: 0171 252 2222, fax: 0171 252 2272, email: 100531.3067@compuserve.com

March 1997

Solar thermal electricity generation in developing countries
International workshop, 1 March, New Delhi, India. Details from Peter Raftery at IT Power Ltd, tel: 01189 730073, fax: 01189 730820, e-mail: itpower@gn.apc.org

CFD in engineering design
Short course at the University of Leeds Department of Fuel and Energy, 3-4 March, Leeds. Details from Jamie Strachan, tel: 0113 233 2494, fax: 0113 233 2511, e-mail: shortfuel@leeds.ac.uk

Arab Electricity '97
Conference and exhibition, 3-5 March, Manama, Bahrain. Details from Pennwell Conferences, tel: +31 30 265 09 63, fax: +31 30 265 09 15, e-mail: frank@pennwell.com

Fluid filled electricity cables
EA Technology seminar, 4 March, Maidenhead, £250 + VAT.
Details from Ms Del Bennett at EA Technology, tel: 0151 347 2557, fax: 0151 347 2178, email: db@eatl.co.uk

Drilling
US Society of Petroleum Engineers conference, 4-6 March, Amsterdam. Details from SPE London, fax: 0171 487 4229

Insuring pollution risks
Conference, 5-6 March, London, £749 + VAT. Details from IBC Conferences, tel: 0171 453 2706, fax: 0171 323 4298, email: gemma_wall@ibcuklon.ccmail.compuserve.com

The implications of the Labour Party proposals for the utilities
Conference, 10 March, London, £495 + VAT. Details from Management Forum, tel: 01483 570099, fax: 01483 36424, email: management_forum@uk.pipeline.com

Industrial Air Pollution Monitoring
Short course at the University of Leeds Department of Fuel and Energy, 10-12 March, Leeds. Details from Jamie Strachan, tel: 0113 233 2494, fax: 0113 233 2511, e-mail: shortfuel@leeds.ac.uk

Executive Development Week for the Utilities
Interactive seminars, 10-14 March, Dublin, £3300.
Details from Learning in Business Ltd, tel: 0181 944 9030, fax: 0181 944 0434

Emissions Monitoring
Exhibition, 11 March, Leeds. Details from Jamie Strachan, tel: 0113 233 2494, fax: 0113 233 2511, e-mail: shortfuel@leeds.ac.uk

The future of the UK gas industry
Conference, 11-12 March, London, £934.
Details from Business Seminars International Ltd, tel: 0171 490 3774, fax: 01424 773334

Microwave and radio frequency heating
Course, 17-18 March, Cambridge University. Details from Dr A C Metaxas, tel: 01223 332680, fax: 01223 332662, e-mail: acm@eng.cam.ac.uk

The impact of climate change on business and industry
IBC conference, 17-18 March, Brussels, £1028
Details from IBC, tel: 0171 453 2704, fax: 0171 631 3214, email: tiffany_goubard@ibcuklon.ccmail.compuserve.com

Heat exchangers
Course, 17-21 March, The Netherlands. Details from The Centre for Professional Advancement, tel: +31 20 638 2806, fax: +31 20 620 2136

Power Generation & Maintenance 97
Exhibition, 18-19 March, Glasgow. Details from Nicky Molloy, FMJ International Publications Ltd, tel: 01737 768611, fax: 01737 761685

Performance indicators in utility companies
Conference, 20-21 March, London, £799 + VAT.
Details from IIR, tel: 0171 915 5055, fax: 0171 915 5056

Where are the Utilities going?
Strategic Planning Society Conference, 24-26 March, Stratford upon Avon, £1050.
Details from the IGE, tel: 0171 636 7737, fax: 0171 323 1692l

The Third International Conference on

COMBUSTION & EMISSIONS CONTROL

11 & 12 June 1997, Bath, UK

ANNOUNCEMENT

The Institute of Energy is running the third in the series of these highly successful conferences. This conference will improve on the success of its predecessors, by expanding on the topics and by introducing new and innovative knowledge to the equation. The conference will act as a forum for discussing the state of the art technology and experience as well as to explore innovative research leading to further developments.

The following areas plus many other subjects will be covered:

- ***Power Generation***
- ***Gas Turbines***
- ***Process Industries***
- ***Biofuels***
- ***Refueling options***
- ***Pollutants***
- ***Industrial Experience of new Combustion Systems***
- ***Novel Combustion Systems***

EXHIBITION

The Assembly Rooms in the centre of Bath are ideal to house a large exhibition, the airy Georgian surroundings give delegates plenty of room to browse, providing exhibitors with an excellent environment to address the delegates. Those interested in exhibiting should contact Louise Collins at The Institute of Energy on (+44) (0)171 580 0008.

LOCATION

The idyllic historical setting of Bath will enthuse any delegate who attends the conference. Discussions on the latest technology and expertise will take place ironically in the beautiful historic setting of the Pump Rooms, beside the Roman Bath, adding an interesting perspective.

Tuesday, 10 June	*(evening)*	**Pre-conference reception & Exhibition preview**
Wednesday, 11 June	*(day)*	**Conference Sessions & Exhibition**
	(evening)	**Conference dinner,** ***to be held in the Pump Rooms***
Thursday, 12 June	*(day)*	**Conference Sessions & Exhibition Close of Conference**
Friday, 13 June	*(day)*	**Technical Visit (Optional)**

If you would like to receive further information on this conference or the Institute of Energy, please contact us at 18 Devonshire Street, London W1N 2AU. Tel: 0171 580 0008, fax: 0171 580 4420.

the institute of energy