ENERGY WORLD

The magazine of The Institute of Energy

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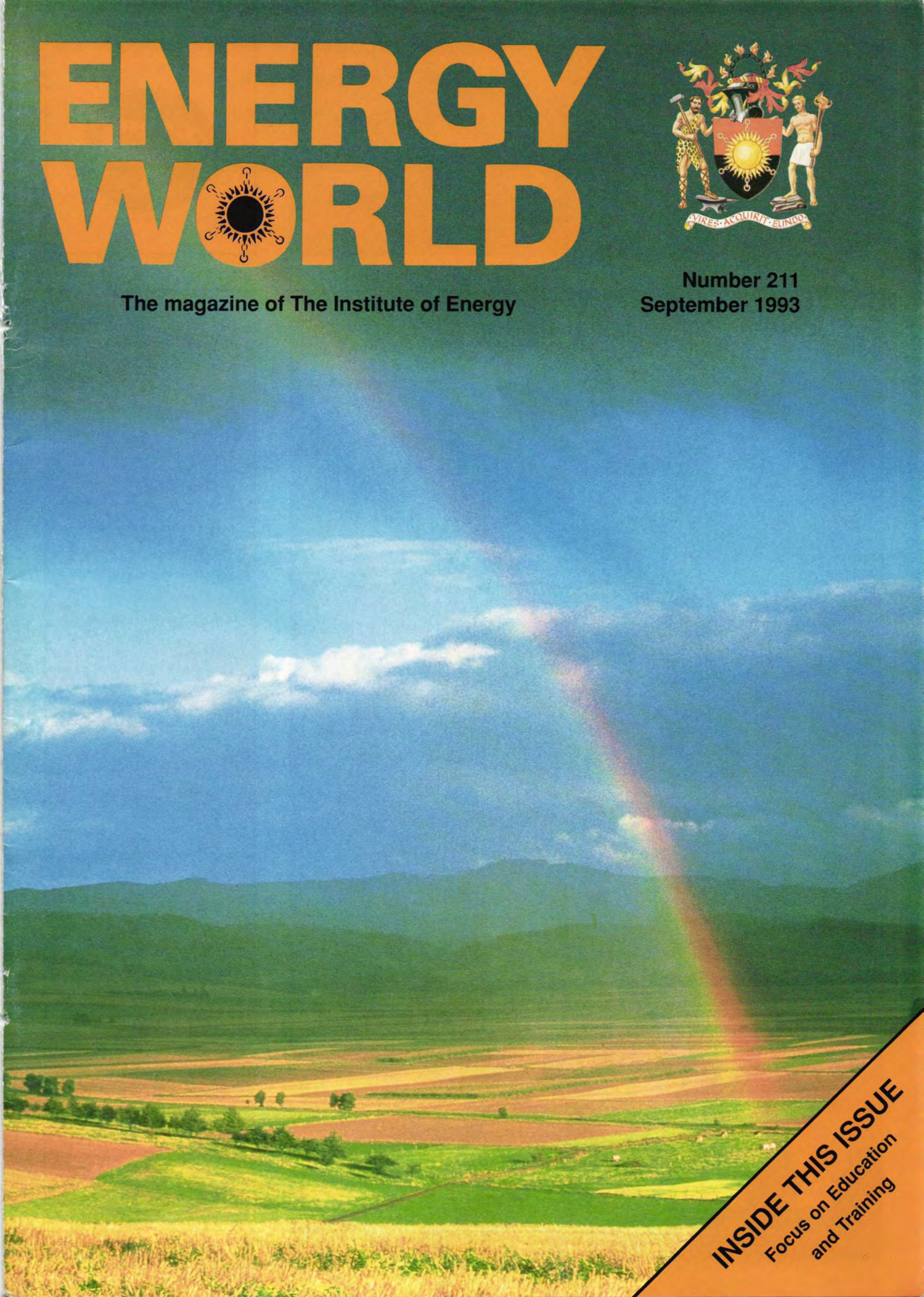
September 1993



INSIDE THIS ISSUE

Focus on Education and Training

National Power is now
generating more power from less fuel.
Just like that.

Abracadabra. More power from less fuel. Tens of thousands of tonnes less fuel last year alone. No trickery, statistical or otherwise, and nothing up our sleeves. We've simply improved the energy efficiency of our power stations and offices with the help of two very attractive assistants - Investment and Technology. More than two and a half million pounds is being spent improving the efficiency of Didcot power station. And energy saving projects at our offices in Swindon have reduced our energy usage by a third. In fact all of our energy saving projects are currently saving us money. A lot of money. Drum roll please. Several million pounds every year at the last very long count. Then there's the environment. A subject everyone's keen on. Thanks to our more efficient power stations, we're already reducing emissions of all the main gases associated with acid rain. In truth we're continually trying to find ways to produce power in cleaner and more efficient ways. As Britain's largest supplier of electricity, it's not only in our interests to do so. It's also in yours. It may be a cliché, but we really are a hard act to follow.

National Power.
Ahead of
current thinking.

ENERGY WORLD

SEPTEMBER 1993 **Number 211**

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COVER

As the Nuclear Review approaches, the industry is making the most of its 'green' image. Whilst many environmental groups continue to campaign against nuclear power generation, the industry points out that if the UK is to achieve projected EC targets for carbon dioxide emissions, more rather than less nuclear power will be needed. Nuclear Electric's chief executive Dr Robert Hawley outlines his hopes for the future of the industry on pages 16-19.

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Higher GNVQs for engineers:
useful ladders or pointless bridges?

ONCE upon a time, long ago (as measured in units of rapid educational changes) there was a Council of Engineering Institutions (CEI), with an Engineers' Registration Board (ERB). One of the early laudable efforts of its successor, the Engineering Council (EC) with its Board for Engineers' Registration (BER) was to produce (1983), publish (1984) and revise (1990) a valuable discussion document based on accumulated CEI experience: *Standards and Routes to Registration* (SARTOR).

The SARTOR document was — and still is — a most commendable attempt to summarise the various educational routes and opportunities whereby professional engineering qualifications could be obtained, using a variety of 'ladders and bridges' from lower to higher levels. The professional engineering qualifications were Chartered Engineer (CEng), Incorporated Engineer (IEng) — replacing the confusing term of 'technician engineer' — and Engineering Technician (Eng Tech).

Admission to the BER register requires evidence at three stages. Stage one is an appropriate academic requirement; stage two is the training component; and stage three, the 'responsible experience' element. For non-mature candidates, stage one accreditation requirements are as follows: for CEng, the Bachelor of Engineering (BEng) or equivalent; for IEng, the Business and Technician Education Council (BTEC), Higher National Diploma (HND) or equivalent; and for EngTech the BTEC National Diploma or equivalent.

But the world does not stand still. There is now much talk of continuing professional development (CPD), and an important new development since 1983 is the emergence in 1986 of the government-driven National Council for Vocational Qualifications (NCVQ).

The NCVQ (Scottish equivalent: SCOTVEC) began with the laudable intention of providing an opportunity for the disproportionately large section of the UK population that has no, or virtually no, qualifications to obtain vocational certification, via their everyday workplace experiences. Assessment of competence to perform certain tasks would be carried out by a NCVQ-appointed award body. Like the driving test, the assessment would be criterion-referenced. Satisfactory competence in the workplace is rewarded by a National Vocational Qualification (NVQ, SVQ in Scotland) obtainable in the widest possible variety of competence areas, defined by employer-led groups called 'lead bodies', approved by the Department of Employment.

NVQs are assessed at various levels of competence. A recent development, the GNQV — 'G' stands for 'general' — requires the candidate additionally to show ability to possess certain knowledge, understanding, reasoning skills, outside their workplace environment. Initially the concern of the NCVQ was to establish a system at the lower levels of NVQ 1 (roughly, basic training schemes standards) and 2 (GNVQ2, roughly comparable to BTEC foundation year standards), where most people with no qualifications are found. Quite rightly, the NVQ system encourages people to upgrade their skills and to consider tasks they might have otherwise thought beyond them.

However, when NCVQ reached level 3 (GNVQ3 comparable to BTEC National/A level standard) and began talking about levels 4 and 5 (BTEC Higher National/University degree standards) it became obvious that professional organisations, such as the EC, and the NCVQ would have to consult each other — otherwise, as Prof Keith Foster so aptly put it: 'industry would think that we had gone mad.' The EC responded in 1991 with the Engineering Occupations Standards Group, funded by the Employment Department, to co-ordinate the dovetailing of higher-level NVQs — 3 and above — into existing professional standards.

The Prime Minister, John Major, is known to be a strong supporter of NVQs, and is keen to see 'parity of esteem' with traditional exam-based qualifications. A test of this will be the reaction of University admissions tutors to the first entrance applicants with GNVQ 3 qualifications, next year, and their subsequent performance.

Such is the pace of change in the engineering education and training scene that certain details of this article will soon be obsolete, if current EC thinking comes to pass. The three familiar categories of registration may be replaced with new levels, the lower two incorporating elements of the existing categories, whilst the third will be higher than the current CEng. The following observations use current terminology in the interests of brevity.

There are major aspects of the developing NVQ system that should be strongly welcomed. Both employers and further education institutions need to respond positively to NVQ/GNVQ developments at levels 1, 2 and 3, where the most serious gaps in our unqualified workforce occur. Here a major concern centres on the logistics and uniformity of testing procedures. Talk of tests on demand and A level modules available several times a year overlooks the time-consuming problems of marking, security and uniformity.

For developments, in particular at levels 4 and 5, the professional institutions have a special interest, and they should not be afraid to push their traditional values. There is merit — at stage 2 and CPD in particular — in welcoming input from any source which would help to harmonise, record more clearly, and more uniformly test the quality of these rather variable experiences in the professional lives of engineers.

Beyond this one is entitled to ask whether the NVQ system really has any valid role. The existing engineering institutions are perfectly capable of absorbing these quality control changes, without the parallel apparatus of NCVQ-originated moderators, most of whom would probably be members of institutions anyway. It is one thing to accept quality assurance procedures, it is quite another to one's accredibility neutered.

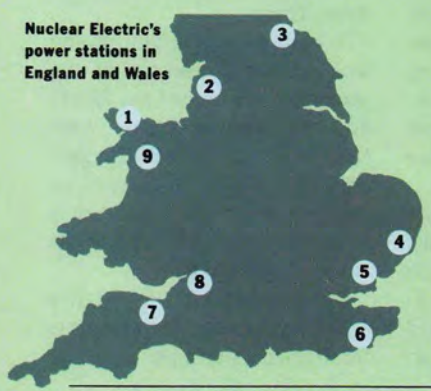
Britain's proportion of graduate-level educated people is amongst the highest in the world. Although it is certainly a source of concern that a higher proportion of these are not engineers, the GNVQ system will do nothing to remedy the problem at CEng level (although it may help at IEng level). There are simply not that many mature CEng level people in the woodwork, and the few that there are can be catered for by present mature candidate regulations. It should also be remembered that CEng level professional engineers should have demonstrably analytical minds — a quality that simply cannot be learned in the workplace as a competence skill.

The engineering profession has major challenges to meet, which the EC is commendably facing. But most important, one must not lose sight of the UK engineering image factor. Overcome this, let manufacturing employment gain in importance and respect, pay engineers what comparable professions command, and much of the present hand-wringing, course-tinkering (often done for little other purpose than providing cosmetic attraction to the increasing proportion of weaker students at present entering the profession) would disappear.

Dr Peter J Padley
Chairman IoE Education & Training Committee; Dean of Engineering, University of Wales, Swansea

We don't contribute to global warming, we don't contribute to ozone depletion and we don't cause acid rain.

Are we friends of the earth?



Currently, 40% of the gases that contribute to the greenhouse effect are caused by the burning of fossil fuels. What's more, if the same amount of power produced by us was produced by fossil fuels it would mean an extra fifty million tonnes of CO_2 every year. Breathtaking isn't it. The fact is the twelve nuclear power stations we operate in England and Wales are safe, environmentally responsible and reliable. Spend an afternoon at a nuclear power station and we'll be able to tell you so much more. It certainly won't affect your body but it might just change your mind.

1. Wylfa **2.** Heysham 1&2 **3.** Hartlepool **4.** Sizewell A&B **5.** Bradwell **6.** Dungeness A&B **7.** Hinkley Point A&B **8.** Oldbury-on-Severn **9.** Trawsfynydd

Nuclear Electric

To visit a nuclear power station, or for more information, write to this address: Peter Haslam, Nuclear Electric plc, 123 Pall Mall, London SW1Y 5EA.

European inspectorate established

A EUROPEAN Committee of User Inspectorates (ECUI) was established in June with a core membership of the UK, Holland, France and Germany.

The inauguration took place in June, following an initiative by the Committee of User Inspectorates (CUI), which represents the in-house or second-party inspection organisations of the major operators of equipment in the oil, process and energy industries of the UK.

The new committee is open to representative groups such as the CUI throughout the EC and EFTA. Switzerland and Sweden have already shown interest.

The broad aim of the ECUI is to reinforce official recognition of the status and competence of second-party inspection bodies, and to promote the advancement of their full potential.

The organisation aims to expand by extending formal invitations to all appropriately representative groups and to encourage the development of others. It will continually monitor evolving EC legislation, and keep its members informed, as well as providing a forum for exchange of views and information. It also aims to seek representation in relevant EC forums to influence legislation when necessary. In addition the ECUI will support the development of suitable EC standards and accreditation and certification schemes relating to inspection.

Interested parties should contact: Chris Hutchins, Secretary ECUI, c/o EEMUA, 14-15 Belgrave Square, London SW1X 8PS.

Concern at population growth

SCIENCE academies will take part in an international summit on world population in New Delhi, India in October.

The stated aims of the summit are to produce a jointly-formulated statement, representing scientists worldwide, demonstrating their concern about the issue of population growth; to increase public awareness of the issue and its impact on the environment; to stimulate research and education and to inform government policies.

The second session will include a paper on 'energy consumption and population' — the speaker was still to be arranged at the time of going to press.

Hydro in China

CHINA'S first high power hydro electric plant, with an output of 1200 MW, was officially opened in August in the Canton province of Guangzhou.

Work began on the plant in 1988, and its success led the Chinese authorities to commission a second, identical stage, making Guangzhou the most powerful pump-turbine plant in the world by the end of this century.

Demand for electricity in China has been growing at such a rate that supply can barely keep pace. Installed capacity was 100 000 MW in 1988. Today it is in the region of 200 000 MW. By the year 2000 it is expected to have reached 300 000 MW.

Electricite de France supplied much of the equipment, conducted trails and will manage the plant's operation.

Environmental study in India

A UK consultancy has begun work on an environmental study to assist the development of a national environmental management programme for coal-fired power generation in India.

The contract was awarded to Ewbank Preece by the Asian Development Bank on behalf of the the Ministry of Environment and Forests of the Indian Government.

The survey will make an examination of coal resources and their characteristics in terms of environmental suitability for power generation.

The project began in May, and is scheduled to be completed by the end of February 1994.

PHOTO: ARGONNE NATIONAL LABORATORY

Pictured above (centre) is Yoon Chang, general manager of the Integral Fast Reactor programme at the Argonne National Laboratory in the United States of America. He is seen here monitoring tests of an electrorefiner that recycles nuclear fuel, and reduces environmental risks of waste storage. On the right is Sadao Hattori, vice president of Central Research Institute of Electric Power Industry. The Japanese utilities organisation and the Japan Atomic Power Company are jointly contributing $40 million to the recycling research effort. The electrorefiner separates uranium, plutonium and other long-lived transuranic materials, used to create new fuel, from the short-lived fission products, which cannot be reused as fuel. The device has been shipped to Argonne's Idaho site for installation in the reactor's fuel cycle facility.

Promised aid spread too thinly

GOVERNMENT aid that complements private investments in Russia would accelerate the country's conversion to a market-driven economy by providing relatively quick examples of success, according to an American energy executive, Constantine Nicandros of Conoco.

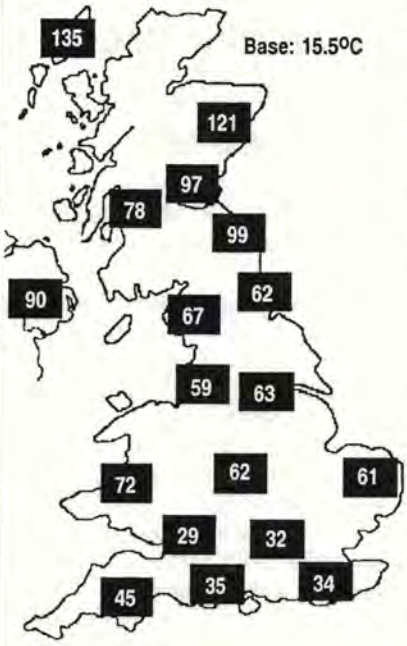
He was speaking at the Royal Institute for International Affairs in London in July. His company, Conoco is part of the first US-Russian joint venture registered to develop a new oil field, located north east of Moscow, in the Arkhangelsk region above the Arctic Circle.

'I believe that much of the western aid promised has the potential to be spread too thin to do any lasting good,' said Nicandros. Aid from OECD governments should be focused on areas where private investment is already taking place, such as the Arkhangelsk region.

Mr Nicandros was highly enthusiastic about the prospects for future partnerships.

DEGREE DAYS: JUNE 1993

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.

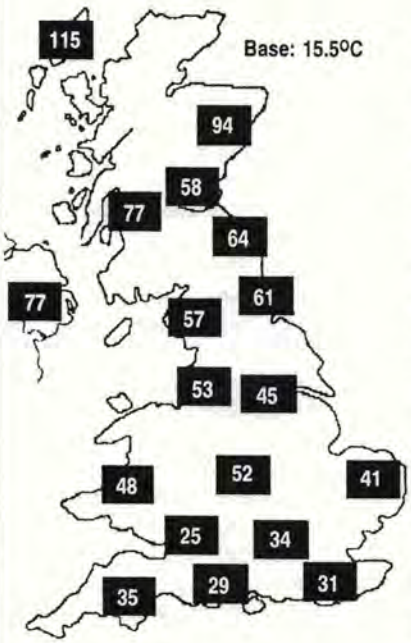
A well-controlled heating system should manifest a straight line relationship between monthly fuel used and the local degree-day value; any significant deviation from this 'target characteristic' is likely to signal the onset of avoidable waste (such as a stopped timeswitch or an open isolating valve).

Readers can get more information on the use of degree days from Vilnis Vesma, 17 Church Street, Newent, Glos GL18 1PU (0531-821350)

 Because different observing stations are used, the figures given here will not necessarily agree exactly with those from other information providers.

DEGREE DAYS: JULY 1993

Source: **Degree days direct**



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Announcing . . .
The Tenth International Symposium on Alcohol Fuels

November 7-10, 1993
Broadmoor Hotel
Colorado Springs, Colorado

At the Tenth International Symposium on Alcohol Fuels, scientists and researchers from around the world will present technical advances relating to the production and use of alcohol fuels. The symposium is yet another step on the road to commercialization of alcohol fuels. Presenters will highlight various aspects of alcohol fuels, with the intent of developing strategies to improve the environment, particularly air quality; to foster and ensure increased energy security; and to create attractive economics for the fuels. In recent years more than ever, these goals have assumed global importance.

Specific topics to be covered during the four-day symposium include:

- Alcohol/ether production technologies
- Alcohol/ether blend utilization in reformulated gasoline
- Neat alcohol utilization technologies
- Economic, political, social, and institutional aspects.

The U.S. Department of Energy is sponsoring this tenth year of the symposium. It will be held at the Broadmoor Hotel in Colorado Springs, Colorado, November 7-10, 1993.

For more information, contact:
Jessica White
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401-3393 USA
Telephone: (303) 231-1158
Fax: (303) 231-7719

MMC concludes British Gas should be split

THE summary and conclusions of the two Monopolies and Mergers Commission (MMC) reports on the gas industry were published in August.

The reports concluded that as both a seller of gas and the owner of the transportation system, British Gas' dual role gives rise to an inherent conflict of interest. The lack of effective neutrality of the transportation and storage system reduces competition to the non-tariff market. The MMC recommend divestment of BG's trading activities by 31 March 1997. It recommends that the threshold for the monopoly supply to tariff customers should be reduced from 2500 to 1500 therms by the same date.

Also recommended is that the rate of return used in setting transportation charges should be between 6.5 and 7.5% on new investments under current conditions. This is equivalent to between 4 and 4.5% on existing, current cost assets.

The tariff formula should be adjusted from RPI-5 to RPI-4 to take account of the recent reduction in the monopoly threshold from 25 000 to 2500 therms.

The MMC's detailed year-long enquiry has culminated in two formally separate, but closely linked reports. The first was to Michael Heseltine, under the Fair Trading Act 1973; the second to Sir James McKinnon, DG of Gas Supply under the Gas Act 1986.

BG chief executive, Cedric Brown, commented: "BG asked for a wide-ranging enquiry in order to provide clarity and stability for the future as well as essential financial relief for the business. The recommendations should allow the company to plan ahead with greater certainty." But he went on to say: "It is clear that the limited financial relief proposed will not greatly alleviate the financial pressure being suffered by both the gas supply business and the company as a whole. We shall therefore undertake a stringent review of our entire investment programme, both UK and international."

Not surprisingly, the reports have been welcomed by the smaller gas companies, several of whom have denied BG's claim that the report will result in higher gas prices for domestic consumers.

New building research group

TWO new Building Research Establishment groups started work at the beginning of September, in response to a growing demand for research related to energy efficiency and the environment.

The Buildings Energy Efficiency Group (BEEG), headed by Dr Vic Crisp, has evolved from BRE's former Building Energy Efficiency Division, which includes BRECSU. The Environmental Engineering Group (EEG) led by Dr Tony Birtles, will manage the Environmental Systems and Environmental Physics Divisions, as well as BRE's laboratory in East Kilbride.

Rock bolts opposed by unions

IN THE immediate aftermath of the massive fall of ground at Bilsthorpe Colliery, which cost the lives of three men, attention was sharply focused on the system of rock bolting which British Coal has introduced in most pits in its bid to speed operations and cut costs.

Unions, including the officials' organisation NACODS but excluding the UDM, had been opposing the universal introduction of rock bolting on the grounds of diminished safety. After the Bilsthorpe accident the Labour Party joined in the condemnation of British Coal.

The inquiry set in train by the Mines Inspectorate, however, even before it began to take evidence, was throwing doubt on the liability of the support system. And experts from Australia and the US threw their weight behind rock bolting, saying that by binding layers of strata together in a laminate, the resulting beam was capable of supporting enormous stress.

Attention is now turning towards the proximity of a worked out coalface which is parallel to the supply gate being driven to open out a new face — in which the massive fall took place. Unconfirmed reports now say that a pillar of coal perhaps no more than a metre across had been left between the old and new roads, providing insufficient support for the enormous pressure that would have been exerted along one side of the laminated beam. No date has yet been fixed for publication of findings.

Fifth windfarm on order

NATIONAL Wind Power (NWP) is to build a new windfarm on land 450 m above sea level at Bryn Titli, 9 km north of Rhayader in Mid Wales.

The company's fifth windfarm will consist of 22 wind turbines, each rated at 450 kW, manufactured by BONUS of Denmark. Each turbine has a 37m diameter, 3 bladed rotor and stands on a 30m high tower.

The 9.9 MW rated windfarm will generate 29 million kWh per year, with total investment in the project of around £11 million. Construction finance will be provided by National Power.

Following completion, expected in May 1994, the project will be re-financed to allow other parties to take equity. The Body Shop have been offered an option which will make a significant contribution to that company's long-term commitment to energy self-sufficiency in the UK. SWALEC and Taylor Woodrow Construction Holdings also have options.

NWP is to establish a local charitable trust, with an initial contribution of £100 000, which will be used to support local schools and training schemes.

UK climate change programme: final proposals

SECRETARY of State for the Environment, John Gummer, has announced the final touches to the UK's CO_2 programme.

Measures announced include a strengthening of the Energy Efficiency Office programmes of information and advice, to stimulate additional savings from business, and to reinforce the work of the Energy Saving Trust.

The target for CHP has been increased from 4000 MW to 5000 MW, with further savings possible in the transport sector.

Mr Gummer's proposals have been criticised as vague and ineffectual. Eurisol, the mineral wool association has expressed concern about the absence from the proposals of any reference to improved energy conservation standards or the building regulations.

Little room for optimism

THE news in August of a further massive round of pit closures seems to confirm the view that the government's coal White Paper has failed. Rather than increasing the market for coal, the White Paper endorses a power generation market rigged against coal.

Cllr Hedley Salt, chairman of the all-party association of coalfield local authorities, the Coalfield Communities Campaign, commented: "Coal is the cheapest way to generate electricity — even the White Paper said that — and yet it is the Government allowing our domestic coal industry to fall apart.

CCC has suggested a moratorium on issuing licences for new CCGT power stations, and close scrutiny of the costs of the aging Magnox power stations. It also recommends the end of generation from Orimulsion, and a revision of the rules on opencast coalmining, taking full account of genuine local concerns.

Advanced fatigue program for steel platforms

AN ADVANCED fatigue analysis program that brings greater accuracy to the prediction of the fatigue lives of fixed steel platforms has been developed by Lloyd's Register.

Application of the program by LR as part of its certification and consultancy activity will pinpoint critical joints and help operators plan more cost-effective inspection schedules. This means fewer costly underwater inspections, reduced joint NDT and, generally, a more economic way of directing limited resources without compromising safety of installations.

For some time LR's offshore division has been actively looking for ways of improving the reliability of fatigue life prediction and the new program is a result of in-house development and testing. LR has improved the accuracy of fatigue life estimation by using the latest stress concentration factor (SCF) data and improved calculation methods to achieve greater modelling accuracy.

A major shortcoming of most existing programs is that they are unable to model complex node behaviour accurately. The stress distribution around each brace-to-chord intersection is affected by forces and moments in the chord and all the braces forming the node. The LR program calculates SCF data based on the distribution of loads in the braces in a single plane of a node as well as the effects of braces and their loads on other planes. Currently this is the only program available that combines the two calculations.

LR has certified over 700 fixed platforms worldwide and around 90% of the fixed installations in the UKCS.

For further information contact Peter Fisher of LR's Offshore Division on 071 709 9166, extension 2523.

Dover Harbour Board contract

HYDRO-ELECTRIC is to sell directly to Dover Harbour Board power from a 9 MW gas-fired CHP plant being built with paper maker Arjo Wiggins Appleton at their Buckland Mill plant in Dover.

The £7.25 million CHP plant is expected to become fully operational in April 1994. Designed to increase efficiency, improve environmental impact and reduce costs at the paper mill, the project also enables Hydro-Electric to sell more power to customers in England and Wales.

Dover Harbour Board has signed a ten-year contract with Hydro-Electric to take surplus electricity from the mill for the port's Eastern Docks, expected to be around 20 GWh annually. Hydro-Electric intends to sell any remaining power available to the local electricity company, SEEBOARD.

UK insulation sales for 1992

ACCORDING to a recent survey published by the Building Research Establishment (BRE) and the Building Services Research and Information Association (BSRIA), the total value of the UK thermal insulation market in 1992 was £321 million.

The UK thermal insulation market can be split into four main sectors: structural, mechanical services, transport and appliances. As one might expect, structural applications represent the bulk of material sales, accounting for 90% by volume and 60% by value. The higher volumetric cost of materials used in non structural sectors, particularly services, increases their significance considerably in value terms.

The structural sector is dominated by mineral wools representing over three quarters of sales by volume. In value terms, the two types of mineral wool have a combined share of 38%, but individually neither can match the 27% share taken by rigid urethane foam. The other significant materials in this sector are XPS and EPS foam which have a combined share of 25% in value terms.

The last two years have been difficult for the UK thermal insulation industry with the market declining in both 1991 and 1992. However the fourth quarter of last year saw the first signs of a recovery which have been more evident as 1993 continues, though for some companies this has been too little too late. Overall the organisations that appear to have suffered most are the large volume producers of general purpose insulants, whilst several specialist manufacturers and added value systems producers have still been able to achieve at least some growth.

The Lord Strathclyde, Parliamentary Under Secretary of State for the Environment is pictured left, with Bill Alexander, Managing Director of Thames Water (centre) and the Major of Hounslow, Cllr Bawn (right) at the official opening of a new £20 million 'power house' at the Mogden Sewage Treatment Works in Isleworth, west London. The CHP plant has an output of 4 MW.

Educating tomorrow's consumers

*by Mike Wolfe**

THE CENTRE for Research, Education and Training in Energy (CREATE) was established jointly in 1988 by the Department of Energy and the Institute of Energy. It was the result of two sets of conferences run by British Gas and the Department of Energy, and the Institute of Energy and the Department of Energy respectively. The delegates, representing a wide range of opinion from education and industry, suggested that an independent organisation, meeting the needs of energy education, was essential because of the importance of energy in education terms and to everyday life.

For the first two years CREATE was supported financially by the Department of Energy, and operated from Institute headquarters in Devonshire Street, London. It is now funded through the Energy Efficiency Office (EEO), by members in industry and commerce (including the Institute of Energy) and by sponsorship of energy education projects. As a registered charity it is governed by a Council of Management elected from CREATE's current members. Although the registered office of CREATE still remains at the Institute, for financial reasons the administrative office is now situated in Wigan, Lancashire.

CREATE's primary function is to coordinate and promote energy education and training within the UK, with particular reference to energy efficiency. This involves:

- researching needs and priorities in primary, secondary and tertiary education;
- evaluating and promoting good practice in the teaching and learning of energy and its efficient use;
- producing teaching and learning materials of the highest quality;
- developing positive attitudes to energy efficiency both in the home and the school;
- establishing a sound continuum of energy education and training through life;
- working with the many other organisations involved in energy education and coordinating their activities through the Energy Education Forum.

CREATE was first set up in 1988 to address the need to educate the nation's young people — tomorrow's consumers. It has survived the government organisation which first created it — the Department of Energy — and is now a well known reference point for both teachers and school energy managers.

The importance of CREATE's role has increased significantly since its formation. The introduction of the National Curriculum and new curricula in Scotland and Northern Ireland, the delegation of budgets under the Local Management of Schools scheme (LMS) and the government's current initiatives on energy and the environment have all contributed to raising the importance of CREATE. At the same time increased government support, both in terms of finance and profile, have lead to CREATE experiencing its most fruitful and rewarding period of activity.

CREATE's function comprises a number of discrete modes.

The advisory mode — CREATE provides a resource and information service for pupils, teachers and others involved in energy education. In addition to responding to postal and telephone enquiries received at the CREATE office, it also processes enquiries on behalf of the Energy Efficiency Office, The Department for Trade and Industry, the National Energy Foundation and the Institute of Energy. Here are some examples of the kind of enquiries received on a regular basis:

'Dear Sir/Madam, I have been learning about energy, and I need to know more, but I haven't learnt that so much so please can you send me some information on it' (primary pupil).

'I would be pleased to receive information you have available, including reading lists, on energy efficiency in schools.' (Surveyor).

'Please could you send me samples of any leaflets you have on energy choice, cost, efficiency, equipment available and safety. Also leaflets on energy conservation.' (Teacher of design and technology).

As you can see, CREATE receives a variety of enquiries from many different sources. Requests range from primary pupils requiring information for their energy topic, to post-16 students, seeking advice on thermodynamics; from nursery providers looking for colourful wallcharts, to physics teachers wanting computer software material; from local authority energy managers needing help with their school energy conservation programmes, to student nurses asking for details on the effects of radiation.

The enquiry mode — CREATE carries out research to assess the needs of pupils and teachers in energy education. The extensive scale of CREATE's research can help to coordinate sponsored and commercial initiatives, identify appropriate requirements, avoid duplication of activities and resources, and assess the quality of energy education and provision.

The last major survey investigated the provision of resources to support the teaching and learning of energy in secondary schools. The results of the research showed that there is a wealth of material available, yet 90% of teachers are unaware of it. In response CREATE has developed a comprehensive resource directory, and provides specific details of materials to enquirers. There are some gaps in provision, particularly in energy efficiency, and teachers indicated that they would welcome more appropriate computer software and video material.

There is also a significant need for in-service training programmes to raise teachers' awareness of energy efficiency, both in the curriculum and in terms of school energy management. Full details of this research are available from CREATE.

*Chief Executive, CREATE

The provisionary mode — CREATE has provided and is developing a number of resources for teachers and pupils. The materials comprise policy documents on energy education, resource directories for the primary and secondary sectors, guidance on effective school energy management, written and practical resources on energy efficiency for primary schools, and environmental publications for secondary students.

In its earlier years, CREATE published *CREATEDigest*, a once-a-term journal, with a different focus for each edition. In 1992 an evaluation of the appropriateness of the digest revealed only nominal support for its content. Teachers required material more suitable for use in the classroom. However, production of such material would have resulted in a duplication of existing and future publications. Consequently the digest was suspended, and replaced by *CREATE Watch*, simply a newsletter informing teachers of current developments in energy education. Teachers registered with CREATE (nearly 4000) receive a copy of *CREATE Watch* three times a year. A complete list of CREATE publications is available on request.

The consultative mode — CREATE provides advice on energy education and training to a number of government departments and agencies, including the Energy Efficiency Office, the Department of the Environment, the Department for Trade and Industry, the Department of Education, the Energy Technology Support Unit (ETSU) at Harwell, and the Building Research Energy Conservation Support Unit (BRECSU) at Garston. In particular CREATE advises the EEO on the appropriateness of educational proposals and current policy in energy education, supports ETSU in responding to educational enquiries and developing curriculum material on renewable energy. It works with BRECSU to encourage the efficient use of energy in schools and colleges, in association with current curriculum initiatives.

CREATE consults with the many voluntary organisations involved in energy and environmental education. It has recently formed the Energy Education Forum in an attempt to rationalise the various programmes of work of the organisations.

The Forum has six major aims. To agree standards in energy education; avoid duplication in roles and production of materials; to identify priorities in energy education; to develop strategies for collective initiatives; to avoid overload in the search for sponsorship; and to establish a body to advise and encourage support from government.

At present members of the Forum are developing a strategy document to outline future needs and priorities in energy education. Hopefully the key elements of the strategy will be presented to government and the private sector to encourage greater support for the work of the organisations, both in terms of profile and finance.

CREATE also advises commercial publishers, examination boards, professional teacher associations, teacher training institutions and local authorities. Requests for help from local authorities usually come from the energy managers seeking to initiate energy efficiency schemes in their local schools.

The vocational mode — CREATE is seeking to encourage the development of National Vocational Qualifications (NVQs) and general National Vocational Qualifications (GNVQs) in energy, with particular emphasis on its efficiency use. Although NVQs with an energy content can be attained in building and engineering courses, there is currently no recognised course of study for aspiring energy managers and advisers. Last year CREATE recognised this gap in provision and, in association with the Institute of Energy, established initial funding and ideas for the development of an appropriate NVQ in energy management. In agreement with CREATE, the development work was eventually carried out by the Institute and the project should be complete this autumn.

GNVQs are a key development for the future of vocational education. Offering a broader course of study they complement the existing A levels and AS examination system, and the more occupation-specific NVQs, to provide for young people three clear qualification routes. At the present time GNVQs are only available in art and design, business, health and social care, leisure and tourism, and manufacturing. They are in modular format, and students must also pass core skill units in communications, numeracy and information technology. New GNVQs are being developed in science, catering and hospitality, and the built environment. The latter and the science GNVQ will offer scope for studies in energy and energy conservation, and CREATE will be seeking to provide its expertise.

CREATE's other vocational work involves teacher training and re-training. It is currently working with a number of authorities to develop training programmes for teachers. The aims are to improve teachers' own knowledge of energy efficiency, to show them how to carry out an energy survey of their school, and to establish monitoring and targeting of a school's energy consumption. In addition, CREATE encourages and offers advice on how energy efficiency strategies can be integrated into a school's curriculum.

The hortative mode — this encapsulates all the functions of CREATE. It represents CREATE's efforts to encourage and promote the best practice in energy education and training. This is achieved by a continuous dialogue with government, the private sector and the many other organisations involved in the development of energy education. CREATE is in a privileged position in that it is at the hub of such development. Through its coordination role, it is aware of current initiatives, instigates new ideas and encourages cooperation between organisations. CREATE endeavors to spread the 'good news' through its many contacts in the field of education, by attendance at exhibitions and conferences, and through articles in a variety of educational, professional and industrial journals.

Recent years have seen numerous and dramatic changes in education. Never before has education been so significant on the political agenda. Is LMS the precursor to privatising the education service? Can education and services such as those provided by CREATE be run commercially? What are the implications for the future?

The economic future of our country depends upon appropriate investment in education and training. Education in the UK

The author

Mike Wolfe joined CREATE in August 1991 as Senior Project Manager, succeeding David Browning as Chief Executive in April 1992.

Prior to his involvement in CREATE he spent five years as a Teacher Adviser in science and technology at Wigan LEA. He was instrumental in training primary teachers in all aspects of science and its technological application, assisting schools with the implementation of the National Curriculum, and preparing teachers to assess and record achievement in the core subjects of science, English and mathematics.

During this period he was active in supporting the work of the Association for Science Education. He was secretary of the Advisory Teachers Group, a member of the Primary Science Committee, and a member of the North West Regional Committee.

Mike lives in Wigan with his wife, Anne and their three children. Given any free time he enjoys cycling, golf and skiing.

should not be determined by market forces, but funded at levels comparable to our industrial competitors. There is a need to improve the fabric of our schools, including grants for energy efficiency measures; to seek higher standards in both teachers and pupils, and to raise the profile of vocational training in line with academic achievements.

Imperative to meeting the above requirements is the need to continue and expand the support provided to schools and colleges by organisations like CREATE. Educators depend upon expertise provided by voluntary groups to enhance and enrich their teaching. Such organisations can only survive through adequate funding from government and the private sector. Despite the government's commitment to maintaining 1990 CO_2 emission levels to the year 2000, there is little evidence of increased investment in education to achieve this target. Naively, government expects legislation and public relations exercises to fulfil its target, whereas a long-term educational commitment to energy efficiency would instill more positive attitudes in young people, who will be the major consumers by the turn of the century and beyond.

CREATE, through the Energy Education Forum, will be seeking increased government funding for energy education and training. Bearing in mind the forthcoming public sector spending cuts, the strategy will be to persuade government to transfer some of the money designated for public information projects to more effective and valuable educational initiatives. Although we are very appreciative of the support we receive from the Energy Efficiency Office, more support is required for CREATE and the other voluntary organisations involved in the Forum.

The private sector also has a vital role to play in promoting and supporting energy education and training. It is a requisite for the success of any industry to have a well educated workforce. Future employees with a sound knowledge of energy and its efficient use would be a bonus for any company committed to avoiding the wasteful use of energy. Energy companies in particular have a specific responsibility to support energy education and training, whether it be to simply raise awareness of the subject, or to encourage students to consider a career in energy.

CREATE appreciates the help it has received from its founder and corporate members: British Gas, British Nuclear Forum, Esso, National Power, Philips Lighting, PowerGen, Sainsbury's, Yorkshire Electricity, The Institute of Energy and the Energy Efficiency Office. Obviously we would welcome additional support, and details of the corporate membership scheme are available from CREATE.

PHOTO COURTESY OF THE *WIGAN REPORTER*

Halifax Building Society Manageress, Denise Cunliffe, hands over a cheque for £2000 to Mike Wolfe. The money has been donated to support the development of the pupil/parent/teacher pack on energy efficiency, which will be available in October.

CREATE is particularly grateful to The Institute of Energy for the support it receives, both financially and in kind. Having jointly established CREATE in 1988, the Institute has continued to back the organisation and has encouraged its development. Rev Robert Buckley represents the Institute's interests in CREATE through his directorship of the organisation and its subsidiary company CREATE Promotions Ltd. He is also a member of the Institute's education and training (E&T) committee, enabling him to catalyse the two organisations. In addition, Don Carey, the present Chairman of CREATE is a member of the Institute, and also attends E&T meetings. CREATE looks forward to a long and fruitful association with the Institute, both for mutual benefit and for the benefit of our young people.

● *CREATE can be contacted at Kenley House, 25 Bridgeman Terrace, Wigan WN1 1SY. Telephone: 0942 322271.*

Training for energy management

*by D R Browning BSc FRSC Chart Chem, MInstE**

IN THE past there have been many problems in defining the exact role of the energy manager in a wide variety of organisations. Indeed in many companies they combine the job with others such as works manager, production manager and increasingly that of environmental manager. This has led to problems in the provision of adequate and appropriate training facilities.

In order to overcome the problem CREATE (The Centre for Research, Education and Training in Energy) in conjunction with PEAL (Pilkington Energy Advisors Ltd) and Eclipse Research Consultants carried out a mapping exercise on behalf of the Employment Department to determine the extent of the energy management function in a wide range of organisations, its nature and the type of people responsible for carrying out this function. Some of the major results of the exercise are given below:

- the function varied from the control of a boiler in a school, to management of a large industrial complex;
- the people responsible for carrying out the function frequently did so, as part of, or in addition to, other tasks within their organisation;
- because they were frequently isolated geographically, training was sparse and sporadic in nature;

The result was a body of employees without any corporate identity or recognisable qualifications.

Coupled with this was a growing realisation that the energy management function was increasing in significance on economic and environmental grounds.

In the public sector, organisations, both large and small, were becoming responsible for managing their own budgets (eg, schools, hospitals, GPs).

Throughout Europe environmental protection was becoming a major issue, if not the major issue, dominating European legislation. The penalties likely to accrue from defiance of such legislation could be severe but could frequently be avoided by organisations becoming increasingly efficient in their use of energy. The ensuing savings could reduce many of the most severe environmental impacts such as global warming and acid rain, in many cases with considerable financial savings.

David Browning, a well known figure within the Institute for many years has recently turned his attentions away from CREATE, towards the increasingly evident problem of a lack of training for energy managers.

The need for training

It was recognised that if energy management were to be effective, an appropriate training regime would be required which should provide the necessary knowledge and experience to achieve this aim, and equally important to provide levels of qualification which gave respect and recognition to practitioners within this important area of expertise.

To this end CREATE in partnership with the Institute of Energy and the University of the West of England (then Bristol Polytechnic) initiated wide ranging discussions with organisations in the United Kingdom and Europe with the aim of setting up an infrastructure within which energy management training and expertise could be developed across Europe. The first part of this development which is now almost complete is the TEMOL Open Learning Package in Energy Management Studies.

Because the population requiring energy management training is widely dispersed, it is possible to run courses on a complete face to face basis in only a few highly industrialised, highly populated, areas. For the remainder distance learning with minimal tutorial support may be all that is possible. These are the opposite ends of a spectrum of a probable range of student requirements. A very flexible system of learning is required to meet all expectations. The TEMOL package has been designed to provide just such a flexible approach.

The writing of the package has just been completed by a team of specialists appointed by the Institute of Energy. The project is funded jointly by DGXVII, the Institute of Energy, ETSU, SEEBOARD and the University of the West of England. Much of the early work in setting up the project was carried out by CREATE.

The programme comprises 14 elements or modules of study covering the major technical and management aspects of the subject. It forms a fundamental and comprehensive course in energy management at around level IV in NCVQ (National Council for Vocational Qualifications) terms or about Higher National Diploma level. It is the beginning of what is hoped will become a developing programme of modular study to meet the needs of all energy managers in the future.

The course content is being widely trialled throughout the UK during September and October 1993 and the final product will be published in March or April 1994.

The course of study will be accredited by the Institute of Energy and individuals or organisations who are interested in finding out more about it should initially contact the Institute at 18 Devonshire Street, London W1N 2AU. All enquiries should have 'Energy Management Course' written on the top left hand corner of the envelope.

Accredited agents will have the responsibility, in conjunction with the Institute of Energy, where appropriate, of setting up an approved tutorial support system.

In addition to the 14 elements contained in the course of study, students will undertake a project based, where possible, on a problem within their place of work. The aim of the

*Project Manager, TEMOL Programme, until recently Chief Executive of CREATE

project is to evaluate the student's ability to bring together the various competences attained in the 14 modules in a cohesive understanding of the overall function of energy management. Assessment will be undertaken by individual accredited organisations with external moderation by the Institute of Energy.

Initially the Institute will certificate successful students. Apart from this it is hoped that the course, with supplementary evidence of attainment, will lead to the qualification of Incorporated Engineer.

The Management Chartered Initiative (MCI) is acting as the lead body in developing NVQ qualifications in energy management. As such MCI, together with the EEO, will be working closely with the Institute and other bodies to coordinate the TEMOL package and subsequent modules in order that they fit in closely with the requirements of the National Council for Vocational Qualifications.

It is clearly essential that any modern programme of training should be capable of assessment and qualification within the NCVQ framework, and of achieving validity, where feasible, within the Credit Accumulation Transfer (CAT) system.

The future

Discussions are already under way to develop additional units in energy management at level IV and V in NCVQ terms linked to general aspects of the subject, but containing specialised units related to industrial needs and to those of the public sector.

Students following this course of study may also be able to develop their studies wider, in engineering or management, to become qualified and chartered, where relevant, in these areas of expertise. This is likely to be achieved through the media of initiatives like the Credit Accumulation Transfer and National Vocational Qualifications Schemes.

Some, if not all, of the elements in existence or being planned can be integrated into a range of other studies in energy and in environmental management.

A major reason for sponsorship by DGXVII is the same perceived need for energy management studies throughout the rest of the European Community, which has been recognised within the UK. It would be invaluable if this common problem could give rise to a common solution.

While it must be accepted that cultural and educational differences within member states may make it very difficult to pursue closely similar programmes of study, it is not inconceivable that the competences required by energy managers can be recognised throughout Europe, and possibly beyond, in agreed levels of achievement.

An investigation is under way to determine if, and how, the TEMOL package can be used, with modification, where relevant, as a basis for an agreed programme of study across the EC. ❑

SUPPLEMENT

The great energy crisis

— could it have been averted?

by Professor Brian Brinkworth FEng

IT IS of course an honour to be asked to speak in the name of Jim Ellis. He was one of that dedicated band of professionals, who, usually out of the public eye, devote their lives to keeping our energy life blood flowing. He flourished in the middle years of the 20th century and I want to take you back to that time, before the great energy crisis; in fact to a specific year: to the year 1993.

We know from our current perspective that it was a pivotal year. They did not know it then, perhaps, and I ask you to adopt the viewpoint that they would have had at that time, to see what the decision makers might have made of the information that was available to them. I shall speak partly from a global standpoint, because it was already recognised in 1993 that energy is a global issue, but

The 1993 Jim Ellis Memorial Lecture was given in April by Institute of Energy Past President, Professor Brian Brinkworth. He took as his theme a retrospective look at current energy 'policy', or lack of it. The September supplement of *Energy World* takes us 'back to the present' ...

I shall also speak of the local situation in what was then the United Kingdom, so I shall shift in perspective from one of those points to the other. To add verisimilitude to the situation, I am going to make use of the rather primitive graphics that they had available in those days. I know you are used to experiencing everything directly through virtual reality nowadays, and it will take you back a little to have to adopt just the two senses of sight and hearing.

Tonight's seminar has as its subject 'The great energy crisis — could it have been averted?' To help you in your contribution to the seminar, I shall first set the scene by reviewing some of the information on resources that decision makers had at that time.

In 1992 there was a meeting of the World Energy Council, which reviewed things like resources. In its summary of available energy resources at that time, it opened with a very upbeat optimistic statement about resources: *'The fears of imminent exhaustion that were widely held 20 years ago were now considered to be unfounded. The concepts of exhaustion or even scarcity failed to appear anywhere in this survey'*[1]. Now I shall ask you to see whether you think they were justified in holding such an optimistic view. Figure 1 is taken from the 1992 report — the summary prepared by BP [2]. For the three main fossil fuels that were then in use, you see here the so-called proven recoverable reserves; for coal and for oil they are in thousands of millions of tonnes, and for gas in trillions of cubic meters. To make them more understandable, they were often reduced to the ratio of reserve to production. This gives, as the number of years supply, what would happen if the reserves were not added to and if they were depleted at the same rate as was the extraction in that particular year. The World Energy Council said that they saw no evidence of scarcity in these figures. As two of the numbers are less than the average individual's lifetime, then it might be possible to

Figure 1: World proven energy reserves 1991

Fuel	Proven recoverable reserves (thousand million/tonnes trillion m^3)	Reserve/production ratio (years)
Coal	1040	239
Oil	135	43
Gas	124	59

Figure 2: UK proven energy reserves 1991

Fuel	Proven recoverable	reserve/production ratio	tonne pc	cube, m
Coal	3800 (1)	36	69	4.4
Oil	535 (1)	6	10	2.3
	1960 (3)	24	36	3.5
Gas	545 (1)	11	10	2.3
	3056 (3)	61	56	4.0

take the view that they were being rather sanguine.

Figure 2 is a corresponding table for the UK. There were endless disputes about how large these reserves really were. For example, those quoted by the World Energy Council for coal were 3800 million tonnes for the UK. British Coal cited figures of 45 000 million tonnes and sometimes as much as 190 000 million tonnes. The differences were mainly between what was present and what was considered to be accessible at reasonable cost. It so happens that these variations will not affect the outcome of this seminar, however.

There were similar differences for oil and gas. For example, the World Energy Council thought the UK had 535 million tonnes of oil; the Department of Trade and Industry, in the Digest of UK Energy Statistics[3] thought there was about four times as much as that, and similar figures for gas. The DTI's Brown Book of resources [4] gave even bigger figures. They had a rather engaging way there of listing something called 'undiscovered reserves'. I have not included those. The reserve/production ratios for these fuels were much smaller than for world resources. They were certainly available to decision makers and we wonder what conclusions they reached from them. To most people they would have been still somewhat remote and so I have reduced them to a rather different form, and that is to see how big those reserves would seem if we thought of them as distributed amongst the 55 million people or so then in the UK. We find that they had 69 tonnes of coal each or 10 tonnes of oil on one measure and 36 on another; in the case of gas I have reduced these to the oil equivalent, 10 to 56 tonnes each. Not many people out these could easily visualise 69 tonnes. If however that was in the form of a cube, it would be a cube with a side of 4.5 metres; if we did the same for oil it would be about 2.5 to 3.5 m and about the same for gas if it were liquefied. We are not sure that many people in 1993 would have had in their minds that if a truck turned up at their door and delivered their share of the UK oil, it would scarcely be enough to fill the sitting room.

'That was when'

It will be instructive to supplement some parts of this review with a few comments called 'That was When'. For instance, that was when restrictions were lifted on the use of gas for electricity generation. About 8 GW of gas-fired plant had been ordered by 1993 and it was expected that this would rise to the order of about 12 GW by the end of the decade. If you work that back you find that it would add about 40% to the required deliveries of gas relative to the 1991 supply. There were voices regretting that a precious commodity like gas should be used for combustion, when there were more valuable uses for its organic carbon-to-hydrogen bond. The impact on the coal industry was considerable. When they produced the 1993 report *Prospects for Coal*[5], it was concluded that there was no market for coal beyond the current order of 40 million tonnes for 1993/4 and up to 30 million tonnes for the next four years, which had been contracted with the electricity generating companies at the time.

Why were they taking that view about coal? Was not the UK at that time the leading country in the development of clean coal technology? There was certainly some activity there. For example, at Grimethorpe, British Coal had been working with others on the development of clean coal technology that involved the pressurised fluidised bed combustor, and later the proposition that this could be incorporated into a combined cycle generating plant, using both gas turbine and steam turbine generation to produce a very effective and clean utilisation method for burning coal for electricity generation. Similarly, British Gas at Westfield had been approaching the use of coal in a clean way by using the slagging gasifier with steam and oxygen in the Lurgi process and then processing the gas in what amounted to a chemical plant, with the sulphur appearing in the form of valuable products. This would form the core of an integrated gasification combined cycle generating plant.

Bleak prospects

All that must have looked very promising for clean coal technology. Well, not exactly. That was when the Grimethorpe plant closed, in March 1992; the Westfield plant followed in December 1992. The DTI review *The Prospects for Coal* showed the climate of opinion among decision makers. It said that advanced coal-based generation would not be ready before the end of the decade and that there was no justification for putting public money into demonstration plant for clean coal technology. Was it right that the technology was not ready for commercial use? Well, Shell did not think so. A short distance away, they were just ready to open a clean coal plant, an integrated gasification plant near Roermond in the Netherlands, and that was not the only one in Europe alone. There were a number of others around the world where new techniques for using coal

The author

Brian Brinkworth is Professor of Energy Studies in the University of Wales at Cardiff, and Dean of the Facility of Engineering there.

His research has been generally in the areas of fluid mechanics and heat transfer. He became aware of the potential for utilising renewable energy sources through his work in the 1960s. His extensive studies were brought together in his book *Solar Energy for Man*, which appeared just before the oil crises of the early 70s, and proved to be a seminal work.

The Solar Energy Unit was formally established at Cardiff in 1974 and Prof Brinkworth has continued as Director to the present time. The work of the Unit has widened over the years to cover aspects of wind, mini-hydro, biomass and other renewable energy work. The extensive capital facilities of the Unit have been made available for commissioned test work since 1980 under an offshoot, the Energy Equipment Testing Service, approved as a NAMAS-accredited laboratory. This now has an associated manufacturing unit, through which complete test facilities have been designed, built, installed and commissioned at leading test centres around the world.

Professor Brinkworth has served on many technical commissions, where he has been an advocate of the systematic development of new sources of energy. He favours simplicity, but does not see renewable energy as a low-technology field. Rather it calls for the full development of the most advanced techniques available, within a framework of the strictest technical, commercial and professional standards.

A member of the Institute of Energy's Council from 1987-1992, he was President of the Institute in 1989/90, and was elected Fellow of the Royal Academy of Engineering in 1992.

Professor Brian Brinkworth

were being pursued very vigorously. So there seem to be some things that do not tie up very well there. What was happening to the market for coal elsewhere? On the other side of the world China was producing coal at a rate of 1000 million tonnes a year, and its rate of increase of coal production had been 60 million tonnes a year over the last five years[2]. The increase was more than the whole production in the UK. Their current 10 year plan required a doubling of their electricity generating capacity by the end of the decade, and most of that would be by burning coal.

How could it be that a public document will say that there is no substantial market on one side of the world, and then on the other side we see things like this? Well, consumption is determined by the demands of users. In this case, the users are all the people in the world, but their requirements might differ. The total number of people in the world in 1993 was about 5.5 billion. The rate of increase was very substantial. If we take the figures from the United Nations population study, they warned in 1993 or thereabouts that the next four decades would add about 100 million people to the world's population every year[6]. So that was when about twice the population of the UK was being added every year to the world population. It was taking only four days to add another million people. It is not easy to bring that home either. Another way of looking at it is to see that about 3 people per second were being added to the customer base for energy. People in the UK or in Europe at that time would not have noticed this — their populations were static or actually falling at that time. These increases were taking place in the undeveloped parts of the world. They were accompanied by all sorts of other factors that I will not be able to deal with in detail. One of them is perhaps quite striking, and that is the movement of the new citizens towards cities and not remaining in rural areas — what is called 'urban drift'. In 1993 or thereabouts, to accommodate the rate of urban drift would have required the construction of one new city the size of Paris every month. To feed these new citizens, the UN reckoned that additional farm land of about four million hectares a month would be needed[6]. How did the decision makers take these factors into account? Well, that was when arrangements were made to withdraw 4.4 million hectares in Europe out of food production altogether, under the 'set aside' agreement of the Common Agricultural Policy[7]. It is doubtful if many people in Europe at that time realised that if all the arable farmland in the world, including the great wheat belts, were shared out equally, an individual's allocation would have been a patch about 50 m square[6].

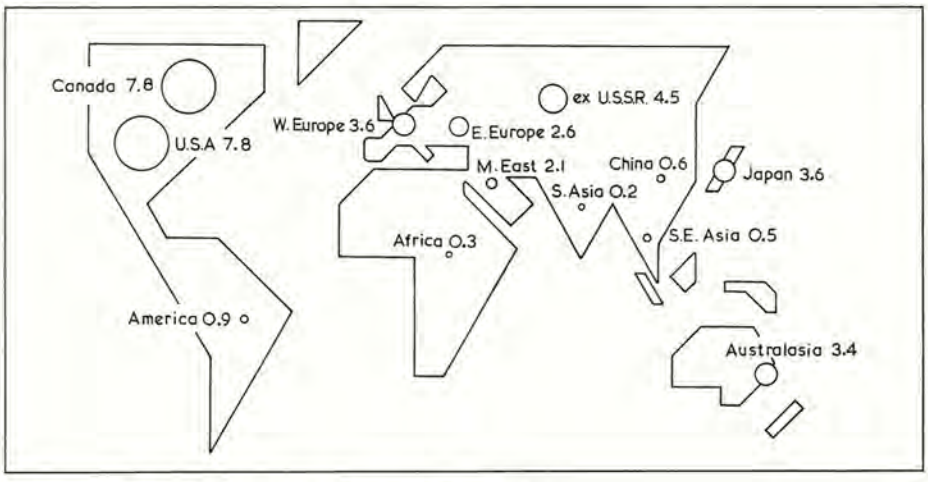

Figure 3: World energy consumption per capita (toe pa)

Another factor in addition to just the extra numbers of customers is their utilisation, and at the time, 1993, that was extremely uneven. Figure 3 is a map of the world in which the circles have a diameter which is proportional to the per capita use of energy per year, in tonnes of oil equivalent. In Western Europe, Eastern Europe, the former USSR, Japan, Australia and New Zealand all about 3.5; rather more in North America, both the US and in Canada — about 7.5. You can hardly see the circles for places like Africa, Latin America, even the Middle East, South-east Asia; they are very small. The distribution of energy availability was very uneven and this had given rise to the notion that the world was divided into North and South, though actually it was the difference between the industrially-developed countries and those that were still undeveloped.

What does that mean in terms of energy

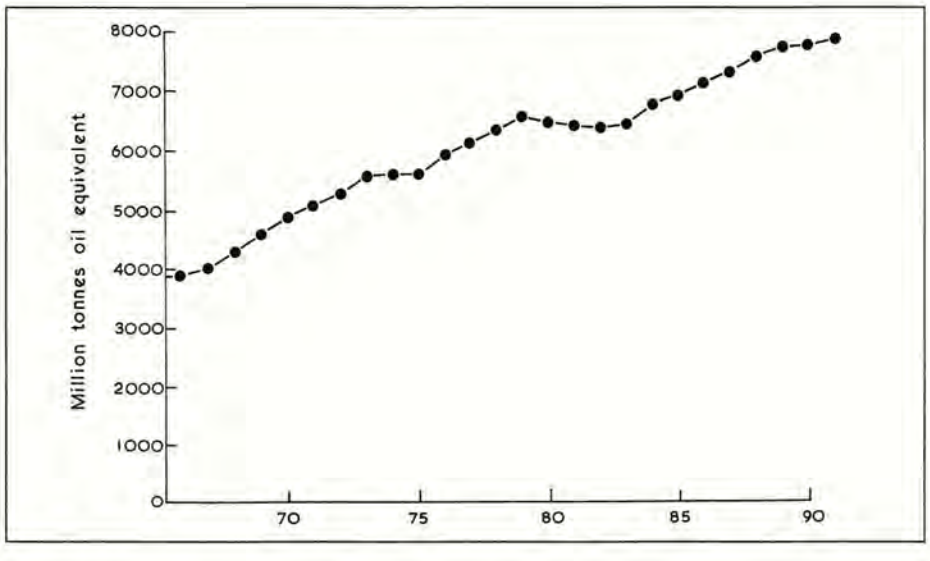

Figure 4: World primary energy consumption 1966-1991

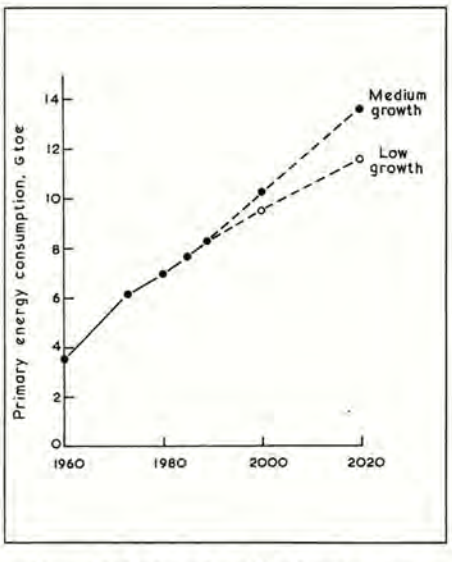

Figure 5: Projected world primary energy consumption

utilisation? From the BP review[2] Figure 4 shows a plot over a period from the mid-'60s of the total utilisation of energy worldwide. It was growing but it looked under moderate control, as though the change in energy availability was manageable. The question is, given the information I have just summarised about the future population of users, how was that likely to increase beyond the time that we are looking at here? From the World Energy Council analysis in 1989, Figure 5 shows the projections forward under two scenarios: a medium and a low one (for some reason they did not think there ought to be a high one). They were expecting a fairly steady rise in the world primary energy consumption, of about 50% over the next 20-30 years. How did they arrive at these numbers? One of the quantities that they used was the per capita energy consumption. For the North, effectively the developed world, they were predicting per capita energy consumption rising somewhat. For the South, only a very modest increase in energy available per capita. So in effect they were really quite pessimistic about the possibility of economic advancements in the South. It was known from experience in the North that they are intertwined. If you want to have economic advancement and development, you are going to have to use energy.

There was a lot of disagreement about whether these projections were reasonable or not. But one fact about them was inescapable, though perhaps not fully recognised then. Sooner or later, the bulk of the increase in world energy demand would be coming from the developing countries. The World Energy Council projections showed that the point, when the (then) developing countries' demand would cross over that of the hitherto industrialised world, would be around 2020-2030; other commentators somewhat earlier. What did that mean? The words of the Population Programme seem apt: *'The scale of adjustment required over the next three or four decades is perhaps the most formidable challenge humans have ever faced.'*

There is not much evidence that this quotation had been noticed by decision makers at that time. But others certainly warned of it. For your contribution to this seminar, you should consult a pair of revealing documents prepared at the time by two leading members of The Institute of Energy, Fells and Lucas[8]. Among other things, they illustrate the constraints within which decision makers had to operate. At that time came the full realisation that there was an impact on the environment from extracting and using energy, and the leading meeting at which that was first brought out was at Toronto in 1988, where we find in the summary this statement: *'The earth's atmosphere is being changed at an unprecedented rate, primarily by humanity's ever-expanding energy consumption'*[9]. It went on to state that these changes represented a major threat to global health and security. It was essential that sound policies were quickly developed and implemented to provide for the protection of the planet's atmosphere.

Earth Summit

We must give credit to the world's leaders that they heeded this message and the next major item in your library search would be to turn up the report on the UN Conference on Environment and Development in Rio, the so-called 'Earth Summit'[10]. It was called that because about 120 heads of government actually attended it. That meeting agreed on three conventions: the Framework Convention on climate change, which was signed on behalf of the UK; the convention on biodiversity which need not delay us tonight, and something called 'Agenda 21', which was a very large package relating to the promotion of development in the underdeveloped countries.

The provisions of the Framework Convention were basically these: all the countries that signed needed to develop inventories of their contribution to the gas emissions that were causing the greenhouse effect in the atmosphere; to establish national policies to return emissions to the 1990 levels by 2000 and thereafter to maintain them; and then to assist developing countries to acquire the technology to improve their environment as well. How did they proceed with that? What options were available to the decision makers? After the Toronto Conference the UK Government produced a report called *This Common Inheritance, the Second Year Report*[11]. These explained the national policy adopted for meeting the requirements of the Framework Convention. The Secretary of State for the Environment reported in 1933 that measures were in hand which would secure two-thirds of the required reduction in CO_2 emissions. That was when the department published an analysis of CO_2 emissions[12] showing the carbon discharged into the atmosphere up to the time that the assessment was made, and some forward projections (Figure 6). The latter depend critically on the scenario assumed for energy usage. But what they all showed was that the numbers would be reasonably steady in the near future, so to bring back the figure at 2000 to the 1990 level does not look like a very big task. We must applaud what was done, but what is much more interesting is the expectation of a more rapid rise in the carbon emissions later. One of the sources is from transport. Figure 7 is a projection forward by the Department of Transport of car traffic in the UK[13]. This was rising very steeply and I think one would have to say was actually out of control at that time. The traffic was expected to double in 35 years.

This was happening right across the world; at the World Energy Conference the delegates were told that transport had now overtaken electricity generation as a source of CO_2 discharges into the atmosphere.

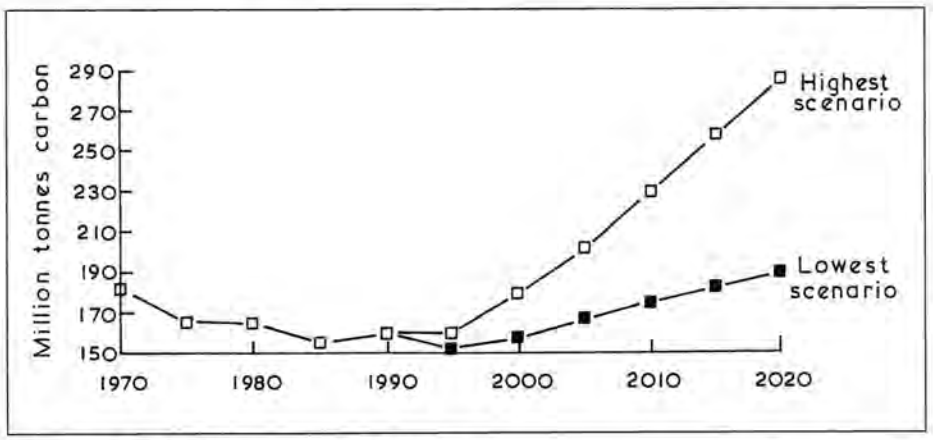

Figure 6: Projected CO_2 emissions for UK (Mtc)

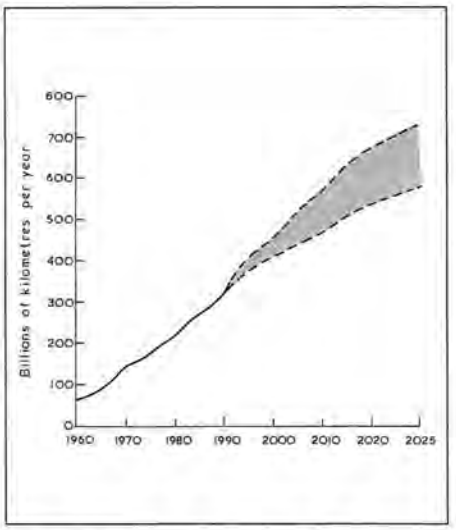

Figure 7: Projected car traffic for UK

Measures to discourage vehicle usage were beginning to be considered. In the budget in the UK there was a forecast that vehicle fuel tax would rise by 3% per annum. Not many people attached a great deal of significance to that, since 3% pa would have taken 24 years to double the tax. At that time, too, the European Commission was considering a carbon tax on all fuels. This attracted quite a lot of attention, usually very adverse, but much more was aroused by another matter. That was when the decision was announced to apply a tax to domestic fuel, the full amount of 17.5% from 1995/96. The newspapers of that day are very interesting to read in that respect. This move was presented as a government deliberately choosing to eliminate elderly folk by reducing their ability to keep themselves warm and to kill them off by hypothermia. This was in fact quite a modest proposal. Between the budget in which it was announced and the first receipt of any income to the Treasury from that tax, the world population rose by something equivalent to the entire population of the United States.

Nuclear	Thermal fission
	Fast Fission
	Fusion
Non-fossil carbon	
	Landfill gas
	Refuse-derived fuel
	Biomass
Non-carbon renewables	
	Hydro
	Tidal
	Wind
	Wave
	Solar thermal
	electric
	hydrogen
	Geothermal

Figure 8: Carbon-limited energy sources

The scientists and engineers of the day knew what was happening and renewed their interest in what we might call 'carbon limited' energy sources. Listed in figure 8 are some of those that were discussed at that time. This is not comprehensive, but will do for our purposes. Nuclear energy of course releases no carbon into the atmosphere during operation. They had available to them at that time thermal fission reactors and a lot of work had been done on fast fission reactors, and work was in hand on fusion. There were also non-fossil carbon sources that merely recycled carbon through the atmosphere: landfill gas; refuse-derived fuels, helping to deal with another problem of refuse disposal; the general use of biological material from biomass. There were a whole lot of non-carbon renewable energy sources: hydro power was already well established, tidal was being looked at, wind — an ancient technology being revived; wave energy, solar energy in various forms producing heat or electricity, or generating hydrogen to be a fuel; geothermal heat from inside the earth and a whole lot of potential sources of that kind.

We have time for only a brief look at some of these possibilities. Concerning nuclear energy, here is an interesting quote from the time: *'We need a balanced energy programme, which means the phasing out of all nuclear power'* [14]. Having decided to choose the year 1993 gives me a certain difficulty in this area, because there was planned to be a major review of nuclear electricity generation a year later in 1994. In 1993, at the time of the *Prospects for Coal* review, it was proposed to bring that review forward to 1993. I am focusing on a time when that review had not yet taken place, so we would have to have some reservations about the future development of nuclear-generated electricity in the UK. Nevertheless, we can realise that there had been substantial development of that source in the UK during the decades prior to that. In 1993 the major activity on the thermal nuclear side was the construction of a 1200 MW plant at Sizewell. It was approaching completion, and the operators had expressed hopes of building another alongside it. But public confidence in nuclear power had been shaken by accidents and high-handed attitudes. There were assiduous pressure groups in opposition to further development, well-supported by the information media. But I can find no reference to anyone pointing out at the time that over the period of the building of Sizewell B, the world population had grown by the equivalent of another India.

The UK possessed great expertise in nuclear energy at that time. Within this, there had been a long history of the development of the fast reactor. The first reactor at Dounreay, constructed in the 1960s had been replaced by a full-scale fast reactor of about 240 MW which had been in operation for some while at the time that we are considering. There was something like thirty years of experience of the fast reactor, which provides a means of accessing the major component of uranium supplies. Only 0.7% of natural uranium can be used in thermal reactors, and in processing that, there had accumulated within the UK a large quantity of so-called depleted uranium, which could have been a fuel for fast reactors. By 1989 there were nearly 30 000 tonnes of depleted uranium within the UK borders[15]. So they had available in that material a resource which in energy terms was greater than that of all the oil and gas in the North Sea, and all the recoverable coal added together. And it was safely within the borders of the UK. You might have expected that this source would be brought to bear as soon as possible. That was when the decision was taken to close down all fast reactor work in the UK, on the grounds that the technology would not be needed in the foreseeable future. The Dounreay reactor would be closed in 1994, and the UK would also leave the European Fast Reactor Associates, to which all its expertise on fast reactors had already been contributed.

Maybe that was because they were working on something better. Well, they had a fusion programme. At the JET site near Culham at that time there was quite a significant experiment. In the reaction vessel there was the first controlled fusion reaction involving deuterium and tritium took place in December 1991. It was seen at the time to be a major step forward in the development of a potential new source of energy. It was a very significant resource because the deuterium for the fuel can be obtained from heavy water, which is present in sea water. The tritium does not occur naturally, but is made in a supplementary reaction which goes on around the reactor vessel. They seemed to be on to something good there. That was when they decided to close it down. As from 1996, after completing runs with the deuterium/tritium mixture, the fusion programme in the UK was to be closed. There were discussions about possible future participation in international collaborations, but no firm commitments.

Scope for renewables

That must have meant that they had something better still. Maybe it was going to be the renewable energy sources that we mentioned. They were actually already more significant than people thought. The World Energy Council was told that renewable sources were then supplying 20% of world energy, mainly through hydro power and through the use of timber as fuel wood. There was a review of policy for renewable energy in the UK at that time. The Renewable Energy Advisory Group produced its report in 1992[16]. It advised its department in government to stimulate the market in renewable energy in the UK, to do this partly by supporting renewable energy electricity generating plants with a total of 1500 MW capacity under the non-fossil fuel obligation (NFFO), and to maintain research

and development on technologies which were not yet competitive, but which had medium-term prospects. Some quick action followed this. It appeared in the *Prospects for Coal* report that the Government of the day had accepted this target of 1500 MW in place of the previous 1000 for renewables under the NFFO. The Renewable Energy Advisory Group's report also put various categories together for renewable sources. Hydro they thought was a technically mature technology and so was solar water heating; the use of waste and biomass, horizontal axis wind turbines, passive solar energy design in buildings, photovoltaics for electricity generation and tidal power would need more research and development. They did not think there were sufficient prospects for geothermal aquifers, or vertical axis wind turbines or offshore wave devices to justify further expenditure on those.

The UK was actually quite well placed at the time to move into these new branches of the energy industry. There was a cadre of experts available, with lengthy histories of R&D experience in all of the technical areas mentioned, and a growing interest by the manufacturing and construction industries, as they became aware of rising activity around the world. We cannot review this activity in detail, except to note that UK involvement was still hesitant and patchy, despite public favour.

Hydro power was technically fully mature, but potential sources near the centres of population were already fully exploited, or hedged about with overriding concerns about impact with the environment. This was a factor also in the responses to applications to open wind farms. There were six operational in the UK in 1993, with a total installed capacity of about 100 MW. However, about 70% of the machines that were in operation in the UK had been imported, the majority of them from Japan, many from Denmark. Nevertheless, this use of renewable energy was becoming very noticeable. That was when the wind energy demonstration site at Camarthan Bay was closed; its visitors' book was found to contain 40 000 signatures.

Severn barrage

It was acknowledged that the UK had the best potential in Europe for wind power, and that was true also for tidal power. A tidal barrage scheme in the Severn estuary would alone have been capable of meeting about 7% of the total UK electricity demand, but a century of refinement of schemes had been unable to overcome the resistance attributable to the front-end loading of the cost. Though operations could be expected for 100 years or more with negligible operating costs compared with revenue, there seemed to be no perceptions that could balance long-term returns against the immediate barrier of the capital costs. Curiously, this did not seem to apply to the Channel Tunnel, a project of about the same scale which was in progress at the time.

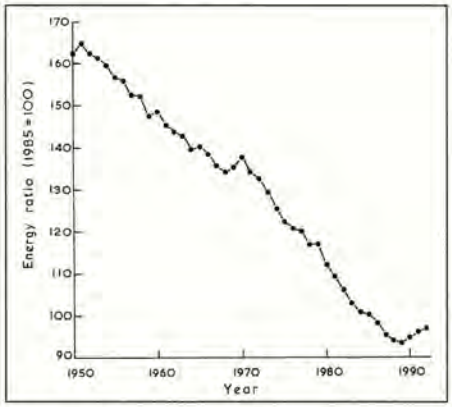

Fig 9: Energy ratio for UK 1950-1992 (1985 = 100).

Other, smaller tidal schemes, such as one for the Mersey, were also stalled. That was when the French, with an operational tidal power plant of 240 MW capacity on the Rance, were building up experience with scheduling techniques that continued to bring improvements in annual energy recovery.

On the other hand, the UK did have a grid-connected wave-power device in operation, on the island of Islay. This drew on the very good wave regime to the west of the UK. It was a shoreline oscillating column wave-power generator, driving a unidirectional and induction generator. Amid the confusion of wave-power policy at the time, the group at Belfast responsible for this development had pressed ahead with a shoreline plant, building up experience that would be indispensable when moving to seek the much bigger potential off-shore. When a review of electricity costs from wave-power was made by the relevant government department in 1993, it was found that the shoreline plant provided the cheapest power of any. It could generate electricity at between five and seven pence per unit using 8% discount rates[17]. This was a good deal less than the price at which some of the NFFO contracts were being placed for things like wind power at this time.

On the solar energy side, a modest industry had contrived to develop and survive in the UK, making solar thermal collectors and systems for things like water heating. Architects were beginning to adopt design features to exploit solar energy passively, with good cost-to-benefit ratios. At least one building had been constructed at the time which required no energy for heating at all. The back of it was built into a hillside, which reduced heat loss and provided for energy storage to moderate temperature swings. In fact, the interior temperature varied only between 17 and 21°C over the year. That was when the Department of the Environment went out to consultation on some modest changes to the heat loss requirements of the Building Regulations, that were said to bring them to the level employed in Scandinavian countries 60 years previously.

The higher temperatures needed for process heating and thermodynamic energy conversion required evacuated absorber envelopes and concentrating collectors. Power plants in the MW range were operating in various countries, both with thermal cycles and photovoltaic energy conversion. It was beginning to be appreciated that dwellings could generate their own electricity from PV cells mounted on, or incorporated into, the external envelope. Some trials had started in the UK.

There had been for some time previously a

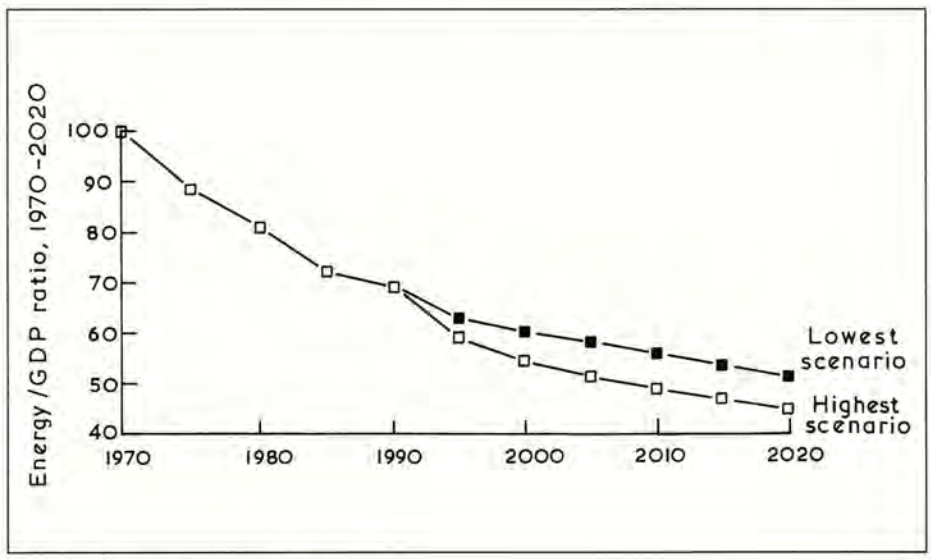

Fig 10: Projected energy ratio for UK.

climate of opinion that viewed renewable energy as not worthy of serious attention in the industrialised countries. That was not understood in the developing world, where there had been hopes of investment and technology transfer from developed countries in these fields. Their situation was deteriorating quickly, even where it had been thought that they were adequately endowed. Consider this statement: *'Renewable resources in some parts of the world are being used faster than they can be replaced and they are fast becoming non-renewable; we are discovering the limit of unlimited resources'*[6]. This happened in countries where they relied heavily on fuel wood. Already in 1993 there was a fuel wood crisis. There were parts of the world from which the indigenous people were having to withdraw, because they could no longer obtain sufficient access to fuel wood and regrowth could not happen fast enough. It was already too late. For them, the great energy crisis had begun. Some developing countries began to institute R&D centres for renewable energy and manufacturing facilities of their own. That was when it was beginning to be asked if the developed world might miss the business opportunities that were emerging for new industry in this area.

Although in the UK government support for renewable energy R&D had begun to rise from the trough through which it passed in the 1980s, it had still barely reached £25 million in 1993. Such a sum would be lost in the marginal noise level of the subsidies for the coal and nuclear industries. Maybe they had yet another option up their sleeves. A House of Commons report at that time said *'the most striking feature about our enquiry has been the extent to which improvements in energy efficiency are almost universally seen as the most obvious and most effective response to the problem of global warming'*[18]. There were far-sighted people from places like the Association for the Conservation of Energy and the Energy Efficiency Office who came along to meetings at the Institute of Energy at that time and promulgated this message. We hope that they fared better than the House of Commons Energy Committee, because that was very soon disbanded, since the Department whose affairs it had to oversee had also been disbanded. That was when the UK decided that it did not need a Department of Energy.

Efficiency campaigns

One measure of energy efficiency is the energy ratio, which represents the usage of energy per unit of gross domestic product. It is a sort of effectiveness for the utilisation of energy in the creation of the nation's wealth. Figure 9 is a plot of the energy ratio for the UK up to about 1990 from 1950[3]. This sort of graph is a nightmare for forecasters because it is very nearly linear. It fell to about half its value over 40 years, so if we projected that, it would have fallen to zero in another 40 years and we would then have had all our GDP without using any energy. But why is that slope so constant? Buried in there somewhere are the effects of numerous national campaigns, such as 'Save It' and 'More for your Monergy'. And yet it had been going down at about the same rate all this time. This was partly the influence of engineers, who are dedicated to efficient operations as part of their way of life. Government advisers projected it forward as in Figure 10 in calculating the CO_2 emissions[12]. There are two scenarios here; in both we can see the gradual decrease in the slope that they expected to develop. Were they right about that? Looking on an enlarged scale at the last few years of the energy ratio plot, we find that it actually turned round in 1989 and begun to go up. Of course, we do not know what the value for 1993 was; the fall might have been resumed.

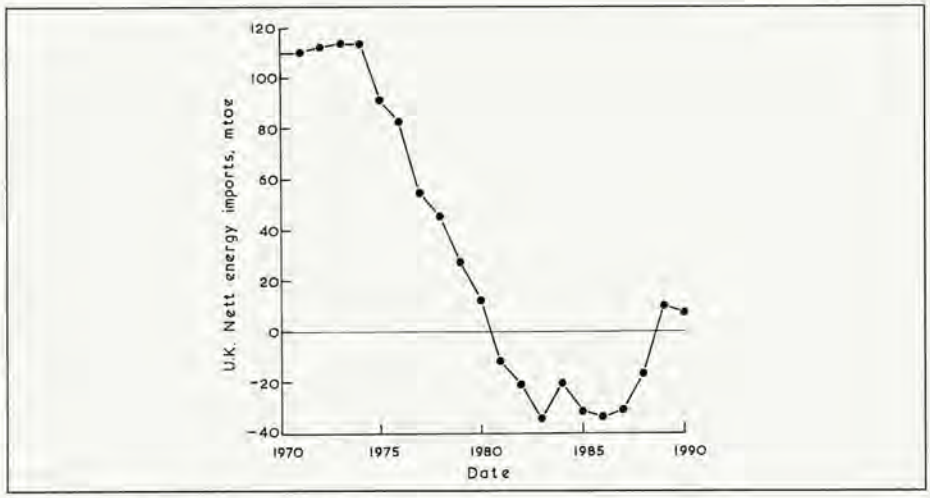

Fig 11: Nett energy imports for UK (Mtoe).

There are a few more pointers before you make your own contribution to this seminar. Figure 11 shows what was happening to the UK's self-sufficiency in energy at that time. Nearly everybody thought that the UK was very well supplied with energy sources. It was believed to be the only industrially-developed country in the world that was self-sufficient, but we see that we need to qualify that. The nett total energy imports to the UK had been positive up until about 1980, when the effects of the North Sea were beginning to be felt prominently. As we approach the 90s, the curve goes back into deficit again. The UK was a nett importer of energy 1993. Where was it going to buy its energy? World Energy Council figures showed where it was: about two-thirds of all fuel supplies remaining were in a very small part of the world. About 70% of the oil was in the Middle East and North Africa; about two-thirds of the gas in the Middle East and what used to be the USSR, and about 60% of the coal in that area and the USA and China. The UK had to go into that market and say, 'Well, I know that we have not been importing very much energy in recent years, but please can we have some now?' Maybe you would expect them at least to exploit what they had left at home. That was when, in the 1993 budget, there was a change in the petroleum revenue tax, which increased the cost of exploration by a factor of four, not perhaps a very large sum, but something of a discouragement.

What then, would you, as decision makers in 1993, have been able to make of this? You have to place yourself in the circumstances in which they had to reach their judgements. Remember that there had been a triumph of the market economy right around the world. The former communist system had collapsed and the market economy had become the predominant ideology nearly everywhere. That is one which emphasised short-time horizons, a couple of years perhaps at the most, and judgements were to be based on measurements. Most of the measures available to decision makers were economic ones. In considering their responses, it will not be sufficient to think that the decision makers of that time were venal, meretricious, self-seeking people, or even lacking in essential competence. They were trying to operate in a very difficult environment, dominated by the market. Note especially the effects of increasingly rapid rates of change. Major changes were beginning to close in, even on their very short-time horizons. Remember that the world population was doubling during a working lifetime. Somehow, even to preserve the prevalent conditions, that were by any reckoning unacceptable in many places, it would have been necessary to duplicate virtually everything that had ever been made, within a single lifetime. That was

in addition to replacing what would wear out in that time. Yet those with the technical capability needed to do this were becoming a progressively smaller fraction of the world's people. Already, as many as a thousand millions in the areas where it was needed most, were unable to read instructions such as those on a bag of seed, or the arrangements for assembling a wind pump[6].

Doom mongers

Problems were closing in, yet few were looking forward sufficiently far ahead to address them in time. There were those who sought to show how delayed responses to accelerating demands for resources inevitably lead to collapse of the provision and calamity for the users[19]. These were however scorned by the media for being doom mongers. But note also the difficulty in arriving at a consensus for action. A part of the victory of the market economy was that social democratic systems of government had prevailed, where governments were elected by a free ballot of the people. Over time, a corrupted form of that had developed in most of the industrial world, certainly the UK, known as the system of party politics. In this, every decision had to be forced past an opposition which opposed for its own sake. It lacked the tendency to arrive at a consensus. Where the professionals in government could see what had to be done, their ministers could gain the power to act only gradually, while events moved ahead too quickly to be properly controlled. Even the supranational bodies, such as the United Nations, continually frustrated their agents in the field by being unable to agree on effective actions. In 1993 they had failed to prevent even forced displacement of peoples and attempts at genocide. Yet you might feel that the agreements at meetings such as the Earth Summit at Rio indicated that concerted actions were after all sometimes achievable.

This, then, is the scene for your seminar. Concentrate on the energy future as they saw it in 1993. What should the decision makers of 1993 have done to avert the forthcoming crisis? Or perhaps, you might ask, what could they have done? Discuss. ❑

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Energy studies

—with an environmental flavour

*by Dr M J West MIEE**

The BSc energy studies degree course at Coventry University has completed its first year of operation, and is now recruiting its second intake. Attracting a large proportion of 'mature' students, the course was validated by a panel of experts, including Dr Gerald Temple at Aston University, on the recommendation of The Institute of Energy. Course tutor Mike West describes the course content, as well as some of the students who have undertaken it in its first year.

IN THE early 1970s, the UK received a double whammy in energy terms. It experienced a robust miners' strike, as well as a considerable hike in oil prices, due to the policies of OPEC members. The two occurrences came quite close together and proved to be very good at concentrating the minds of politicians — among others — on an energy crisis, possibly not too far distant. It was fashionable in the 1970s to suggest that the oil supplies off the shores of the UK would not last much beyond the year 2000, and that alternative energy sources should be looked at, and research undertaken with some urgency.

In the UK the Energy Technology Support Unit (ETSU) was set up and based at Harwell, with the overall technical responsibility for a research programme into the alternatives. Wave power, wind power and other renewable energy sources became rather more respectable topics for research, and more importantly, for research funding.

A group of researchers at Coventry University (in those days known as Lanchester Polytechnic after the famous mechanical engineer, Frederick Lanchester) started a research programme in the wave energy field, funded largely by a petty cash operation, and carried out significant reservoir tests on a device known then as the Salter Duck, after its inventor Stephen Salter of Edinburgh University. This work attracted support from the Department of Energy and was the start of intensive research (initially in collaboration with Edinburgh, and later independently) into wave energy.

Loss Ness, the largest 'wave tank' in the UK was used for Coventry wave energy model tests for several years. Readers may have seen items on the work on TV programmes such as *Tomorrow's World*. At the end of the '70s the group proposed a new wave energy device, the Sea-Clam, which has evolved over the years into the circular Sea-Clam of the 1990s. In parallel, during the mid '80s interest in low head hydro energy systems also developed and continues to the present day. A 500 kW scheme, at present commercially sensitive, is being planned jointly with a well known company.

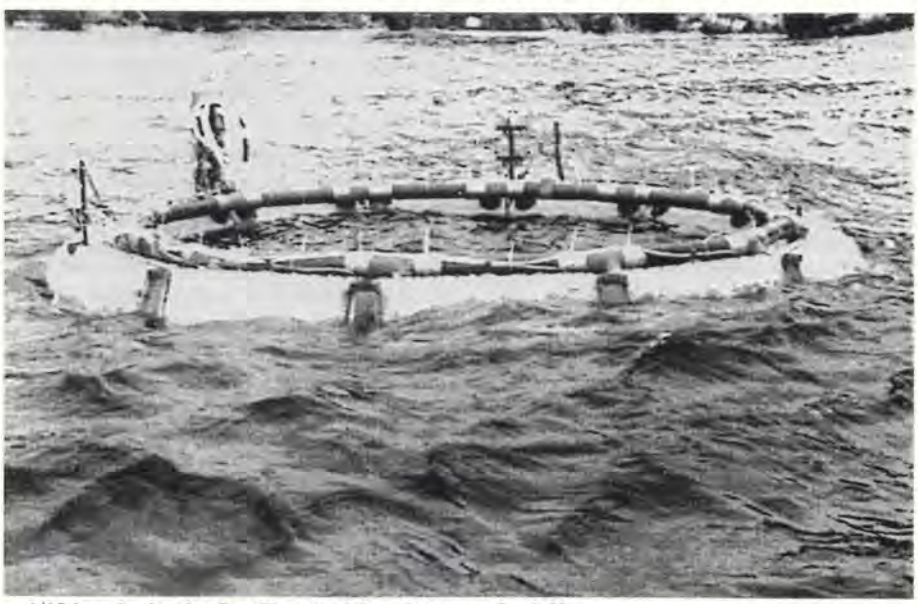
Over the years funding for the group has come from four main sources: the Department of Energy, Sea Energy Associates Ltd (SEA), Hydro Energy Associates Ltd (HEA) and the European Community. SEA and HEA are companies set up by RMC Group plc specifically to support the work at Coventry. Private investment has also been attracted into both companies to give further impetus. This has allowed much progress and a wide response. The Coventry research group is well known in the international wave energy community as a result.

The work of the group has been carried forward by an interdisciplinary team of seven University academics with support staff. Because the research team has remained unchanged since the early 1980s there has been an energy expertise available at the University for a considerable time, involved heavily in research, but able as a spin off to provide a range of interesting areas of investigation suitable for undergraduate and post-graduate projects. The transfer of knowledge in this way has always been seen as a great benefit to engineering courses.

In October 1990 I was asked by the Head of the School of Engineering to look at the possibility of setting up a first degree course with an energy theme. The opportunity was interesting in that it would be a degree course which could identify as its origin a specific area of University research activity. This is not an everyday occurrence.

The School of Engineering offers a wide range of courses at sub-degree, first degree and post-graduate level, but attracts only a small minority of women to them. The number grows each year, but is nevertheless much below what is possible. Traditionally, as one would expect, many of the students of both sexes attracted to engineering join the University with an A level background of mathematics and physics, or through a BTEC route which provides the correct background of study at the appropriate level.

I made an early decision at the course plan-



1/15th scale circular Sea-Clam model, under test at Loch Ness.

*Course Tutor, BSc Energy Studies, Coventry University

ning stage that it would not be wise to set up an energy engineering course which would rely for its operation on the recruitment of students with the traditional maths/physics A level of equivalent BTEC background. This would put it in direct competition with a range of other degree courses at Coventry as well as other institutions nationwide chasing a student market of finite size.

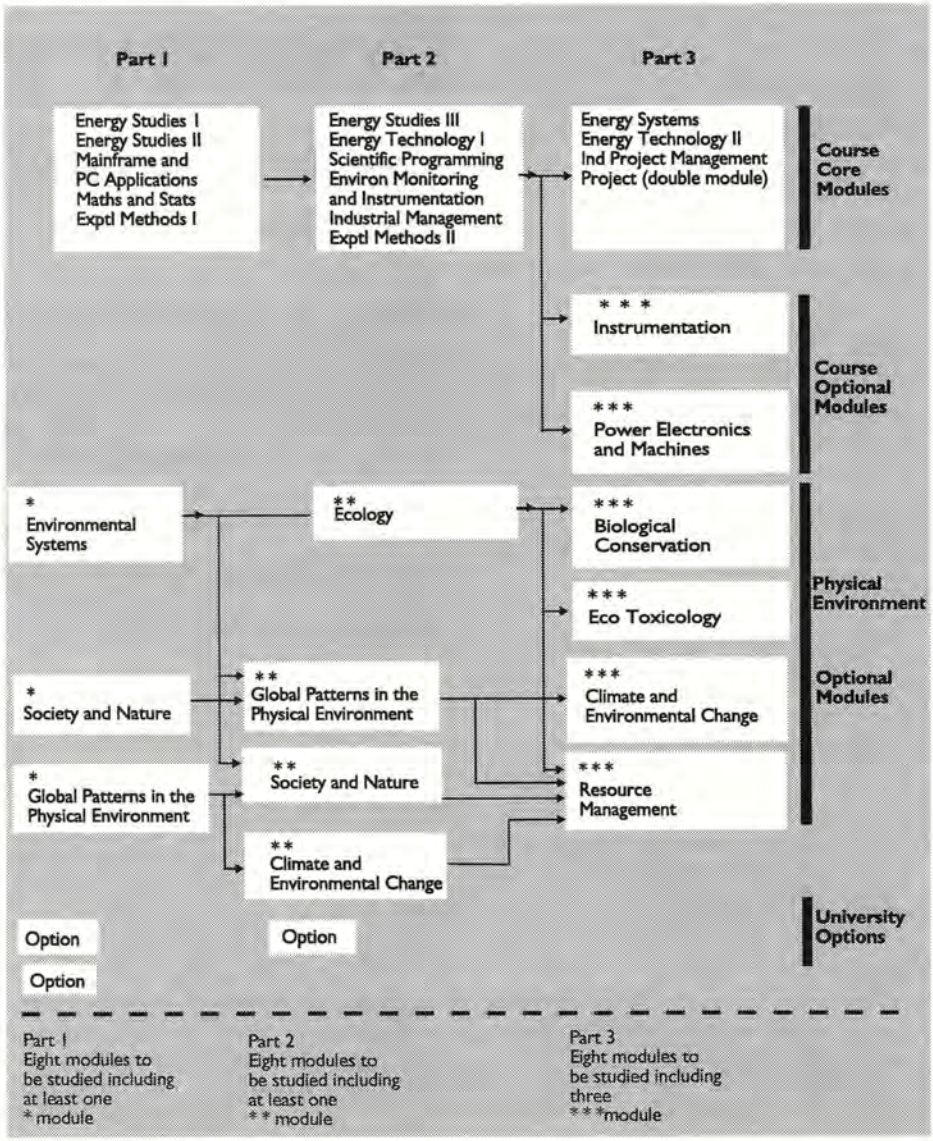
As a result I set out quite intentionally to devise a course which would attract a very different student market to the School, whilst still providing a valid course which would feed industry in an appropriate way. The result was the development of a course with three interlocking themes:

- energy and modern energy trends, looking at conventional and renewable sources;
- environmental studies, either with an ecology or physical geography bias to suit the background and/or career aims of the students;
- management, covering industrial and project management, and also the management of human and physical resources.

The course is underpinned with mathematics and statistics as a compulsory first year subject, and also a course in the use of mainframe and personal computers and teaching, amongst other things, the use of wordprocessors, spreadsheets and other packages and general techniques required in the everyday use of computers. A second year module in scientific programming supplements the computing module described.

The flow chart indicates how the course operates and how a student may progress through it. The compulsory energy core is supplemented by modules provided by the School of Natural and Environmental Sciences at the University. Cross fertilisation between ecological and geographical modules was already in place when this course was set up, and the flow chart takes account of the pre-requisite study that is needed to pursue a route through to final year. At the present time, the University is in its first year of modularisation of courses. As a result, this course reflects the requirements imposed by the University scheme. The first year minimum study pattern would require energy students to choose at least six modules from the first year list, plus two others from a range of modules on offer. Many students choose to study a modern language as one of their options and supplement this either with another module from the flow chart, or something of relevance, for example, law, economics, business studies.

Full-time or sandwich routes are possible with the course. Sandwich course students work in an appropriate post in the UK or Europe for about a year after successful completion of the first two academic years of study. Students studying a modern language are well placed to work abroad if they wish to do so.



BSc energy studies — course routes.

Course content

The energy core running through the course covers, in the first two years, a history of energy, 'consumption' patterns (energy is not truly consumed, but converted), energy systems, energy conversion, power generation, energy management, energy accounting and economics, supported by electrical circuits analysis, electrical energy distribution, and heat transfer and thermodynamics. The final year includes a module devoted entirely to renewable energy sources, drawing upon research expertise at the University already referred to, whilst a further module looks at energy in the built environment.

Course approval does not come automatically. The course, its content, aims and philosophy have to be defended under close scrutiny by a team of academics and experts, brought into the University for the purpose. The validation process is a traumatic experience for those who have initiated the course. The Coventry University BSc in energy studies was validated in May 1991, after an interesting day of deliberation by the experts, with very minor adjustment to syllabus material required for validation to be given. One of the visiting team for the process was put forward by The Institute of Energy: its Midlands representative, Dr R G Temple of Aston University. He provided what course tutors are always anxious to receive — a positive approach to the proposals, and very supportive recommendations and comments. After six months spent in intensive course preparation, no course tutor is particularly anxious to see a course panned by the imported experts!

The first intake has provided an interesting mix of students. Thirty students arrived for induction week, of which one third were women. This is a much larger percentage than we could expect on other courses in engineering. Typically, on our electrical and electronic engineering degree course we find a four or five percent female intake. The

other interesting factor was that the energy studies course attracted a much higher percentage of mature students than we had previously been used to. The mature students came to us with a range of qualifications, with some from our own University foundation HITECC course. Appropriate success on the latter guarantees a University degree place at this establishment. 20% of our intake was 'mature' and in their twenties, thirties and forties.

Though the traditional two relevant A levels or other appropriate qualifications' requirement is quoted, students have to be aware these days that other entry routes are possible and can be looked at on an individual basis by our admissions staff. In particular, we are allowed to be very flexible when considering mature students. If someone in their forties (as has been the case in the first year) is prepared to interrupt their career and return to higher education, we feel they have a great incentive to succeed; we are pleased when we can support such initiative. ❑

Jacky Lawrence, aged 33, married with two children. Worked at the NCB laboratories with day release to study chemistry and physical sciences. Left work in 1983 when her first child, born with cerebral palsy, arrived. Later had a second child and did voluntary work for MIND. Joined the HITECC foundation course in science and engineering when the children started school, transferred to a degree course in 1992. Finds it "good to get the brain working again", and her industrial experience "a good background". Jacky is a student member of The Institute of Energy.

Roy Hughes, aged 49, married with daughters of 21 and 24. Left school with two O levels; recent spare time study with Open University; 11 years with the Royal Navy; ten years in the switchgear industry. The course allows Roy to capitalise on his industrial experience and find out about environmental issues. Supported on course by switchgear company Merlin Gerin and his wife. He is a student member of The Institute of Energy.

Teresa Woodcock, aged 35, married with three children. Left school with four O levels; worked for social services briefly until family arrived. Entered HE via Coventry University HITECC course. She likes the mix of energy and environmental subjects, and studies French as part of the course. Teresa is also a student member of The Institute of Energy.

Tara McKay joined the course from grammar school in Ireland, with A levels in maths and physics. Interested in environmental issues, Tara was attracted to the course by the mix of subjects, and finds it an "interesting challenge".

Matthew Newton left school in 1990 with 9 GCSE subjects and A levels in geography, physics and economics. He could have joined a geography course, but was attracted by the combination of scientific and geography options. The course is "interesting, challenging and has a lot to offer."

Nuclear power — the future

*by Dr Robert Hawley DSc FEng**

Following the Coal Review earlier this year, the Government took the decision to bring forward the Nuclear Review from 1994 to this year. When the nuclear element was removed from the privatisation of the UK electricity industry, decommissioning costs were perceived to be too great a burden for the private sector to bear. Four years on a more optimistic picture is beginning to emerge.

THE UK nuclear industry is yet again at a crucial point in its life. Following the November 1989 decision to withdraw the nuclear stations from its privatisation plans, the UK Government became the sole shareholder of the two newly formed nuclear generating companies: Nuclear Electric plc and Scottish Nuclear Ltd. At the same time they placed a moratorium on the construction of further nuclear plant beyond Sizewell B, pending an industry review in 1994. That Review has now been brought forward, with Terms of Reference due to be announced shortly. So the nuclear industry is about to face its most important challenge of all.

Since 1989 there have been many changes, both in the nuclear industry and the privatised electricity market. In October last year Michael Heseltine's announcement of 31 pit closures led to the Government's Coal Review which concluded earlier this year. The nuclear industry fared well in the Coal Review. The Government acknowledged the contribution nuclear makes to security and diversity of supply as well as helping the UK meet its environmental targets. They also concluded that there was no economic justification for closing down any of the the existing nuclear stations or mothballing Sizewell B.

But now the Coal Review is over and the Nuclear Review has been brought forward to start this year. Much work has already been done for the Coal Review and, although it means another year of frantic activity for the industry, a successful outcome to the Nuclear Review is needed to remove the uncertainty which has been with the UK nuclear industry since 1989.

Nuclear Electric, like the rest of the nuclear industry, expects the Nuclear Review to recognise the competitiveness of current nuclear operations, the outstanding success of the construction of Sizewell B and the opportunity that now exists to build on this success for the future. The economics of the industry's current and future plant will feature high on the Government's agenda, recognising that attracting private sector finance will be necessary for future plant. It should also consider the possibility of transferring some or all of the existing state-owned nuclear assets into the private sector.

At the time of the ESI privatisation there

The author

Born in England in 1936, Dr Robert Hawley served an apprenticeship with BICC Ltd. After graduating with a first class honours degree in 1959 from King's College University of Durham, he continued his studies, receiving his PhD in 1962.

In 1961 he joined C A Parsons & Co Ltd to head a team studying vacuum, liquid and solid dielectrics. He became chief electrical engineer in 1970, a director in 1973, director of production and engineering in 1974 and managing director in 1976. During this period he became acknowledged as an international expert on power generation and energy.

He is the author of several books and many papers on various aspects of power generation and dielectrics, for which work he was awarded a DSc from the University of Newcastle upon Tyne in 1976.

In 1984 Dr Hawley was appointed to the main board of NEI plc and became managing director of the Power Engineering Group. In 1989 he was appointed managing director responsible for all the trading activities of NEI. In the same year NEI merged with Rolls Royce, and he became a main board director of Rolls Royce, as well as being on the boards of many NEI companies in the UK and overseas. He is past chairman of NEI ABB Gas Turbines Ltd, and is past president of the Energy Industries Club.

In 1979 he became a Fellow of Engineering. He was awarded the 1989 IEE Achievement Medal for his outstanding contribution to power engineering, and was elected vice president of the IEE in 1991.

He has been a member of the Court of Newcastle University since 1979, and is a Freeman of the City of London. During 1992 Dr Hawley became a member of the RNLI Boat and Shoreworks committee, and chairman of the IEE International Committee.

He was appointed chief executive for Nuclear Electric plc in June 1992.

was concern over the risks and quantification of costs associated with fuel reprocessing, long-term storage of waste and the eventual decommissioning of nuclear facilities. These issues are likely to feature in the Review and the Government will no doubt take into account the progress that has been made by the industry on these fronts.

Nuclear power has environmental benefits and is helping the UK to curb its emissions of carbon dioxide, the main contributor to global warming. The Government has already acknowledged the environmental benefits of nuclear power in meeting EC emissions targets as well as its competitiveness in the market place and it is hoped that the Review will give substance to that endorsement.

Nuclear Electric's principal objective is to make its existing business profitable and to secure a viable commercial future into the 21st century. To do that the company must be able to invest in new plant to replace its existing assets as they reach the end of their working lives. Future investments must be attractive to private finance and customers in the market place. Nuclear Electric hopes that the Review will open the way for the Government to recognise that a move away from the state sector is both feasible and desirable. Nuclear Electric believes that its future lies in the private sector with the rest of the privatised electricity supply industry and with this in view it aims to make itself privatisable as quickly as possible. However, the decision on its ownership lies with the Government as shareholder.

Sizewell B: being completed ahead of programme and within budget.

Performance

The Magnox stations continue to perform reliably — still setting records. Oldbury holds the world record for continuous reactor operation (713 days) and has just completed a statutory outage in a record time of only 30 days. Wylfa achieved a record output of nearly 8TWh last year and was top of the world league for energy availability over the last three years. BNFL's Calder Hall and Chapelcross Magnox plants produced a record 3 TWh last year and the Nuclear Installations Inspectorate (NII) gave their approval to allow Bradwell to operate beyond its original 30 year life of the other Magnox stations.

Nuclear Electric has recently announced the closure of its Trawsfynydd Magnox station. The station had been shut down since February 1991 due to concerns about the effects of radiation embrittlement on the pressure vessel welds. Following prolonged discussions with the NII, the company decided that the continuing delay and additional resource required to satisfy the NII's concerns could not be justified economically. The decision to close the station was therefore taken on business grounds. Nuclear Electric operates in a challenging commercial environment and can only afford to operate plant if it makes commercial sense to do so.

Meanwhile the AGR stations have been going from strength to strength. The investments made on technical and safety issues are now paying off. Limitations on output have been progressively removed and this year Nuclear Electric's AGRs produced almost 35 TWh, an increase of 59% since vesting. Four of the five AGRs in England produced record outputs last year with Hinkley Point B producing nearly 9 TWh, and there is still room for further improvement. The work to extend the interval between statutory outages from the current 24 months to 36 months is well under way and the NII have given their approval to such an extension at Hartlepool. Reductions in the length of refuelling and statutory outage times at Nuclear Electric's Magnox and AGR plants saved Nuclear Electric over £26 million.

In just three years the business performance of Nuclear Electric has been improved out of all recognition. Output is up 29%, productivity up 54% and market share is now over 21%. Controllable costs are down by 22%, staff numbers have fallen by 20% and the cost per unit of electricity generated from its plants is down from 5.1p per kWh in 1989/90 to 3.6p per kWh in 1992/93. Nuclear Electric plans to build on these improvements

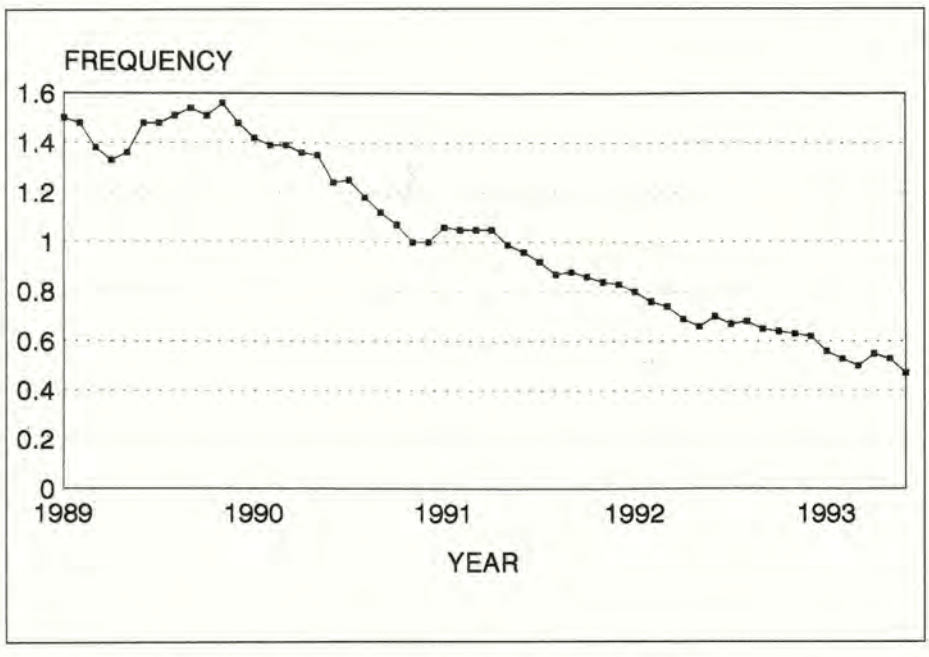


Fig 1: Nuclear Electric plc: lost time accidents per 100 000 hours worked.

and within the next two years expects to turn an operating loss of £900 million at birth into an operating profit before taking account of the Fossil Fuel Levy.

Improving the performance of its operating business is only one of Nuclear Electric's success stories: Sizewell B, one of the largest and most impressive construction projects in Europe, is close to completion. Aggressive project management and a fine performance by Nuclear Electric's contractors and their workforce is bringing the project in ahead of its committed programme and within budget. There is increasing international recognition of the Sizewell design and Nuclear Electric is currently working with Westinghouse in a bid for a twin reactor nuclear island in Taiwan. If successful the bid could be worth up to £700 million to British industry, bringing both work and profits for Nuclear Electric and a welcome boost to UK manufacturing industries. Further export opportunities are being sought in other Pacific Rim countries.

These improvements reinforce the confidence that Nuclear Electric is capable of operating in the private sector, competing on equal terms with the other generators. The Coal Review concluded that on economic grounds there was no case for shutting down any of the industry's Magnox or AGR plant. The further improvements that have been announced since the Coal Review given even more confidence in the future of existing plant.

However, continued operation of its existing assets is not enough to secure a long term viable future for Nuclear Electric. The company need to be able to build new plant to replace older plant that retires at the beginning of the next century.

Proposals for future plant

New nuclear plant must be competitive with coal and gas fired stations and be able to meet the UK's safety and licensing requirements. The industry is no longer in the business of building prototypes. It is seeking a competitive, modern and proven PWR design which it can replicate. The only plant available at present which meets these requirements is the Sizewell B PWR. Nuclear Electric's current preferred option for new plant is a twin PWR reactor station based on this design at Sizewell C. Electricity produced by Sizewell C will be cheaper than new coal and competitive with gas fired plant.

Looking further ahead, Nuclear Electric is working with other European utilities in seeking a PWR design, able to be licensed and built across Europe without significant modification.

Nuclear stations are capital intensive and as such have long pay back times. Short term market forces have resulted in investments in projects with a quick return such as CCGTs. However, nuclear stations have low operational costs and can offer long term price stability. Demonstrating to private sector finance providers that nuclear power stations can be a sound investment is the challenge for Nuclear Electric and the nuclear industry.

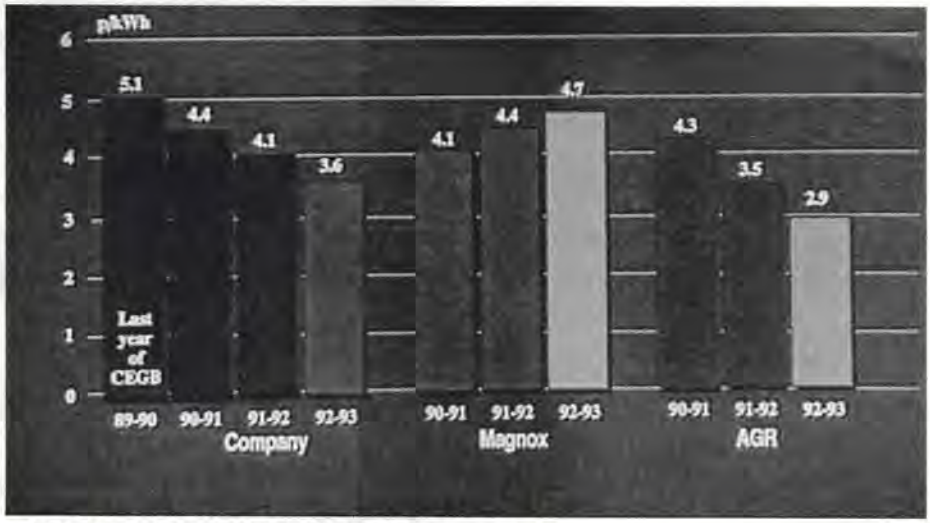


Fig 2: Operating cost per unit p/kWh (1992-93 prices)

Safety

Safety remains the industry's top priority.

Nuclear Electric is proud of its safety record, one which is improving year on year. The number of lost time accidents at operating stations continues to fall, and the number of reportable events is also on the decline. Five of Nuclear Electric's sites received RoSPA awards for their achievements in safety during the past year. Like all quality companies, Nuclear Electric is proving that high performance goes hand in hand with safe working.

In the period leading up to the privatisation of the electricity supply industry, BNFL's costs had increased significantly in response to regulatory demands being applied to an essentially cost-plus industry. Nuclear Electric took forward the principle of establishing fixed price contracts with BNFL and reached agreement on overall terms. However, this agreement was dependent on government providing risk sharing support which has not been re-opened. Nuclear Electric expects to come to a final agreement with BNFL shortly.

There is the option of long term dry storage and possible eventual direct disposal of AGR fuel — the option that Scottish Nuclear have chosen for some of their AGR fuel. The reason Nuclear Electric has opted for reprocessing the first half of its AGR fuel arisings is that commercially it is the best option for its mix of Magnox and AGR fuel, noting that there is a technical imperative to reprocess Magnox fuel promptly. Scottish Nuclear with only two AGRs find dry storage is cheaper.

The industry's fiercest critics often claim that no one knows how to decommission a nuclear power station and that the costs involved cannot be quantified. This is simply not true. More than forty reactors around the world are currently being decommissioned, and Shippingport in the United States has successfully been returned to a green field site. The industry has recently developed a new plan for decommissioning its reactors, the 'deferred safestore' strategy has the advantages of being simpler, less expensive and safer than the current strategy. The strategy has been submitted to the Government and the industry awaits their approval.

In the UK, the Magnox stations at Hunsterston A and Berkeley are being decommissioned and Trawsfynydd will shortly follow. Defuelling of the Berkeley reactor was completed ahead of programme and £30 million below budget. AEA Technology are also making good progress in decommissioning the Windscale AGR. The industry now has practical experience of the early stages of decommissioning its plant and has quantified the cost in great detail.

The National Audit Office recently published its report on the costs of decommissioning the UK's nuclear facilities. The figure for the total undiscounted costs (£18 billion) resulted in unjustified fears of cost escalation. Nuclear Electric's share of the undiscounted total is £7 billion. Nuclear Electric and the other nuclear utilities are investing money now to cover these future liabilities. These investments will grow until the money is needed — in say 100 plus years' time. Nuclear Electric's cash flow — without any investment in new plant — is more than adequate to service all the company's liabilities.

The industry also has to dispose safely of its waste and has been doing so for over 40 years. Nirex have been commissioned to design and construct a deep waste repository

for the long-term storage of intermediate level waste, similar to those in use in other parts of Europe. They are making good progress in developing plans for a repository at Sellafield.

Environment

Concern for the environment is growing. Public concern about problems such as acid rain and depletion of the ozone layer has been recently overtaken by the threat posed by global warming. The reality of global warming is now widely accepted, but the actual severity of the phenomena is still uncertain. If precautionary measures are not taken now as a sensible insurance policy against the risk that fears about global warming turn out to be justified, the world could face a real threat from flooding, famine and desertification.

The UK and European commitment is to return carbon dioxide emissions to their 1990 level by the year 2000. Without nuclear power these targets are unlikely to be achieved. France provides a good example of the potential nuclear power has to reduce global warming; her carbon dioxide emissions from electricity generation fell by 80% between 1980 and 1987, thanks to a massive programme of nuclear capacity increases.

However the maintenance of nuclear power generation alone may not be enough and the Government have not ruled out the possibility of introducing a carbon/energy tax which will ensure that at least some of the environmental costs of fossil fuels are reflected in the price to the consumer. The Commission of the EC strongly favour a carbon/energy tax.

Nuclear generators, as well as being able to offer stable long term prices for their electricity supply, will be free from a carbon tax making nuclear generated power even more attractive than fossil fuel generated power.

Last year Nuclear Electric saved the emission of some 55 million tonnes of carbon dioxide when compared with generating the equivalent amount of electricity from existing coal fired stations. Many people are now understanding that nuclear power is an important part of the solution to some of today's environmental problems, and indeed is essential if future global energy demands are to be met.

Public opinion

In the past the industry has been criticised as being too secretive, leading to popular misconceptions and safety fears fuelled in part by the now long-distant links with the nuclear weapons programme. The industry has done much to combat this through its 'open door' policy.

Scottish Nuclear's 'come and see' programme has attracted over 50 thousand visitors to their stations since it was implemented two years ago. BNFL's Sellafield visitor centre attracted over 160 000 members of the public last year, and Nuclear Electric's eight visitor centres, at power station sites throughout England and Wales, attracted over 230 000 people. Nuclear Electric receives many letters complimenting its trained guides who provide information on operation, safety and the environment.

The latest Gallup opinion poll conducted on behalf of the British Nuclear Industries Forum indicated that almost two thirds of those polled (61%) consider some element of nuclear power to be necessary to meet the UK's energy needs.

The dramatic improvements in performance of existing plants and the success with the Sizewell B construction project, place Nuclear Electric in a position where it can put forward a credible business case to the Government's Nuclear Review. The proposals for future competitive PWRs, based on the world class exportable Sizewell B design, give confidence that construction of further plant offers an attractive commercial proposition.

Fixed price fuel contracts are well on the way to being concluded, the costs of decommissioning are being reduced and long-term storage of waste is being addressed. Combine this with the industry's increasing public support and its safety record, and the industry has done much to achieve the necessary successful outcome to the Review.

The nuclear industry is an essential part of the UK's energy market and the nuclear generators are suppliers of clean, safe, economic energy for the 21st century. The industry is ready to face the Government's Review. ❑

Berkeley power station: stage one of the decommissioning process has been completed £30 million below budget.

Training with the Oracle

by Johanna Fender

A RECENT addition to The Institute of Energy's growing list of group affiliates is the Oracle Corporation UK Ltd, the information technology organisation. Its energy division is four years' old, and has been thriving on the dramatic changes which have taken place in the energy sector during that period.

Neil Weston, general manager of Oracle's energy division, attributes their success in this particular field to the scalability, flexibility and portability of their software systems, databases and access tools, which run across 120 hardware platforms.

Another of the company's strengths is their recognition of the importance of training. There is little point in a customer investing large sums of money on a dedicated software system if their staff are unable to reap the benefits, because they are not fully conversant with the system. In line with their flexible approach, Oracle are happy to carry out on-site training, although they do have extensive training facilities at their Bracknell headquarters.

Oracle's training department is large: 130 staff have trained 23 000 people in the last year alone. 30% of the company's business is now in training, 10% of which is within the energy business. Les Meadows, general manager of Oracle's training services department, claims that of clients consulted, 98% said they would recommend Oracle's training services.

Oracle training has a diversity of forms: from the conventional 'classroom' style, to case videos and even training 'mentors' on each site, providing a permanent training back up. Oracle's philosophy is that you don't just sell a product: the company is increasingly asked to find solutions, gradually distancing them from their core activity of information technology databases.

Among Oracle's training clients in the energy field are: National Power, PowerGen, Nuclear Electric, National Grid Company, British Gas and most of the regional electricity companies.

Because the solutions and attendant training Oracle provides tend to be specific to each client, it is difficult to generalise about their services. An interesting case history upon which to elaborate is their contract with the Pumped Storage Business of the National Grid Company (NGC).

NGC is a wholly-owned subsidiary of The National Grid Holding plc, the shareholders being the 12 RECs of England and Wales. The Pumped Storage Business is one of five businesses set up within the company and is responsible for the operation of two hydro-electric pumped storage power stations.

These storage stations, both in North Wales, at Dinorwig and Ffestiniog, utilise a development of hydro-electric power. Water flows from an upper reservoir under pressure to drive the turbines, as in a conventional hydro scheme but, instead of being allowed to flow away, the water is collected in a lower lake. Dinorwig and Ffestiniog then use off-peak electricity to pump the water back into their reservoirs for future use.

The stations provide a rapid source of power, helping NGC to cope with sudden changes in demand. The stations' combined output is in excess of 2000 MW, with a storage capacity of 10 600 MWh. The storage capacity ensures that the speed of response can be followed by a sustained supply of power for the transmission system.

The benefit to NGC of responsibility for these pumped storage facilities lies not solely in their ability to provide such an emergency reserve of power. Because they operate as a separate business, they are permitted to compete with other generators in bidding within the pool. They also help to achieve the frequency and voltage control necessary to ensure a stable and secure supply of electricity.

Dinorwig, opened in 1984 at a cost of £450 million, is the larger of the two stations, able to generate around 1800 MW constantly for five hours from its six 300 MW turbines. Its underground chamber housing the main plant is one of the largest excavated caverns engineered worldwide — twice the length and half as wide as a football pitch, and higher than a 16-storey building. Dinorwig reaches full power within around 12 seconds from start up, and water flows through the hydraulic tunnels from the upper reservoir at a rate of 420 m^3/second. The plant runs constantly with at least two turbines in 'spinning reserve', ready to meet any emergency demand.

Privatisation of the UK's electricity industry resulted in the IT department of Pumped Storage Business being formed in January 1990 to address new regulations requiring it to report independently on all its own finances, without recourse to NGC's corporate IT resources. It therefore had to develop a complete IT strategy from scratch, guided by NGC's corporate strategy and basing its management information requirements upon Oracle Financials.

To get its systems running live within a short timescale, Pumped Storage Business utilised Oracle consultancy and training services. It acquired the system in June 1990, and had the General Ledger program running by October. It was also one of the first UK customers to implement Oracle Financials. General Ledger and Payables are part of the Oracle Financials suite now running on its Sequent S3 computer, with over 20 online users amongst nearly 200 staff at Pumped Storage Business.

The importance of quality training was recognised in the five-strong IT department, to ensure all personnel understood the systems and their capabilities. Each staff members has averaged nearly four courses each, with Oracle recommending particular courses for different individuals, ensuring maximum benefit from training. Believing there to be too many distractions in the work environment, IT manager Capell Aris insisted user staff attend Oracle's special training centre in Bracknell. "It is a far more congenial environment in which to learn, with good facilities and course layout. The workshop principle is particularly beneficial," Mr Aris concluded.

The Oracle Financials users had to undergo a substantial learning curve. "Most of the accounts and administrative staff were already computer literate, but the new system has so many facilities and such functionality that we had to ensure everyone knew exactly how to get the best from it," said Bill Newman, management accountant for Pumped Storage Business. "Oracle Financials is a set of very user-friendly products, despite its immense functionality and complexity, but training is still paramount in achieving staff productivity. What's the point of spending thousands on the best systems if your staff can't use or understand them?"

If you would like to know more about Oracle UK, contact Jim Wickett on 0344 860066. ❑

Obituary

F R McBride MBE

ERIC MCBRIDE, director of the John Kelly Group Belfast, who died at the age of 69, was for almost a quarter of a century associated with organising the Northern Ireland Branch of the Institute of Energy.

To many in the field of energy consultancy he was respectfully known as 'Mr Energy Northern Ireland', and the work he achieved in this specialised field of engineering was acknowledged when Her Majesty the Queen bestowed on him the honour of Member of the British Empire in 1978.

The experience gained from following a very varied engineering career started with an apprenticeship in Harland and Wolff, followed by two years as a seagoing engineer with the Union Castle M/S Co Ltd. Shore based again, he faced employment with the Works Department of the Government of Northern Ireland (at the Fuel Efficiency Service) and finally with John Kelly Ltd as technical director. His achievement and promotion within all these appointments was highly regarded and respected by his peers in many of the professional engineering institutions throughout Northern Ireland and the mainland UK.

It was as a founder member of the Northern Ireland Branch of the then Institute of Fuel that he was better known, and during a long and successful period as secretary and chairman, he made a lasting impact on engineers both young and old, in what had become the specialised field of energy conservation and efficiency.

It was his enthusiasm for the subject that impressed the University of Ulster to introduce academic courses suitable for recognised qualifications, allowing young students to become professional fuel technologists. Soon after, his considerable organising ability was directed at a more practical approach to the wastage of energy throughout manufacturing industries and public buildings in Northern Ireland. In cooperation with he energy division of the Department of Economic Development, a new and worthwhile forum called the Energy Managers Group was established, which included the bringing together of experienced engineers nominated by local industry, consultants and representatives to share experiences together on proven energy saving schemes in the hope that economic advantage could be gained for Northern Ireland industry in particular.

It was often said he could have made a successful career in public relations. To those of us who had the privilege of attending the many annual dinners of the Institute, it was his personality and influence that resulted in honoured guests being of the highest calibre, for instance, Lord Robens, Lord Grey and Sir Derek Ezra, persuading them to visit Northern Ireland, in spite of the media image of the troubles.

Important also was the opportunity offered to Northern Ireland industries to display their wares at the bi-annual heating and power exhibitions, held at Balmoral Showgrounds in cooperation with WHC Promotions. He was also instrumental in founding the Northern Ireland branch's annual yearbook, making Northern Ireland the only branch of the IoE to produce such a publication.

Extremely proud of his birthright as an Ulsterman, he took every opportunity to uphold Northern Ireland's interests in the many councils, committees and business meetings held in the UK mainland.

One homily told by himself concerned his rush home from one such meeting, which found him standing waiting for a bus in London's Oxford Street. In the rush to board the bus he was knocked down, tramped on and badly bruised. Having been attended to by a medic he retorted: "I'd feel a lot safer in Belfast!"

To have known Eric McBride and to have shared his wisdom, humour and experience was indeed an unforgettable privilege and honour. To his surviving wife and daughter we extend our deepest condolences.

W J Crowther OBE CEng FInstE FIMechE *(reproduced from **Institute of Energy Northern Ireland Section Yearbook & Directory 1993**).*

Evaluating climate change for UK business

THE INSTITUTE OF ENERGY'S most recent conference: *How climate change will change your business* was opened by the Secretary of State for the Environment, the Rt Hon John Gummer MP.

The ambitious aim of the conference was to disentangle the often contradictory advice given to and by government since last year's Earth Summit at Rio, and to clarify the options available to UK business.

Addressing the morning session were Michael Kohn, chairman of the International Chamber of Commerce Energy Commission; Peter Bach of the Danish Energy Agency and Sir John Collins, chairman of Shell UK. These three speakers considered the variety of voluntary, enforcement and fiscal instruments introduced to cope with the problem of climate change.

The afternoon session concentrated on practical responses to global warming, and featured such eminent speakers as Andrew Warren, director of the Association for the Conservation of Energy, whose paper was entitled 'Cost effective energy management'; George Barrett, PowerGen's environmental adviser spoke about 'The importance of fuel selection'. ETSU's Dr Kevin Brown discussed 'The role of renewables' and Professor Peter White of the University of Westminster outlined various approaches to 'Reducing energy use in transport'.

Both sessions were chaired by Institute President, Professor James Harrison, who supervised the open forum sessions held at the end of the morning's and afternoon's offerings.

The next Institute of Energy conference will be held in Cardiff from 21-22 September, and will be the first international conference on *Combustion and Emissions Control*. The two-day conference will include contributions on the subjects of boilers and furnaces; emissions reduction in oil and gas systems as well as solid fuels; waste utilisation and combined cycle generation.

For further information contact Judith Higgins or Louise Evans on 071 580 0008, or fax: 071 580 4420.

Future for clean coal in Europe

THE 1993 Robens Coal Science Lecture will be presented by Mr P Fernandez Ruiz, the energy programme manager with the EC's DGXVIII.

Mr Ruiz will take as his subject: *Clean Coal Technologies: Future in the European Community Energy Scene.*

As usual, the lecture will be held at The Royal Institution at 21 Albemarle Street, London W1. The date for this year's presentation is Monday 25 October at 5.30 pm, with tea being served at 5 pm.

Admission is free of charge, but by ticket only. Tickets are available by post from Dr J C Whitehead (Lecture tickets), Chairman of Council, The British Coal Utilisation Research Association Ltd, Coal Research Establishment, Stoke Orchard, Cheltenham, Gloucestershire GL52 4RZ.

British Steel Prize of the Institute of Energy

THE Institute of Energy wishes to award an annual prize for the best final year project on Energy and the Environment. Entries, which would be welcomed from any tertiary education establishment, should be received by 31 October 1993. The prize, which is being funded by British Steel, will be up to the value of £500. Entries should be sent to: **The Education Secretary, The Institute of Energy, 18 Devonshire Street, London W1N 2AU.**

Wide view of R&D

'Research and Development in the Nuclear Industry' Edited by J D Lewins and J H Gittus
Published by James Wiley & Sons, 376 pp, price £99.00.

THIS book presents the reader with a series of technical papers taken from a Conference held in the University of Cambridge in April 1992.

The range of papers presented were drawn from many sides of the nuclear power industry and so represent a wide view of the current position for R&D. The questions as to who funds, who resources and who needs R&D in the nuclear industry, are important and the series of papers reproduced from the meeting do identify some solutions as well as to restate the problems.

Nuclear energy is a high technology profession in engineering and for many years has been in receipt of government funding both in Britain and overseas. The financial support which has been indicative of commitment to R&D over the years, has changed radically during the last decade. Privatisation of service industries has led to new management systems, calling into question expenditure in many areas of business. The Atomic Energy Authority in the UK, while still government owned, now has to operate within a strictly commercial framework.

On an optimistic note, the papers in the book show that all is not lost. For high technology companies to maintain growth and market dominance, requires new products to be sought, which means research and the subsequent development of the product.

The Cambridge conference not only produced papers explaining the work of a number of companies and utilities in the nuclear field, but also showed the present interaction between universities who have the expertise in nuclear technology and industry. The valuable links established are recognised by many and it is hoped that this conference, now supported by these published proceedings, will encourage further liaison.

The book's content are not restricted to the UK. A paper by Sergio Finzi deals with the work throughout the Community which underpins nuclear safety. Matters surrounding radiation protection research, waste management, decommissioning as well as accident management are given in his detailed paper.

The opening paper in the book describes the current work of AEA Technology, and is written by Dr Derek Pooley, managing director of AEA's nuclear business group. Dr Pooley provides us with five clear sighted objectives that are essential for the industry to follow if it is to have a strong future.

An important contribution is provided by Sir John Mason of Imperial College, London, latterly head of the UK Meteorological Office. His excellent paper on Modelling Global Climatic Changes is well worth reading. There are, of course, a number of other interesting papers but space restricts description of these.

The reader is provided with a summary of the whole meeting by Sir John Gittus, the director general of the British Nuclear Industry Forum. A useful insertion into the proceedings is some 30 or so pages of the discussions which took place, prepared in an Appendix at the end of the book. This publication is highly recommended.

Eur Ing F John L Bindon

Scientifically impartial

'Global Environment Protection Strategy Through Thermal Engineering' Edited by Keizo Hatta and Yasuo Mori
Published by Hemisphere Publishing Corporation, New York, Washington, Philadelphia & London, 1992, 345 pp, H/B, price £57.00.

THE Japanese Society of Mechanical Engineers have studied 'concrete counter measures for protecting the global environment' through the activities of the research subcommittee of their thermal engineering division. After analysing reports of various international and national conferences on environmental problems, especially the problems of the increase of atmospheric carbon dioxide, the destruction of the ozone layer and acid rain, they found that most of the reports were basically political in content and were too general and lacked substance. The subcommittee noted that they could approach the problems from the relative advantage of not needing to be influenced by external pressures and the set of papers contain both research results and informed overviews of a series of technologies.

In the introduction, Yasuo Mori points out that a combination of appropriate energy technologies has not only controlled oil imports to Japan, but has actually reduced them — a factor which has helped Japan to achieve considerable economic growth in the past decade.

The second chapter examines the place of thermal energy in the overall energy situation in Japan on observed climatic data and discusses the future climatic condition if predicted carbon dioxide levels are reached.

Carbon dioxide problems and methods for controlling their emissions in chapter four are followed by a detailed examination of hydrogen as a by product in chapter nine.

Advanced energy conservation measures, including various combined cycles, are outlined in the next chapter, while the final chapter gives a fairly philosophical view of energy conservation, ending with a call for technology transfer, and the transfer of technical assistance for energy management from developed to underdeveloped countries. There is also a brief index.

This is a very useful and scientifically impartial set of papers which will appeal to professional energy engineers. The papers were selected from the subcommittee's final report (in Japanese), submitted towards the end of 1990 and rewritten in sound technical English. As a scientifically based overview of the state-of-the-art at the start of the 1990s, it fills a gap in the literature and can be especially recommended for University courses dealing with energy and the environment.

Dr Cleland McVeigh

Written with clarity

'The International Politics of Nuclear Waste' by Andrew Blowers, David Lowry & Barry D Solomon.
Published by Macmillan Academic & Professional Ltd, Basingstoke, Hants, 1991.

IN their preface, the authors point out that they have attempted to give an understanding of the contemporary politics of radioactive waste, and that because there is no ultimate political solution, public acceptability becomes the test and the key to achieving the political legitimacy of nuclear waste policies. But public acceptability does not in itself guarantee the interests of nuclear communities who may unwillingly have to bear the costs imposed on them by the majority. Nor does today's public acceptability secure the interests of future generations who will be forced to maintain surveillance over facilities that, to them, represent yesterday's outdated technologies.

The book is based on an extensive database of original source material, participation in protests and on visits to several nuclear communities in a number of countries. Virtually everyone agrees that 'something' should be done about nuclear waste. But the disjointed and incremental policy for nuclear waste management, outlined in the book, is incompatible with the need for the development of public acceptability of any proposed solutions.

All three authors have published extensively in the social policy issues of various energy topics, and this scholarly work can only enhance their reputation. A book for all concerned with energy futures, written with clarity and full of references and notes.

Dr Cleland McVeigh

Technology in National Curriculum 'needs sharper focus'

THE Engineering Council has welcomed the National Curriculum Council's (NCC's) interim report, published in July, supporting the view that further development work is necessary to provide a sharper focus for the subject of Technology.

The Council has called for a number of broad issues to be tackled by the NCC in addition to those highlighted in their report. The NCC should give clear guidance on the balance between the design-and-make tasks and other learning. They also recommend that the requirements of the order should be set out in such a way that they can be easily understood, and that technology should have a sharper focus.

Director general of the Council, Denis Filer, commented: "I am particularly pleased to note that the NCC is looking again at the place of food in Technology. While certain aspects of food production lie properly within Technology, other aspects such as cooking and nutrition lie elsewhere ... we feel these should have their own status in the curriculum."

He also stated that the Government would need to take further action in areas such as resources and ancillary staff in schools if such measures were to be possible.

The Council reiterated its view that the Government's action in introducing Technology into the National Curriculum was a major step forward in preparing young people for life in a technological age, but it must be properly defined. Despite the delay, they hope the Government will not consider putting technology into temporary abeyance by making it optional until 1995.

Can 50 000 students a year be wrong?

A LEVEL General Studies is failing to bring breadth to the education of young people aged 16-19.

Although the examination is claimed to assess general ability and to be a good predictor of capacity to benefit from higher education, results are biased in favour of scientists and males, and there is little relation to degree performance. There is no obvious explanation why scientists and males should get better results in General Studies.

The subject is being treated with varying degrees of seriousness by schools. Rather than a key part of the timetable, it is sometimes being seen as a subject to be fitted in when the main timetable has been settled.

These findings are published in The Engineering Council's report *General Studies: breadth at A level?* published in July.

The report also found that General Studies can usually only help to secure a place in higher education as a third or fourth A level, and is often regarded by admissions tutors as not quite 'the real thing'. This creates a paradox: 50 000 students a year are taking a qualification that appears to mean very little.

The report has been written by Prof Alan Smithers and Dr Pamela Robinson of the University of Manchester. It is based on a study of the subject in action in 30 schools, including interviews with 44 teachers and 300 pupils; analysis of the A level entries of the Joint Matriculation Board (now the Northern Examinations and Assessment Board) at three-year intervals from the introduction of the subject; a study of admission policies and practices of higher education institutions, in particular in eight subjects across ten universities and colleges; analysis of the A level and degree results of over 2300 students; and scrutiny of published documents, examination papers and national statistics.

General Studies was invented as an examination subject by the Joint Matriculation Board and first examined as an A level in 1959. Since then it has been taken by increasing numbers of students and is now sat by some 30% of the school-based A level population. In 1992 there were in excess of 54 000 entries.

Of the 30 schools considered in the report, two-thirds saw General Studies as a specific programme leading to an examination. Others saw it as encompassing all non-specialist activities. This ambivalence is carried over into the higher education sector where 90% of institutions make no reference to it in their general requirements.

The report suggests that the time has come to take stock, and lists seven possible options for increasing the breadth of the subject:

- supporting studies — a range of non-examined subjects complimentary to the specialist programme;
- re-cast General Studies, possibly along the lines of the theory of knowledge component of the International Baccalaureate;
- another qualification — for instance the Certification of Extended Studies (sometimes called E level) currently being piloted in independent schools;
- GNVQ units which would complement purely academic work with vocational studies;
- more A levels, achieving greater breadth by increasing the number taken from the usual three to five;
- a baccalaureate, imposing breadth by requiring students to choose a set number of subjects from within a framework;
- core skills focusing on the generic skills of numeracy, communication and problem-solving.

Each of these options has its own strengths and weaknesses, says the report. A preference is expressed for a norm of five subjects at A level, creating the opportunity for all students to think seriously about breadth. This would render General Studies superfluous, but if it is to be replaced then it should be on the basis of a rational, rather than than rhetorical, approach to breadth in education for 16 to 19 year olds.

Awards offered

WOMEN undertaking a two-year full-time course, or a block release course in electronic, electrical or allied engineering subjects leading to a Higher National Diploma (HND) are invited to apply for awards of £500 per annum.

The awards will be granted by the Caroline Haslett Memorial Trust (CHMT), which is administered by The Institution of Electronics and Electrical Engineers (IEEIE). Anyone interested in obtaining an award should apply immediately, as the closing date for applications is Thursday 14 October 1993.

Application forms are available from the Caroline Haslett Memorial Trust, IEEIE, Savoy Hill House, Savoy Hill, London WC2R 0BS. Tel: 071 836 3357.

Cultural change required in E & T

THE EDUCATION and training and further education of engineers must undergo a fundamental culture change in order to meet future needs.

An Engineering Council report *Review of Engineering Formation* suggests redefining the existing three-tier registration structure, and proposes three new categories, the lower two combining elements of the three current classifications. The demands for the highest tier will be more demanding than the present CEng status. Progression between grades will be via credit accumulation, accreditation of prior learning and NVQs.

Review of Engineering Formation was produced by three working groups, drawn from academia, industry and the engineering profession, supported by consultants jointly funded by the Employment Department, commissioned by the Council.

The groups analysed the main challenges that will face industry up to the year 2010, and argue that engineers will need not just a foundation in generic knowledge and skills, but also in team working, languages and project management.

EVENTS

September 1993

Combustion & emissions control
1st international conference, 21-22 September, Cardiff. Details from Judith Higgins, IoE on 071 580 0008; fax: 071 580 4420.

Coal exploration '93
Seminar, 23-24 September, Ranchi, India. Details from Dr R P Verma, General Manager & Chief of Exploration, CMPDI Ltd, Gondwana Place, Kanke Road, Ranchi-834008, India. Tel: 304358/3045528; fax: 0651 33001851/0651 3005447.

The degree-day method
Energy management short course, 28 September, London. Details from Eclipse Group Limited, tel: 071 354 5858.

Fire and explosion
Course, 27 September - 1 October, Leeds. Details from Miss Julie Charlton, Dept of Fuel & Energy, University of Leeds, Leeds LS2 9JT. Tel: 0532 332494; fax: 0532 440572.

1st European conference on applications of meteorology
Four-day international conference, 27 September - 1 October, Oxford. Details from Lucinda Middleton, IBC Technical Services Ltd, Gilmoora House, 57/61 Mortimer Street, London W1N 7TD. Tel: 071 637 4383; fax: 071 631 3214.

3rd Grove Fuel Cell Symposium
28 September - 1 October, London. Details from Kay Russell, Conference Dept, Elsevier Advanced Technology, Mayfield House, 256 Banbury Road, Oxford OX2 7DH. Tel: 0865 512242; fax: 0865 310981.

Induction in industry: a technology with a future
European workshop, 30 September, Bilbao, Spain. Details from the Technical Secretary, Tisa Congresos, Edif Albia 11 7º - S Vicente 8, 488001 Bilbao, Spain.

October 1993

Diploma in Engineering Management
Postgraduate qualification. Details from The Secretariat, Joint Board for Engineering Management, PO Box 81, Northgate Avenue, Bury St Edmunds, Suffolk IP32 6EU

Environmental design of buildings
MSc, one-year full-time, two years part-time. Details from Jane Matthews, Welsh School of Architecture, Bute Building, King Edward VII Avenue, Cathays Park, Cardiff CF1 3AP. Tel: 0222 874000; fax: 0222 874192.

Cut the cost of operating buildings
Half-day seminar, 1 October, London. Details from Elaine Cox, tel: 071 378 0101.

2nd NHER national conference: Affordable homes: affordable warmth
4-5 October, Nottingham. Details from David Crewe Associates, 101 Judd Street, London WC1H 9NE. Tel: 071 387 2221; fax: 071 387 2485.

Regulation & marketing in the UK gas industry
Conference, 4-5 October, London. Details from AIC Conferences, tel: 071 779 8848.

Pumps users forum: managing lifetime costs
4-6 October, Manchester, UK. Details from Miss Sharon Kennedy, Forum Organiser, BHR Group Ltd, Cranfield, Bedford MK43 0AJ. Tel: 0234 750422; fax: 0284 704006.

Environmental Protection 1993
Conference & exhibition, 4-7 October, Brighton, UK. Details from National Society for Clean Air & Environmental Protection, 136 North Street, Brighton BN1 1RG. Tel: 0273 326313; fax: 0273 735802.

Applied Fault Tree Analysis
Course, 4-8 October, Warrington, UK. Details from L Fairman, AEA Technology Consultancy Services, Thomson House, Risley, Warrington WA3 6AT.

Introduction to risk assessment
Course, 5 October, Warrington. Details from L Fairman, AEA Technology Consultancy Services, Thomson House, Risley, Warrington WA3 6AT.

The nuclear fuel cycle
Conference, 5-6 October, London. Details from Jane Worman, IBC Technical Services Ltd, tel: 071 637 4383; fax: 071 631 3214.

100 kW+ Electricity Purchasing
Conference, 5-6 October, London. Details from Debbie Lock at ICM, tel: 0483 37557/37107

British Wind Energy Association's Annual Conference
Conference, exhibition & workshop, 6-8 October, York, UK. Details from David Bodger, Residential Courses Unit, University of Nottingham, 14 Shakespeare Street, Nottingham NG1 4FJ. Tel: 0602 516526; fax: 00602 472977.

Privatisation, energy utilities and the law
Conference, 7-8 October, London. Details from Helen Williamson, IBC Legal Studies & Services Ltd, 57/61 Mortimer Street, London W1. Tel: 071 637 4383; fax: 071 631 3214.

Workshop for energy managers
11 October, Birmingham, UK. Details from British Institute of Management, tel: 0536 204222/205247.

Opportunities for trade and investment in the Russian and CIS gas industry
Conference, 11-12 October, London. Details from RIIA Conference Dept, Chatham House, 10 St James's Square, London SW1Y 4LE.

Avoidable waste in space heating systems
Short course, 12 October, Newent, Glos, UK
Details from Vilnis Vesma & Co, tel: 0531 821350.

UK Corrosion '93: asset management
Conference & exhibition, 19-21 October, London. Details from Jane Worman, IBC Technical Services Ltd, tel: 071 637 4383; fax: 071 631 3214.

The Filtration Society's 1993 International Conference
19-21 October, Karlsruhe, Germany. Details from The Filtration Society, 48 Springfield Road, Horsham RH12 2PD. Tel: 0403 259419; fax: 0403 265 005.

1993 Robens Coal Science Lecture: Clean coal technologies — future in the European Community energy scene
25 October, The Royal Institution, London. Details from Dr J C Whitehead (Lecture Tickets), BCURA Ltd, Coal Research Establishment, Stoke Orchard, Cheltenham GL52 4RZ. Tel: 0242 673361.

Nuclear power plant safety standards: towards international harmonisation
International conference, 26-28 October, London. Details from IMechE, 1 Birdcage Walk, London SW1H 9JJ. Tel: 071 222 7899; fax: 071 222 4557.

Subsea & pipeline engineering
Three-day training course, 26-28 October, London. Details from BPP Technical Services Ltd, 2 Tavistock Place, London WC1H 9RA. Tel: 071 837 6362; fax: 071 837 0822.

Risk Assessment 2000
Conference, 28 October, London. Details from Nadia Ellis, IBC Technical Services Ltd, tel: 071 637 4383.

INSTITUTE OF ENERGY CONFERENCES

Please note that the conference programmes are subject to modification. For the latest information please telephone Judith Higgins on 071 580 0008.
The Institute of Energy, 18 Devonshire Street, London W1N 2AU, UK.

First International Conference on

Combustion & Emissions Control

21-22 September 1993, Cardiff

Keynote speeches from international figures will precede contributions on the following subject areas: Boilers and Furnaces, Emissions Reduction — Gas & Oil Systems, Emissions Reduction — Solid Fuels, Waste Utilisation and Combined Cycle Power Generation.

Making Energy Privatisation Work

The Future of Regulation

17 November 1993, London

Queen Elizabeth Conference Centre, London SW1

Speakers include: Tim Eggar MP, Minister for Energy; Professor James Harrison, Institute of Energy; Professor Nigel Lucas, Imperial College; John Baker, National Power plc; Malcolm Chatwin, Yorkshire Electricity Group, plc; David Jefferies, National Grid Company plc; Cedric Brown, British Gas plc; Alan Marshall, GAS; Lady Wilcox, National Consumers' Council; Ian Blakey, British Iron and Steel Producers Association; OFGAS speaker to be advised; Richard Caborn MP, Trade & Industry Select Committee. Conference Chairmen: Mr Ian Powe, Gas Consumers' Council and Professor Nigel Lucas, Imperial College.

Modernising Central Europe's Energy

Organised in association with the Parliamentary Group for Energy Studies

9 March 1994, London

The Church House Conference Centre, London SW1

The morning session will comprise keynote presentations covering financial and political aspects. The afternoon session will give in depth analyses of investment opportunities including the discussion of technology transfer, case studies on district heating, housing stock renovation, transmissions systems, restructuring and development of state industries and power generation.

2nd International Conference on

Ceramics in Energy Applications

20-21 April 1994, London

The conference will consider material solutions to new and existing applications of interest to energy suppliers and users. Important aspects of materials innovation in energy saving will be explored. New Developments & Applications; Energy Saving & Heat Transfer; Evaluation & Performance; Power Generation; Sensors & Catalysts; Energy Efficiency.

Events Co-Sponsored by The Institute of Energy

26 October 1993

The Monitoring & Management of Combustion Processes following the EPA 1990

8 December 1993

Process Controls For Boilers & Furnaces

General Enquiries should be directed to:
David Suthers, Combustion Engineering Association, PO Box 15, Farm Road, Aberaman, Aberdare, Mid Glamorgan CF44 6YZ. Tel: 0685 879119

January 1994, Calcutta, India
First International Conference on

Combined Cycle Power Generation

General Enquiries should be directed to:
Professor Prabir Basu, Technical University of Nova Scotia, PO Box 1000, Halifax, Nova Scotia, Canada B3J 2X4, Tel: 1-902-420 7531
Paper Co-ordinator for the submission of abstracts from European Countries:
Dr J R Howard, Tel: 44-21-705 1946

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