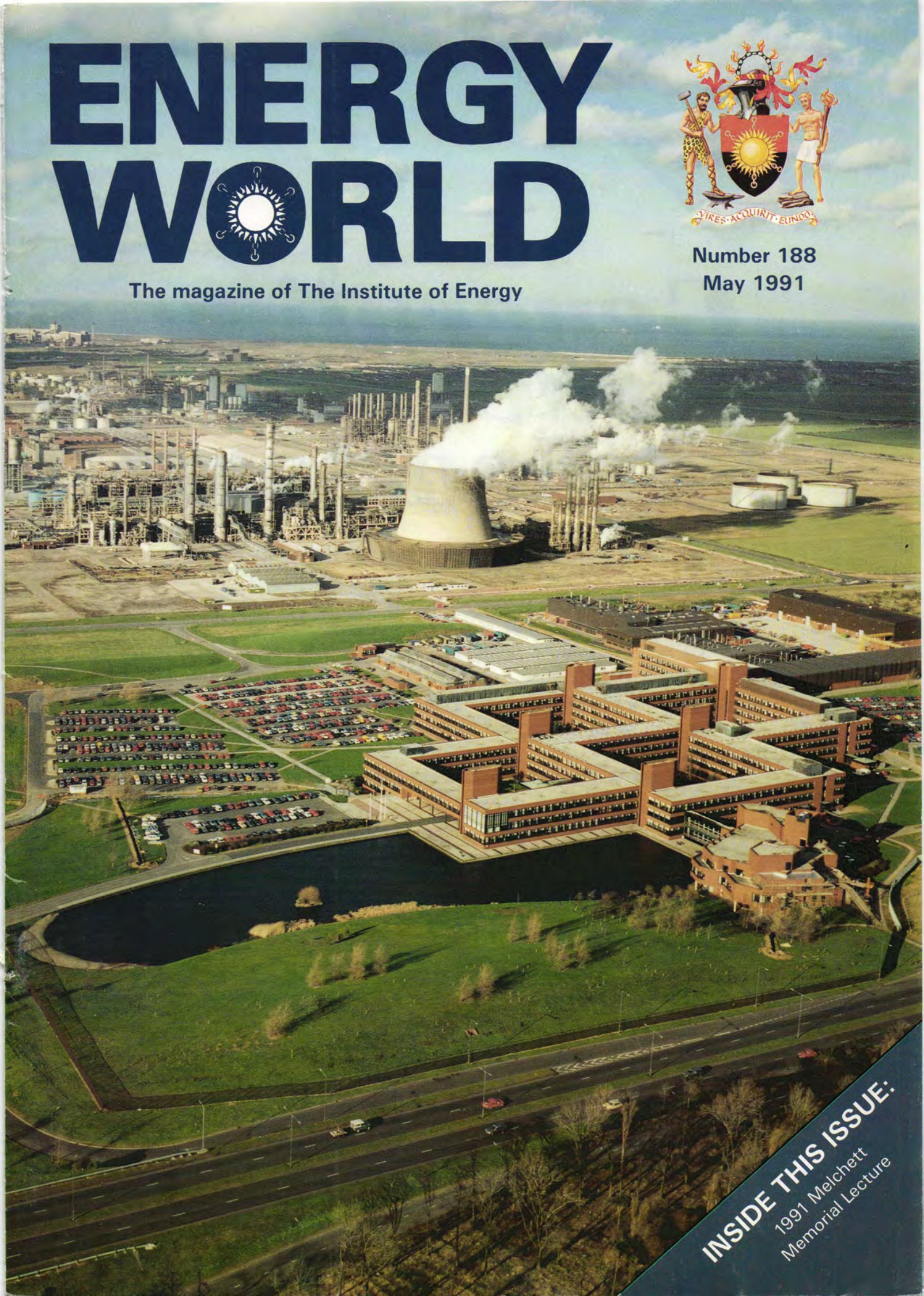
ENERGY WORLD

The magazine of The Institute of Energy

Number 188
May 1991



INSIDE THIS ISSUE:
1991 Melchett Memorial Lecture

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ENERGY WORLD

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CONTENTS

COVER

The photograph on the cover of this month's issue shows an eastern section of ICI's chemical complex at Wilton, Middlesbrough, with Tees Bay and the North Sea in the background.

In the foreground is the site headquarters, incorporating ICI's materials research centre. Immediately behind, the plant with the large cooling tower is one of the largest olefines plants in the world, owned by ICI and BP.

Other principle plant on the site makes plastics and intermediates for polyester fibres, films and bottles.

ICI is one of the largest industrial users of energy in this country, and published as a supplement to this month's *Energy World* is the paper given by Ralph Hodge, chief executive officer of ICI Chemicals and Polymers Limited, at the Institute of Energy's Melchett Memorial Lecture last March.

US National Energy Strategy

THERE IS a legend of a car driver, lost in the countryside, asking the way to a certain town, and being told "Don't start from here."

This advice fits exactly the problem of formulating a long-term energy strategy, aimed at a world in which humanity lives in stable equilibrium with the environment. For this the engineer must develop 'equilibrium engineering'.

Engineering has so shrunk the world that, in the long term, no continent or group of individuals can isolate itself from the disasters of another. It follows that stable equilibrium will only be reached when every human has enough energy to give them all the necessities for a self-fulfilling life — that is, the benefits of the industrial revolution without its damage. Aspects of the damage which particularly concern the fuel engineer are the greenhouse effect, acid rain, damage to the ozone layer, the production of long-lived artificially radioactive materials, and derelict power stations. All these are a sin against our descendants.

Renewable energy can be used without limit in this stable world, but to avoid the greenhouse effect each person's limit for the combustion of fossil carbon is less than ½ ton per annum. The fuel engineers can undoubtedly provide all that is necessary from this energy but only if they are given the means and the encouragement.

What we see in this 'National Energy Strategy' shows clearly the difficulty of 'starting from here'. 'Here' is a world in which each UK citizen puts about 10 tons of fossil carbon into the atmosphere every year; this strategy is concerned with the USA "achieving greater energy security", "reduced exposure to oil price shocks", and "securing future energy supplies".

They say that the growing US economy will need some 30% more electricity generating capacity: the present installed capacity is 3.5 kW/capita. In Britain we have about 1kW/cap capacity, and use about 400W/cap averaged over the year. It has been calculated that well under 50W/cap is sufficient to give the essential benefits of the industrial revolution.

Solely for the short-term benefit of the US, it is proposed to: increase oil production in countries outside the Persian Gulf; benefit from the enormous low-cost oil reserves in the US, expand the natural gas industry by removing regulations, and increase nuclear power generation in 2020 by almost 10% — in spite of "the power technology". It is terrifying to read that "researchers have demonstrated that both high-temperature gas-cooled reactors and liquid metal reactors can shut themselves down safely under conditions that would be extremely serious for present-day reactors".

Damage to the environment is hardly mentioned, and increases in efficiency are proposed purely to help ensure future energy supplies.

"Public comment revealed virtually unanimous support for the development and use of renewable resources". This well illustrates Abraham Lincoln's axiom 'You can't fool all the people all the time'. However, the use of renewables is proposed purely to contribute to a growing economy and exports. The tremendous potential of renewables to supply energy without putting fossil carbon into the atmosphere, or artificial radioactivity into the earth, is not mentioned.

Thus, 'here' is a world situation in which a fraction of humanity continues to live 'high on the hog', squandering fossil fuel with no regard for their descendants or for the rest of humanity. This strategy is aimed solely at continuing this extravagant life in the US for another two or three decades.

This document demonstrates that it will be much easier to bring the world's poor up to the level of equilibrium fuel engineering than it will be to bring the rich down. However, unless these sacrifices can be made in the next century by the heavily consuming nations, our civilisation will go the way of all previous civilisations. Unfortunately, we engineers have produced ways of destroying people and the environment many thousandfold more powerful than those which destroyed earlier civilisations.

There is one ray of hope: many people are returning to the traditional wisdom that their quality of life is much higher if they try to maximise creative self-fulfilment rather than possession of status symbols. They listen to their conscience, which tells them to care for future generations of mankind and the world in which they will live.

Prof M W Thring *ScD FEng*
Senior Fellow and Past President of the Institute of Energy

The author

Professor Meredith Thring is a Past President of The Institute of Energy (1962-63) as well as a former Professor of Fuel Technology at Sheffield University and Professor of Mechanical Engineering at Queen Mary College, University of London.

His brilliant career in the fuel and energy sector began when he graduated in mathematics and physics at Cambridge and joined the British Coal Utilisation Research Association from 1937 until 1946. His work in this period on the flow of producer gas in mains gained him the Student Medal of the Institute, then the Institute of Fuel, in 1938.

At the beginning of World War II he led a small research team on the design and theory of small gas producers and on electrostatic precipitators. This led in 1944 to his appointment as Head of the Combustion Research Laboratory.

From 1946 to 1953 he was head of the Physics department of the British Iron and Steel Research Association and was made Assistant Director in 1953. During this period he was closely connected with the setting up of the International Research Project on Flames.

In 1953 he was appointed to succeed Professor Sarjant as Professor of Fuel Technology at Sheffield University and in 1955 the scope of his Department was extended to include chemical engineering.

He moved on to become Professor of Mechanical Engineering at Queen Mary College, University of London, in 1964, retiring from that position and as Head of the Mechanical Engineering Department in 1981.

During his retirement, Professor Thring has maintained an interest in appropriate technology for energy utilisation in developing countries.

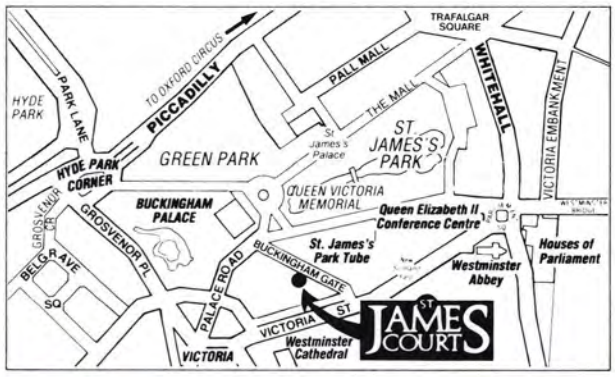
BRITISH COAL

Options for Privatisation

One day conference in London
Tuesday 18 June 1991

The Government has recently confirmed its intention to privatise British Coal in the next Parliament. Over the last few years a number of ideas have been floated as to how privatisation could be achieved. The Government has yet to decide which route to take, but with the Conservative Party's election manifesto under preparation, the merits of the different options need to be assessed. The alternatives include selling off British Coal as a single entity; splitting the company into smaller components; selling British Coal directly to another company; allowing National Power or PowerGen to buy a stake in the privatised company; and even allowing mineworkers the opportunity to buy individual mines. These and other issues will be examined by a panel of experts, including **Dr Michael Clark MP**, Chairman of the House of Commons Select Committee on Energy; **Malcolm Edwards**, Commercial Director of British Coal; and **Roy Lynk**, President of the Union of Democratic Mineworkers.

ADAM SMITH
INSTITUTE



WHO SHOULD ATTEND?

- Electricity generating and supply companies
- Oil companies
- Private coal companies and satellite industries
- Merchant banks
- Financial and legal advisers
- Gas companies
- Suppliers of goods & services to the coal industry
- Natural resources companies
- Environmental consultants and analysts
- Energy correspondents

RESERVATIONS

To reserve your place, mail or fax your completed application form to:

Robert Thomas, Conference Director
The Adam Smith Institute
23 Great Smith Street, LONDON SW1P 3BL
Fax number: 071 222 7544

Telephone bookings and general enquiries can be made to Robert Thomas on 071 222 4995.

The conference fee is £145.00 plus £25.37 VAT, total £170.37, which includes coffee, lunch, afternoon tea and all conference documentation. In the event of cancellation, substitutions will be accepted, but no refunds are possible within seven days of the conference date. Cheques should be made payable to ASI Research Ltd (VAT No 340 6472 71).

The venue is the prestigious St. James's Court Hotel, Buckingham Gate, London, SW1 (near to St. James's Park and Victoria Underground Stations).

CONFERENCE OBJECTIVES

- How should British Coal be privatised?
- What are the implications for the other sections of the power industry, including newly privatised companies?
- How will privatisation affect existing private coal companies and what measures can be taken to stimulate competition within the coal industry?
- How will privatisation affect the price of electricity?
- What lessons can be learnt from past privatisations?
- Should the workforce be given a stake in the industry?

BRITISH COAL
Options for Privatisation

PROGRAMME

9.00 Registration and coffee

9.30 **The role of the existing private coal industry**
RICHARD BUDGE
Managing Director, Budge Mining

10.00 **British Coal - background and future prospects**
MALCOLM EDWARDS
Commercial Director, British Coal

10.35 Coffee

10.55 **Privatisation - the political perspective**
DR MICHAEL CLARK MP
Chairman, House of Commons Energy Cttee

11.30 **The impact of privatisation on British Coal**
HOWARD HYMAN
Head of Corporate Finance (Europe),
Price Waterhouse

12.05 **Options for privatisation**
DIETER HELM
Director, OXERA Associates

12.40 Lunch

2.00 **The response of the workforce**
ROY LYNK
President, Union of Democratic Mineworkers

2.35 **Managing the transition to the private sector**
LYNDA ROUSE
Director, BZW Privatisation Project Advisory Unit

3.10 **Privatisation - tackling the legal hurdles**
CHARLES RANDELL
Partner, Slaughter & May

3.40 Closing summary

BOOKING FORM

BRITISH COAL
Options for Privatisation

One day conference - Tuesday 18 June 1991

I/We wish to make ..... reservation(s) at £145.00 plus £25.37 VAT - total £170.37 for the following:

Organisation.....

Address.....

.....

Telephone: ..... Fax: .....

Names and titles of delegate(s) .....

.....

.....

☐ I enclose cheque in favour of ASI Research Ltd

☐ Please invoice me

☐ Please charge my VISA/Access card no

Expiry date ..... Signature .....

Amount £.....

Billing Address .....

.....

.....

Please return completed form: **Adam Smith Institute,** 23 Great Smith Street, London SW1P 3BL or make telephone reservations on 071 222 4995 (Fax 071 222 7544)

East German takeovers

SIEMENS Power Generation Group (KWU) took over Goerlitzer Maschinenbau GmbH, Goerlitz/Saxony, in April. An application for approval has been filed with the Federal German Cartel office. The company will in future be known as Siemens Turbinenbau GmbH.

Goerlitzer Maschinenbau, founded in 1847, manufactures steam turbines for industry as well as CHP plants. Some 1000 turbines produced in Goerlitz are on line not only in CMEA countries, but also in the western world. The necessity to modernise the energy supply system and industry in the former GDR means that there is an enormous demand for such plant and Siemens intends to use the Goerlitz factory to meet most of this demand. Goerlitz Maschinenbau is to carry out additional work by joining forces with Siemens' turbine manufacturing plants in Wesel, Mulheim/Ruhr and Berlin. Since the beginning of 1990, Siemens has been awarding contracts to Goerlitz for the machining of turbine components and the fabrication of condensers.

In the course of the past year the employment situation at the Goerlitz factory deteriorated — just as it did in other plants in the former GDR — because many orders were cancelled. Siemens is to embark on a modernisation programme to make the Goerlitz plant competitive.

ASEA Brown Boveri AG, Mannheim, part of the worldwide ABB Group, has acquired Bergmann-Borsig GmbH, Berlin. Following the acquisitions of Energiebau Dresden GmbH in December 1990, and Automatisierungsnalagen Cottbus GmbH in February, Bergmann-Borsig is the third major company in Eastern Germany to be acquired by ABB.

Bergmann-Borsig, which has its major production facilities in Wilhelmsruh, Berlin, is the leading manufacturer of power plant components in Eastern Germany. Its main products are turbines and generators, as well as thermal equipment for power stations and industrial processes. The company currently employs about 3750 people, including 250 apprentices.

ABB intends to invest about $30 million in its new company over the next three years, most of it to modernise and revamp production. ABB Bergmann-Borsig GmbH, as it will be called, will concentrate on the production of turbines for power generation, the design, development and fabrication of thermal systems and equipment, and all-inclusive servicing of power stations. The company plans to achieve annual sales of $180 to $240 million in the medium term.

Gulf wildlife team returns

A TEAM from the International Council for Bird Preservation and the Royal Society for the Protection of Birds has spent two weeks collecting information on birds and other wildlife affected by the Gulf oil spill off Saudi Arabia.

The most heavily polluted coastline is north of Jubayl with oil up to four feet thick in places. Oil has been washed off some of the narrow beaches, while oil and water was being skimmed off in some places and trenches dug to drain away oil at the high water mark. Access to much of the coastline for cleaning is difficult.

The initial spill caused nearly complete oiling of the grebes and cormorants offshore between Khafji and Abu'ali. About 800 of these were received by the Jubayl Rescue Centre for cleaning and release, but approximately 80% of oiled birds were dead.

The main threat is now to waders, which feed in the bays during their spring migration. In some flocks up to 50% of waders and a total of 27 species were oiled, including dunlin, lesser sand plover, bar-tailed godwit, curlew, redshank and terek sandpiper.

This information forms the basis for future action to help protect the Gulf and its important wildlife, to include further monitoring by experienced teams who will ascertain the full impact of the spill on birds and study their numbers and movements in the Gulf. The new teams will also be advising on where best to attempt clean-up operations, evaluating priority sites for cleaning and areas which should be left undisturbed during the breeding season.

Hybrid power system for Mexico

INTEGRATED Power Corporation, a subsidiary of Westinghouse, has commissioned an IPC RAPS® for the village of Santa Maria Magdalena in Hidalgo, Mexico. The system is presently providing power for 43 homes, three schools, three stores, a church and an auditorium and is used for basic residential purposes such as lights, radios and televisions as well as refrigeration for stores. Future plans include powering a clinic, computers, and support for local economic development.

IPC's 45 kWh/day centralised hybrid power system consists of a 4.32 kW photovoltaic array, a 5 kW wind turbine, an 1100 ampere-hour 120 volt DC battery bank, an 18.4 kVA diesel generator, IPC's alliance inverter and IPC's TM3 microprocessor. The system is located in the centre of town and provides utility-grade power to the village via an aboveground network.

The system was funded by Compania de Luz y Fuerza Del Centro (CLYF), utility which serves the area; Pronasol; the Mexican Rural Development Fund, and Westinghouse.

CLYF installed the distribution grid and assisted IPC with the assembly on-site. The villagers installed the foundations for the wind turbine and the power system shelter. They are to assist CLYF with maintenance and their participation will contribute to the project's long-term success.

Irrigation turbine wins award

A WATER-POWERED turbine for irrigation in developing countries has won this year's Appropriate Technology Award, one of the four categories in the Better Environment Awards for Industry which seek to raise the standard of environmental excellence in business and industry. The awards are sponsored by the Environment Foundation, the Department of the Environment and Shell UK Ltd, promoted by the CBI and the Financial Times and administered by the RSA.

Peter Garman and Barbara Sexon have developed a turbine which harnesses the kinetic energy of the Nile. They hope this will enable vegetable plots and shelter belts to flourish in the deserts of Sudan.

The majority of local people can't afford irrigation because of the high cost of running a diesel pump, the lack of fuel to run it (especially in remote areas) and the need for expensive imported spare parts. Peter's original idea was to develop a water turbine which could be manufactured at a local workshop, using the minimum of machine tools.

The first prototype was developed in the UK but all the development work has been done in Sudan. The last will be the final production design with, it is planned, 90% of the parts made in Sudan. This will cut down on imports and so keep costs down as well as providing local job opportunities.

NNC wins tritium order

NNC has recently been awarded a multi-million pound contract, by the Kernforschungszentrum Karlsruhe (KfK) in Germany, for the design, manufacture, assembly and commissioning of an experimental tritium facility. This new facility will enable the Fusion Project at Karlsruhe to continue their experimental programme, which is aimed at proving the process to be used for the plasma exhaust clean-up system for a future Fusion Reactor System. The purification of tritium from exhaust gases is one of the key objectives within the European Technology Programme to be resolved in the next phase of the development of a fusion reactor design. The leading organisation at KfK is the Institute of Radiochemistry. This important contract extends NNC's experience in the design and construction of tritium facilities.

The intricate task of assembling and proving the system will be undertaken in NNC's Engineering Development Centre at Risley, Warrington, which has recently completed manufacture of complex detritiation units for the European Tritium Handling Experimental Facility in Italy.

Work begins on King's Cross gasholders

BRITISH RAIL has appointed consulting engineers Oscar Faber to carry out a feasibility study into decommissioning the seven landmark gasholders near King's Cross station in London.

This precedes plans to locate a low-level rail terminus for the Channel Tunnel under the existing mainline station. Some of the gasholders stand above or adjacent to the proposed site and before any construction work begins, all seven of the these formidable structures will have to be decommissioned and made safe. Three listed holders will be retained *in situ* while a fourth, also listed, will be dismantled and re-erected close by. Three others, not listed, will be removed completely.

Oscar Faber is looking at surface and subterranean ground and water conditions, site obstructions and contamination, tank and frame construction, waste removal and ecological effects. Two weeks' site investigation and drilling work is being followed by laboratory and desk analysis.

All gasholders are fully operational and have extensive underground pits and associated systems and buildings.

Coal in the environment

ENERGY Secretary John Wakeham has stated his government's commitment to coal as an essential fuel of the future.

Mr Wakeham was speaking at the opening ceremony of a three-day international conference *Coal in the Environment* in London on 3 April. He went on to praise British Coal, notably for their 'recent performance'; their tackling of environmental problems was, he said, to their credit. The future of coal turns upon new clean coal technologies, Mr Wakeham added.

He said the government wanted coal "to achieve its full economic potential in the energy market," to which end they had recently announced additional funding for BCC's topping cycle technology, and was contributing nearly £20 million towards 15 coal R&D projects. Mr Wakeham described himself as "far from despondent about the future of coal".

Dr Gerhard Ott, Chairman, International Executive Committee, World Energy Council, predicted that coal will overtake oil as the world's largest energy source, and saw the public's perception of coal as a 'dirty fuel' as one of the greatest problems the coal industries of the world have to overcome. The projected increase in world population by the year 2020 means an increased energy demand that cannot be met by other world resources: a strong contribution from coal is essential.

In his opening speech at the conference, Chairman of the World Coal Institute, Mr J B Thompson, stated his opinion that coal is "*the* most important fuel for power generation."

'Scots or not' (but it helps if you are)

THE privatisation of the two Scottish electricity companies, ScottishPower and Hydro-Electric, was launched at the end of March with simultaneous press conferences in London and Edinburgh. On the same day, the share information office opened in Glasgow.

In a campaign which for the first time targets the Scottish retail customer, emphasis has been given to the wider role played by the Scottish companies compared with that performed by the English generators National Power and PowerGen. The campaign slogan 'from power station to plug point' highlights the essential differences between the companies north and south of the border. The two Scottish companies each generate, transmit, distribute and supply electricity to their 2 300 000 customers, having a joint capacity of over 9500 MW.

Incentives will be offered to existing customers who register for shares, although the details of these are still to be announced. As with the privatisation of the English companies, Scottish Nuclear remains in the public sector. Unlike the previous share offers there will be no automatic registration of people who registered in the earlier electricity privatisations. Preference in allocation will be given to existing customers, who will be able to apply for shares either in their own company, or for a 'package' containing shares from both. Non-customers will only be permitted to apply for the package, the proportions of which are yet to be announced, although a 2:1 ratio was mentioned as a possibility, with Scottish Power being the larger company.

The government's financial advisers for this flotation, Barclays de Zoote Wedd, and British Linen Bank, dismissed speculation that the timing of the privatisation could be altered by a June election, citing October as a more likely date for Mr Major to go to the country

With an advertising campaign featuring famous Scottish heroes and monsters, one wonders what the Scottish people's reaction will be to this uniquely targeted campaign.

Free entry to Science Museum

BRITISH GAS has become the first Founder Patron of the Science Museum's Corporate Partnership programme, giving company employees and pensioners free entry for a year from April 6th.

British Gas Chairman and President-Elect of the Institute of Energy, Robert Evans, said: "We welcome this scheme and are delighted to be its first Founder Patron. We hope it will succeed in further strengthening the links between industry and education. It should also, by encouraging a wider understanding of science and technology, show more young people how exciting and challenging careers in these areas can be."

British Gas employees and senior citizens, with one companion, will be allowed free entry to the Science Museum in Kensington (currently £3.50 per adult) and the National Railway Museum in York, on production of an identity card or copy of a letter to be sent to senior citizens.

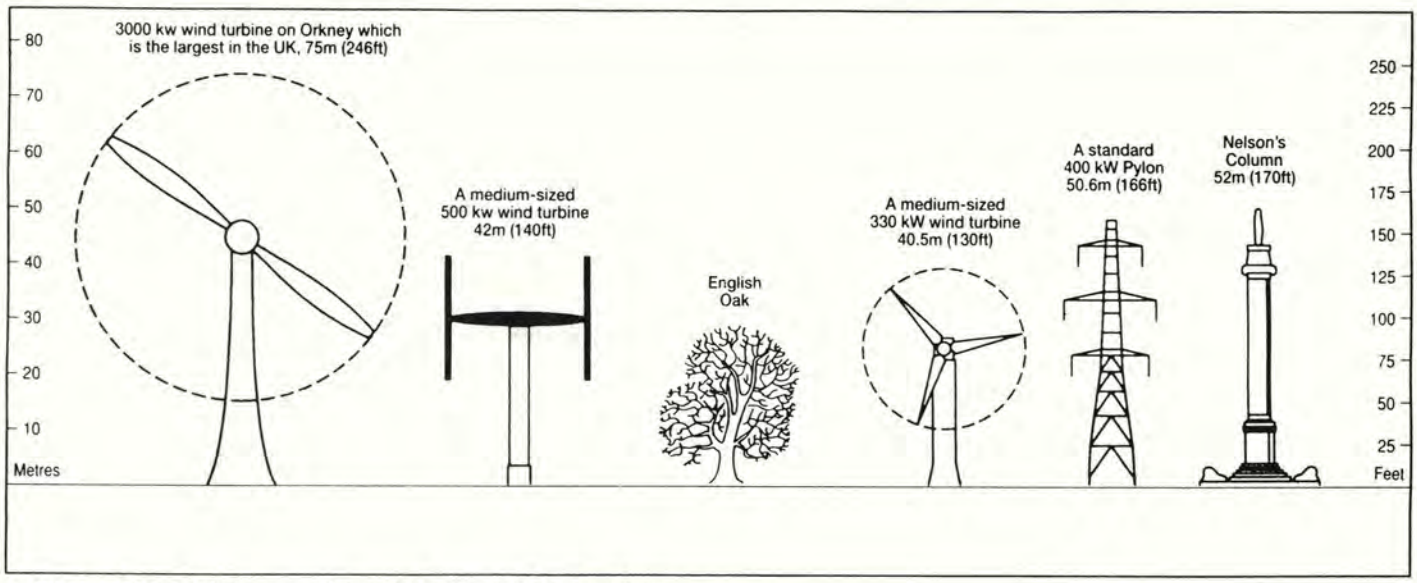
Obituary

Lord Penney

WILLIAM GEORGE PENNEY, Baron Penney of East Hendred, died on 4 March, aged 81.

During the war he worked for the Ministry of Home Security and the Admiralty until 1944, when work on the atomic bomb gained momentum. Lord Penney was sent to Los Alamos as DSIR's Principal Scientific Officer. He saw the project through to the dropping of the Nagasaki bomb, which he witnessed from an accompanying plane, and was part of the team which visited Hiroshima and Nagasaki to assess the effectiveness of the blasts. In 1946 he accepted the challenge of making a British bomb.

Lord Penney was appointed director at Aldermaston in 1953. In 1964 he moved on to weapons R&D at the AEA, and later became Chairman.



Wind turbines: height comparisons with other well-known objects.

No go for wind farms

NATIONAL parks, areas of outstanding beauty and heritage coasts should be no-go areas for wind farms, the Countryside Commission has advised the Government.

The Commission is calling for guidelines to be drawn up urgently for local planning authorities, regulatory bodies and developers.

"Until such guidance is available, we believe that controversial proposals should not be granted approval," said Derek Barber, Chairman of the Commission, in a letter to Michael Heseltine, Secretary of State for the Environment. The letter has also gone to John Wakeham, Secretary of State for Energy, and David Hunt, Secretary of State for Wales.

The Commission is concerned about the visual impact on the landscape for wind turbine generators towering up to 150ft in height. It is estimated that to achieve 10% supply of Britain's electricity from wind (as suggested in the Government's White Paper, *This Common Inheritance*), no fewer than 30 000 to 40 000 turbines would be needed, covering an area in all of up to 3250 sq kms — bigger than the largest national park.

The exclusion of such development from key landscape areas will still leave areas of England and Wales, where wind speeds are deemed sufficient for viable wind farms. But even here, the Commission warns that care is needed, and has offered to discuss the matter in more detail with the Minister to aid the Government in its recently stated intention to introduce a planning policy for wind farms.

£2.5m ECOS for Sizewell B

SD-SCICON, the UK's largest independent systems house, is implementing a £2.5m engineering computer system (ECOS) to help manage the UK's first pressurised water reactor (PWR) at Sizewell B.

The implementation of ECOS is part of a £3m contract awarded to SD-Scicon by Nuclear Electric. SD-Scicon has already completed the £500 000 design phase of ECOS, which will support engineers in technical sections such as reactor physics, efficiency and chemistry in monitoring plant performance and operation, and help build complex plant model calculations and identify problems. SD-Scicon will be responsible for the design, installation and testing of the system.

The system configuration will comprise six Digital VAX computers running VMS and connected via an Ethernet local area network. Three VAXs will be dedicated to a data acquisition system that will gather data from various sources such as the station's sampling, processing and data logging systems.

ECOS also involves a sophisticated historical database which will store data on optical disks maintained for the duration of the station's 40-year life. During peak periods this system will be storing data at 1 Gbyte a day.

Sizewell B under construction.

Our incoming President — a profile
Mr Robert Evans, CBE

Mr Robert Evans, CBE became the Chairman and Chief Executive of British Gas plc on 1st July 1989.

A native of Liverpool, Robert Evans initially trained as a mechanical engineer and worked for six years for an engineering company before joining the North Western Gas Board in 1950. In 1956 he left to take up an appointment with the Burmah Oil Company where he was involved with the exploration and development of natural gas fields mainly in Pakistan and India.

He rejoined the gas industry in 1962 as an executive with the Southern Gas Board and became Director of Engineering in 1970. Two years later he moved to the Gas Council as Deputy Director of Operations and was appointed Director of Operations in 1973. In 1975 he was appointed Deputy Chairman of the North Thames Gas Region and two years later he became the Chairman of the East Midlands Region.

In 1982 he was appointed Managing Director, Supplies at the British Gas Corporation Headquarters. In October 1983 he was appointed Chief Executive and Member of the British Gas Corporation and continued in that role after the privatisation of the Corporation in 1986.

He was awarded a CBE in the 1987 New Year's Honours.

Robert Evans is a Chartered Engineer; an Honorary Fellow of the Institution of Gas Engineers; Fellow of the Institution of Mechanical Engineers; a Fellow of the Institute of Energy and a Companion of the British Institute of Management. He has been a non-executive director of the Senior Engineering Group since 1987 and a director of the International Management Institute of Washington DC since 1989. He also has several directorships in British Gas Group subsidiary companies.

He holds a number of energy-related and business appointments including President-Elect of the Institute of Energy; Governor of the World Energy Forum; executive council member of the Parliamentary Group for Energy Studies; President of the Pipeline Industries Guild; member of the British Section Committee of the Trilateral Commission; member of the British National Committee of the World Energy Council; member of the President's Committee of the CBI and a council member of the Industrial Society.

A Past President of the Energy Industries Club and the Institution of Gas Engineers, Robert Evans is an internationally recognised authority on world energy needs and has lectured extensively both at home and abroad. He is the holder of the Institution of Gas Engineers' Charles Hunt Memorial medal for gas supply.

Robert Evans has a number of community and education interests. He is a member of the Archbishop's Council and the Church Urban Fund, as well as being a trustee of the British Liver Foundation and an Honorary Vice-President of Opportunities for the Disabled and a member of the Industrial and Commercials Appeals Committee of Help the Aged. He is a member of the Council of Industry and Higher Education and an engineering ambassador for the DTI Enterprise and Education Initiative, a management council member of the CBI Education Foundation and a national enterprise team member for Business in the Community. He is a Freeman of the City of London and a member of the Worshipful Company of Engineers. Married, with a son and daughter, his interests include reading and golf.

Annual Report and Accounts — corrections

Page II. Annual General Meeting, point 4 should read 'Harris Kafton' not 'Messrs Lawford & Co'.

Page XII. In 'Accumulated fund Income and Expenditure Account for the year ended 31 December 1990': below SURPLUS (DEFICIT) OF TOTAL INCOME OVER TOTAL EXPENDITURE, 'Restatement of opening figures £6 820' should be above, not below, the column rule.

Page XIV. The table *11* **Institute Award Funds** should have read as follows:

Double bill

THE ANNUAL summer lecture of the South Wales and West of England branch this year will be a double bill.

Walt Patterson, independent energy analyst, freelance writer and well-known broadcaster will speak on 'Sustainable Energy'.

Professor Dr Viktor Zykov, head of department of the All Union Research Institute for Complex Fuel and Energy Problems in Moscow, will speak on 'The Soviet Coal Industry: Present and Future Developments'.

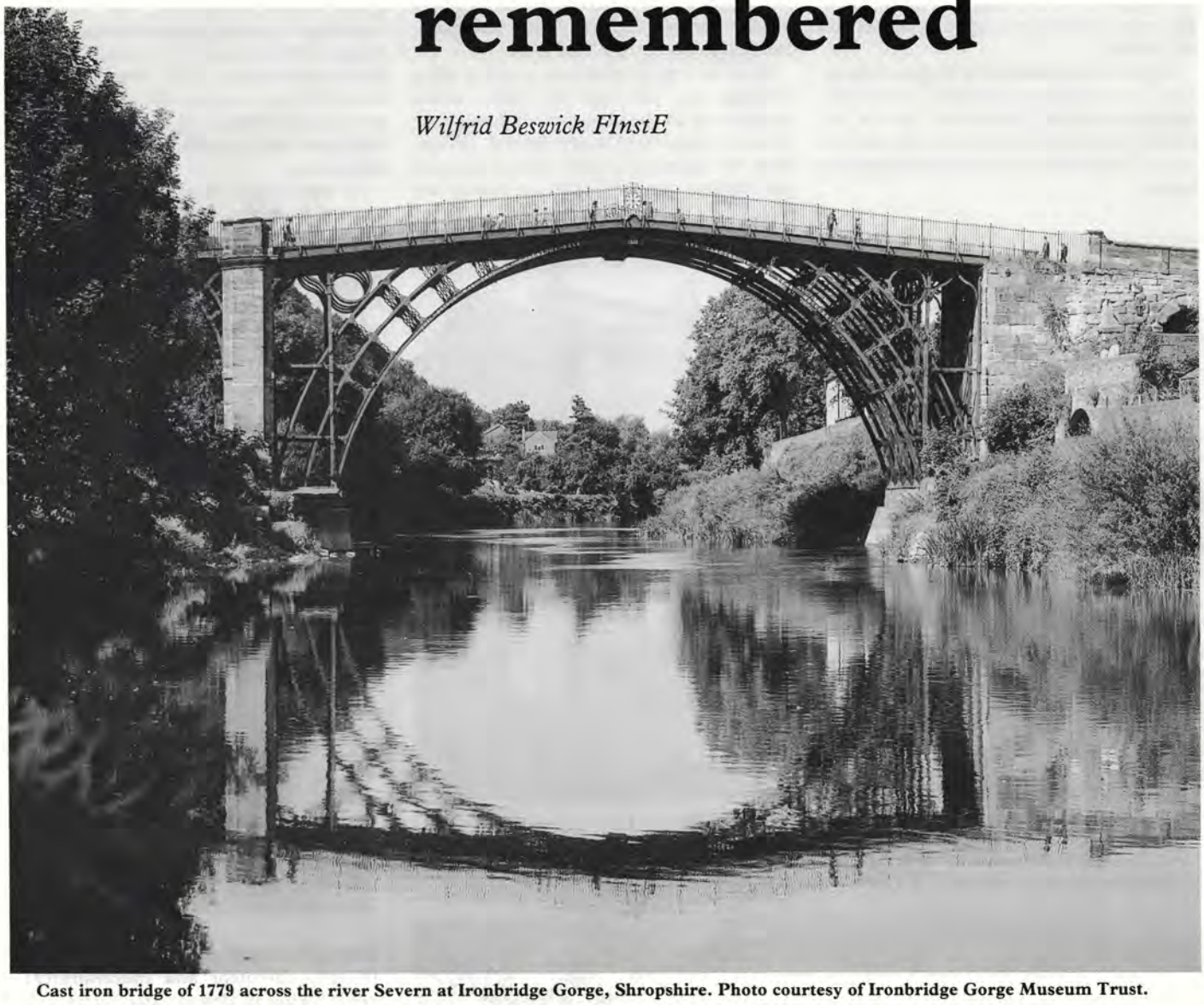
The meeting will be held at the Coal Research Establishment, Stoke Orchard, near Cheltenham on Friday, 21 June, at 11.15 am. A buffet lunch will be provided, courtesy of British Coal. Please contact Barry Woods at CRE on 0242 673361.

11 **Institute Award Funds**	*Total*	*Foxwell Memorial*	*R H Gummer Exhibition*	*Thring Award*	*Lubbock Sambrook Award*	*The Roscoe Bequest*	*Townend & BCURA Award*	*British Steel Award*	*Shell Award*
	£	£	£	£	£	£	£	£	£
Movement of funds									
Balance at 1 January 1990	45 032	13 708	6 248	1 216	1 595	5 775	946	5 031	10 513
Donations received	5 125	–	–	–	–	–	125	–	5 000
Interest and investment income	6 491	2 238	1 103	150	189	765	125	611	1 310
	56 648	15 946	7 351	1 366	1 784	6 540	1 196	5 642	16 823
Less: Awards	4 500	500	250	–	250	–	250	500	2 750
Balance of funds at 31 December 1990	£52 148	£15 446	£7 101	£1 366	£1 534	£6 540	£946	£5 142	£14 073
Represented by:									
Investments at cost	5 414	3 263	1 435	236	480	–	–	–	–
Due from the Institute	46 734	12 183	5 666	1 130	1 054	6 540	946	5 142	14 073
Total net assets as shown in Institute's Balance Sheet	£52 148	£15 446	£7 101	£1 366	£1 534	£6 540	£946	£5 142	£14 073

The Melchett Medal was transferred to, and the Award is now wholly funded from, the Accumulated Fund. Investments are held by investment managers, Singer and Friedlander Investment Management Limited. The market value of investments held at 31 December 1990 was £24 688 (1989: £26 541). There is no fund for the Steetley, Babcock Power, Foster Wheeler and Sainsbury Awards. The sums received for those Awards are paid out to the prize winners concerned. Where awards anticipated in the previous year were not, in the event, made and vice versa the amounts involved are shown as prior year adjustments.

Times remembered

Wilfrid Beswick FInstE



Cast iron bridge of 1779 across the river Severn at Ironbridge Gorge, Shropshire. Photo courtesy of Ironbridge Gorge Museum Trust.

FEW, if any, who have completed a career in the technical or administrative branches of industry, can fail to find something of interest in the markers left behind by travellers along the same path. Sometimes these remains can take us back to those times when the three renewables of wood, wind and water were the only sources of fuel and energy upon which industry could be built. So were cast and bored the guns which roared out against the Armada.

Within the past quarter of a century, such interest has become increasingly focused via the Industrial History and Archaeology Groups, which have been formed in many counties to record and, where possible, preserve the remaining evidence of industry. The period from the Industrial Revolution onwards is normally taken as a suitable timescale within which to work, although researchers may well choose to trace an industry back to its original roots.

An instance would be the brick and tile industry, with remains going back to Roman times. Another case would be the iron industry, where the tiny clay Iron Age and Romano-British bloomery furnaces, with their scatter of slag and charcoal, can still be found — sometimes almost intact. Those who have visited the Ironbridge Gorge museums in Shropshire, Beamish in County Durham, or the Chalkpits museum in West Sussex cannot fail to be impressed by the efforts of the groups concerned to preserve something of Britain's industrial heritage.

These groups can form a splendid local meeting ground for retired status members of professional and academic institutions and others who would like to join in the spread of that work which remains. In the case of Sussex, with which the writer is best acquainted, there had been in existence a main archaeological society for over a century, with a rent-roll of castles, abbeys and houses. However, when 24 years ago the time came to face the challenge of industry in addition to its allotted tasks, and with an increasing number of young professional archaeologists demanding attention and space in the annual journal, it was felt impossible to embrace a whole new horizon. Therefore, with a gift of £25 and encouraging noises in the wings, the Sussex Industrial Archaeology Society was invited to pursue its own destiny. At about the same time a separate grouping formed, dealing only with the iron industry. Today the industrial group has over 200 members, its own annual journal, a quarterly bulletin and a programme of site visits. The Secretary is Mr R G Martin, 42 Falmer Avenue, Saltdean, Brighton BN2 8FG.

The Society has a fairly simple structure,

but a hard-working management committee performs a remarkable balancing act between an extremely wide remit of interests. At the same time support is given to a number of sub-groupings: for instance the wind and water-mill members have a separate programme of their own, but also have space in the bulletin and journal.

Contact is maintained with similar organisations in neighbouring countries, principally through an annual conference. One of the societies acts as conference host; this year the event is being held at the Science Museum in London.

The national body located at Ironbridge is the Association for Industrial Archaeology. In no sense a 'controlling' body, it nevertheless can be helpful to individuals or groups, it runs an annual seminar and publishes a biennial journal and a quarterly bulletin. The Secretary is Mr Stuart Smith, The Wharfage, Ironbridge, Shropshire TL8 7AW.

Records of many industries, as well as those covering the provision of public utility services, can frequently be traced through the archives stored at County Record Offices. Here the pattern of a past industry's growth and decline can very often be traced and possible information leading to the identification of an actual site.

It was in this way, for instance, that the final blowing-out date for the last Sussex blast furnace was determined as February 1813. Yet again, much information was uncovered regarding the making, in local Ordnance brickyards, of the vast quantity of bricks required for the construction of the Martello Towers along the Sussex coast in 1804. Needless to say, the Record Offices very much welcome the lodging of such records for safekeeping and cataloguing.

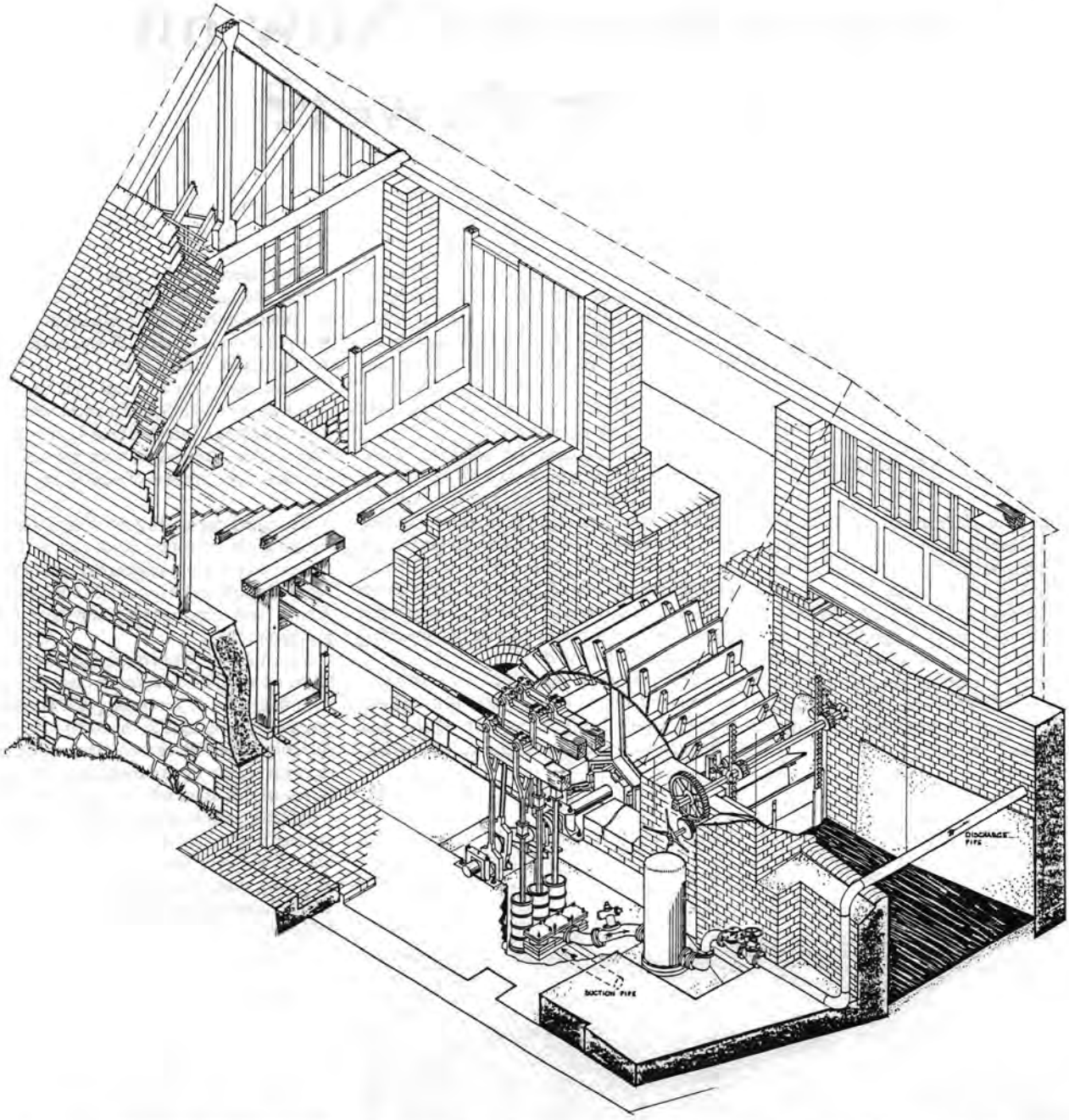
As an example of a reconstruction task, undertaken during the early 1970s by the Sussex Group, mention may be made of the watermill situated at the National Trust property of Batemans, Burwash, East Sussex. Taken out of use in 1902 in order to accommodate a water-turbine-driven dynamo, the

Small beginnings. In 1902, The Natural Gas Fields of Britain Ltd was incorporated to 'Revolutionise the Industrial life of Britain' by wide distribution of natural gas found near the railway station at Heathfield, Sussex. Supplies proved just enough to light the station. This is one of the two small holders in use up to about 1960.

National Trust watermill at Batemans, Burwash. Restored to full operation by the Sussex Industrial Group.

The author

Wilfrid Beswick received his training in gas, chemical and metallurgical engineering in Britain and Germany. After a career in public company life and holding directorships in England and France, he formed, in 1958, a Westminster consulting partnership and became involved in chemical and metallurgical developments, particularly in the Middle East. For 14 years he served as chairman of the Chemical Engineering Industry Committee of BSI and took an active part in the post-war export drive as a member of the UK Engineering Mission to Canada, The Benthall Mission to the Middle East and visits to South America. He acted for some time on the import duty advisory committee of the Board of Trade, with regard to chemical plant. On retirement to Sussex in 1967, Mr Beswick developed an interest in Industrial Archaeology and has served as chairman of the county body dealing with that subject.



Above: Water-driven water supply pump near Petworth. Rebuilt by the Sussex Industrial Group, copyright R. G. Martin.
Left: Internal machinery of Batemans watermill.

mill as it stood was already a 1750 rebuild of a much earlier mill. In this case, the Industrial Group entered into a formal undertaking with the National Trust to provide full engineering and supervision of the mill reconstruction. In addition, one of its members, who was ex-Army, arranged for the Mechanical Wing of the Royal School of Engineering at Chatham to volunteer the repair of the horizontal shaft 280 rpm vortex reaction turbine, by Gilbert Gilkes of Kendal, driving a Crompton generator of 105/150 volts.

Most of the work was carried out on a voluntary basis and some generous gifts were made of heavy oak timbers and a larger-diameter steel penstock. Free use was given at weekends of a precision woodworking factory. The restored mill has now been grinding and selling stoneground flour for many years. Other conservation work has included the restoration of the water-driven water supply pump, which once served the town of Petworth in West Sussex and is now on display as a tourist attraction. A segment from a medieval watermill wheel of c. 1360 has been rebuilt after conservation and with smaller artefacts from the mill will be placed suitably on display. Other similar wheel segments from the blast drives of Tudor iron-blast furnaces have had similar treatment and are lodged in various museums.

It can finally be said that volunteers, to help both the work of site surveys, archival investigation, physical recovery and conservation and, above all, perhaps the essential task of recording, will find a warm welcome from their colleagues already involved. □

Where Are We Now on Nuclear Power?

*Andy Oppenheimer**

IN THE wake of trading in the country's two main electricity generators, the Institute of Energy held its March conference 'Where Are We Now on Nuclear Power?' at the Conference Forum in London.

'Hibernating — or about to blossom?'

The President of the Institute, Doug Willis, opened the proceedings with a reminder that the only public generators left were nuclear, and that cost depended on station output and load factor. Before introducing the Chairman, David Fishlock, OBE (Science Editor, Financial Times), Mr Willis questioned whether decisions on nuclear power should be left to politicians in 1994, when the industry will be reviewed, and how far concern for safety increased costs.

The opening speech, by Prof J R A Lakey (Immediate Past President, Institution of Nuclear Engineers), concentrated on recent events in the UK programme, presenting the nuclear engineers' standpoint on the way forward.

Nuclear power, together with improved energy efficiency, was vital in meeting increased demand and for reducing global CO_2 emissions by as much as 20%, by the year 2005. The UK industry had had to absorb the cost of improved safety at Sellafield. In relating recent difficulties to post-Chernobyl moratoria and problems of privatisation, Prof Lakey insisted that the withdrawal of nuclear power from the sale was not due to disposal and decommissioning costs and that the fossil fuel levy had always existed.

The Institution of Nuclear Engineers' recommendations to the government include:

- preventing further loss of skills and resources from the industry, which had been intensified by separation into nuclear and non-nuclear groups
- a public information programme
- replication of Sizewell B and hastened construction of Hinkley 'C'.

Prof Lakey went on to say that the existing yearly limit of 50 mSv for nuclear workers had been set by the International Commission on Radiological Protection, with the sievert unit remaining the symbol of equivalent radiation dose.

He called for an urgent manpower study, stressing an ongoing need for at least 70 nuclear engineering undergraduates (there are currently only six). He pointed out how EdF in France was conducting innovative training programmes.

John Collier (Chairman, Nuclear Electric) followed with his company's plans to increase the lifetime of its seven Magnox stations. He proposed a reduction in the fossil fuel levy and its replacement by carbon taxes, emphasising the importance of the completion of Sizewell B, already ahead of schedule, to time and cost.

Despite political problems, technically nuclear power was doing well. Extending the life of Magnox for up to 37 years would increase capacity to 20TWh at 1.5p per unit. This extension was determined by the cost of Sellafield and the need for Magnox stations to be closed down in stages to avoid bunching. Mr Collier described progress on encapsulation and vitrification of intermediate-level waste (ILW) and showed how concrete vaults built onto the low-level waste (LLW) Drigg site 'looked more professional' without making much difference to radioactivity levels.

Decommissioning existing stations will cost 5% of the unit cost of electricity; for a PWR, 1%. Building new plant depended chiefly on commercial viability; with the electricity

Aerial view of BNF Sellafield in Cumbria.

Conference Chairman David Fishlock OBE.

Jean-Claude Charrault, Head of the Nuclear Division of the EC Energy Directorate, speaking on a common reactor design for Europe.

'pool', competition had increased. Cheaper nuclear power, as well as the prospect of reduced pollution, would improve the industry's image.

A common European design

Jean-Claude Charrault (Head of the Nuclear Division of the EC's Energy Directorate) anticipated a 50% growth in electricity demand by 2010 and compared scenarios of future high and low demand. Outlining energy and environmental problems in eastern Europe and the Soviet Union, on which the EC could capitalise, Dr Charrault called for an international conference to draft a European Energy Charter. This would focus on trans-European cooperation, particularly the revamping of Soviet-designed nuclear plant.

A common industrial strategy was needed to counter stagnation and compete on the international market. All new reactors should be standardised under a common PWR design based on uniform regulations. Collaboration, already embarked upon by France's Framatome and Germany's Siemens, would be open to eastern and western European participants. Dr Charrault felt that cooperation was preferable to the imposition of regulations by the EC.

'Aggressive tackling of costs'

The final morning speech, by Mr R M Yeomans (Chief Executive, Scottish Nuclear), outlined the company's inception following privatisation and its contribution to nearly half of Scotland's electricity requirement.

Hunterston A had been closed but Hunterston B AGR was undergoing improvements and the fuel route had yet to be completed on a 1250 MW AGR at Torness. A two-tier energy contract penalised shortfall of declared output and did not include Scottish Nuclear in the non-fossil fuel obligation.

Knowledge versus apathy

Christopher Harding (Chairman, BNF) began the afternoon session on a subject of timely importance: the Power of Public Opinion. He questioned the value of opinion polls, criticising the 'prompting' of interviewees and the forcing of spontaneous answers from 'the unthinking, uninformed and largely apathetic majority' who had little or no knowledge of the technical issues. He pointed out differences between what people wanted and what they expected, also stressing how polls reflect media coverage. He thought it fortunate that policy in Britain was not left to the 'crude mechanism of the popular vote', referring to referenda held in Sweden and Switzerland.

Most imperative was the need to influence those with influence: think-tanks, politicians, academics, professional institutions and, especially, the media.

Mr Harding was followed by Sam Goddard (Executive Director of Nuclear Electric's future programmes), who stressed the dependence of future projects on the success of Sizewell B. In reviewing the competition from new gas-fired combined cycle (CCGT) plant, he added that British Gas was to increase prices by 35% for electricity generation. All new UK nuclear plant would have to be PWRs; no 'first-of-a-kind' plant would be selected for purchase.

Mr Goddard echoed Dr Charrault's call for a common European design — a cooperation arrangement with EdF already having been signed. Only four major companies were able to supply complete stations on a turnkey basis: NPI (Framatome/Siemens); ABB/Combustion Engineering, leading development of the Safe Integrated Reactor (SIR); Westinghouse, and Mitsubishi.

A second programme (1997-8) of internationally-designed PWRs, based on modification of existing designs to meet UK licensing needs, would go commercial by 2005. A third would be based on new evolutionary designs containing passive safety features.

Keeping the skills

The problems of retaining skilled people were described by Mr A Green (Technical Director, NNC Ltd). Without an ongoing construction programme, it was increasingly difficult to motivate people. Skills and motivation acquired since the early days of the UK programme had to be replicated if a restart occurred, as well as for maintaining safety standards. Evidence from highly skilled staff had been vital to the recent public inquiries; UK engineers visiting the Soviet Union had warned of RMBK weaknesses that subsequently contributed to the Chernobyl accident. And because new plant would be from overseas, close interaction between UK engineers and vendors would be necessary to adapt PWRs to UK licensing requirements.

Acknowledging that skills were now in short supply, Mr Green concentrated on the need to improve motivation rather than education. Extending Magnox, finishing Sizewell on time, and continuing with the European Fast Reactor would help to increase motivation. Prices had to be kept down and a commercial plan formulated for a lean, competitive industry.

**Managing Editor, Energy World*

Model of a vitrified waste container, sectioned to show the waste inside.

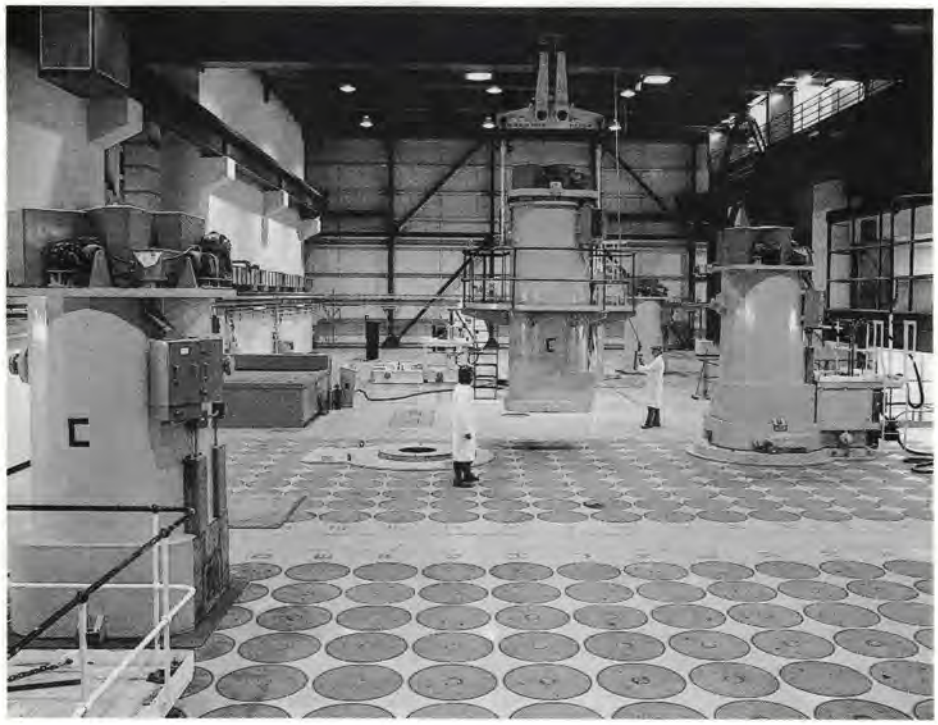
Reality and perception

The final speaker, Dr John Gittus (Director-General, British Nuclear Forum) compared energy reserves, based on the political complications associated with each type of fuel. He stated that there were in fact no energy shortages: we have more fuel sources today than 10-20 years ago. Coal and oil supplies were threatened by political action (miners, both British and Soviet; Middle East wars). Uranium, however, involved no political tension and, with the fast reactor, was unlimited.

As far as nuclear power was concerned, the reality of danger did not equal people's perceptions of it. Dr Gittus said there had been far fewer deaths from accidents in the nuclear industry than the rest of the energy sector, for which he supplied a combined toll.

The future depended on European collaboration and a new US energy plan, heralding a nuclear revival.

Mr Willis rounded off the conference by thanking speakers and all those who had contributed towards the success of a stimulating event which, concentrating as it did on cost effectiveness and cooperation, greatly reflected the present mood of cautious optimism in the industry. □



The Vitrified Product Store at Sellafield, built to store containers of highly active vitrified waste cooled by natural air convection.

Energy: the Industrial Customer's Experience and Expectations

by R N Hodge, Chief Executive Officer, ICI Chemicals & Polymers Ltd

OVER the last decade energy suppliers and large users have been increasingly and rightly concerned about environmental pressures and impending legislation. Meanwhile, former worries over supply security and price had been partially laid to rest. Then the Iraqis invaded Kuwait and suddenly the same old ghosts were abroad once more. Thus, President Bush has recently unveiled his National Energy Strategy aimed at reducing the USA's oil import vulnerability and the EC Commission is considering strengthening the Community's emergency-response capability.

I am going to review the main challenges energy-using industry has faced and will have to face over the next few years, from the viewpoint of the chemical manufacturer. In particular I will refer to the challenge posed by energy supply security, environmental pressures, the need for international competitiveness, energy taxation and regulation issues, and the reinvestment conundrum.

Based on the 5th Melchett Lecture of the Institute of Energy, presented at the Royal Institution, 7 March 1991.

I will also discuss the opportunities offered us in the UK by the privatisation of our domestic energy supply industries, and will describe in this context Teesside Power Ltd's new power station. But I will outline first the operations of ICI Chemicals & Polymers Ltd, because my remarks must inevitably reflect our own particular needs and fears.

ICI's commodity chemicals

ICI is the largest chemical manufacturer in the UK, with over 60 individual manufacturing sites. These make a wide range of products including basic industrial chemicals and polymers, plus a large and growing branded speciality range, notably pharmaceuticals, paints, explosives and agrochemicals.

The main energy-consuming operations are in industrial chemicals manufacture, undertaken by ICI Chemicals & Polymers Ltd (ICI C&P) at two principal locations: Teesside (hydrocarbons, plastics and detergents; polyamide and polyester fibre intermediates; methanol, ammonia and fertilisers), and Merseyside (inorganic chemicals; chlorine derivatives).

There are textile-spinning, plastics and fertiliser plants at other locations, including some in continental Europe. An oil refinery, owned jointly with Phillips Petroleum, is also located on Teesside.

Even without taking oil feedstocks into consideration, ICI accounted for over 10% of UK industrial energy demand in 1989. Nearly all factories are equipped for dual or multiple fuel firing. Twelve of the larger ones are served by company-owned combined heat and power (CHP) stations, in which electricity is generated in back-pressure turbo-alternators before intermediate- or low-pressure steam is distributed to nearby chemical plants. By the efficient use of steam in this way, overall energy efficiencies of around 80% are attained. Electricity generation is limited by the demand for steam and so most of the factories also purchase electricity from public supply; this is particularly so for the large chlor-alkali plants on Merseyside.

Most of the CHP capacity is conventional steam cycle plant, but there are also several gas turbine units. The existing power station at Wilton is, at 2500 MW thermal input capacity,

The author

After reading Engineering at Liverpool University, R N Hodge joined Castner Kellner Works in 1956 as a Graduate Engineering Apprentice in the General Chemicals Division. In September 1959 he was appointed as plant engineer at Gaskell Marsh Works and in 1961 as an assistant design engineer. After the merger of Alkali and General Chemicals Divisions, he was appointed Project Design Engineer in 1965 and Section Manager, Production, Castner-Kellner Works three years later. In 1971 he became Project Design Manager and in 1974 General Manager (Production) of the Solvents and Monomers Group and later of the Chlor-Alkali Group. In 1976 he was appointed as Director of Mond Division and in 1977, as Deputy Chairman (Technical and Commercial). In 1981 he joined Head Office as General Manager (Personnel) and in 1985 became Chairman, Petrochemicals and Plastics Division.

On the formation of ICI Chemicals & Polymers in 1987 he was appointed Deputy Chief Officer and took over as Chief Executive Officer in August 1990. Currently a member of the Board of ICI Americas, he previously served as a Director of Finnish Chemicals and was also Chairman of the Magadi Soda Company.

possibly the largest private industrial utility in Europe. It can be fired with coal, gas, oil and factory by-products, just to demonstrate our flexibility or our inability to forecast which are likely to be the more economic at any point in time.

Apart from fuel and electricity, the Teesside plants require large quantities of oil products and natural gas as chemical feedstocks. Part of the oil feedstock comes as naphtha from the 5 m tes/year Phillips Imperial refinery mentioned above. Built in 1965 to process African crude oil, it is now conveniently located to take Norwegian crude from the Ekofisk complex, which is piped to land and stabilised less than two miles away. Phillips operates the Ekofisk field and the Teesside crude oil treatment plants.

Energy supply security

Between late 1973 and 1975 OPEC countries raised oil prices sharply, embargoed exports to the USA and Holland, took control of their national production and threatened to limit future output. In these circumstances ICI's energy priority naturally became security of supply; other chemical companies took the same view.

We took the following steps to improve our supply security:

- we increased support for hydrocarbons exploration, initially in the North Sea but later extended to North America and Indonesia. ICI was a member of a consortium which discovered and developed the giant Ninian oilfield
- we negotiated long term contracts to purchase other North Sea oil production
- we undertook crude oil processing at third-party refineries to supplement Teesside refining
- we made an engineering study for a major expansion of the Teesside refinery.

The aim was to bring at least 50% of oil needs under ICI's control. Physical possession of the oil was considered to be of paramount importance — the traditional oil company suppliers were also ICI's fierce competitors and their attitude in times of difficulty was uncertain.

These were bold actions for a traditional manufacturing company to take. They must be viewed in the context of businesses which had grown very rapidly, to which huge sums had been recently committed and which could not be allowed to wither away for lack of a feedstock supply.

In the event the company was never left short of oil, even if it found its major oil company suppliers becoming harder-nosed regarding prices. Nevertheless, the Ninian oilfield made a most valuable cash contribution from 1978 onwards, when oil prices were higher still and petrochemicals producers suffered first thin margins and then outright losses.

The collapse of oil prices in 1986 and a perception that real prices would remain low for many years removed the incentive to sustain our upstream North Sea operations, for which we no longer saw any strategic need. We sold them to companies which specialise in these activities.

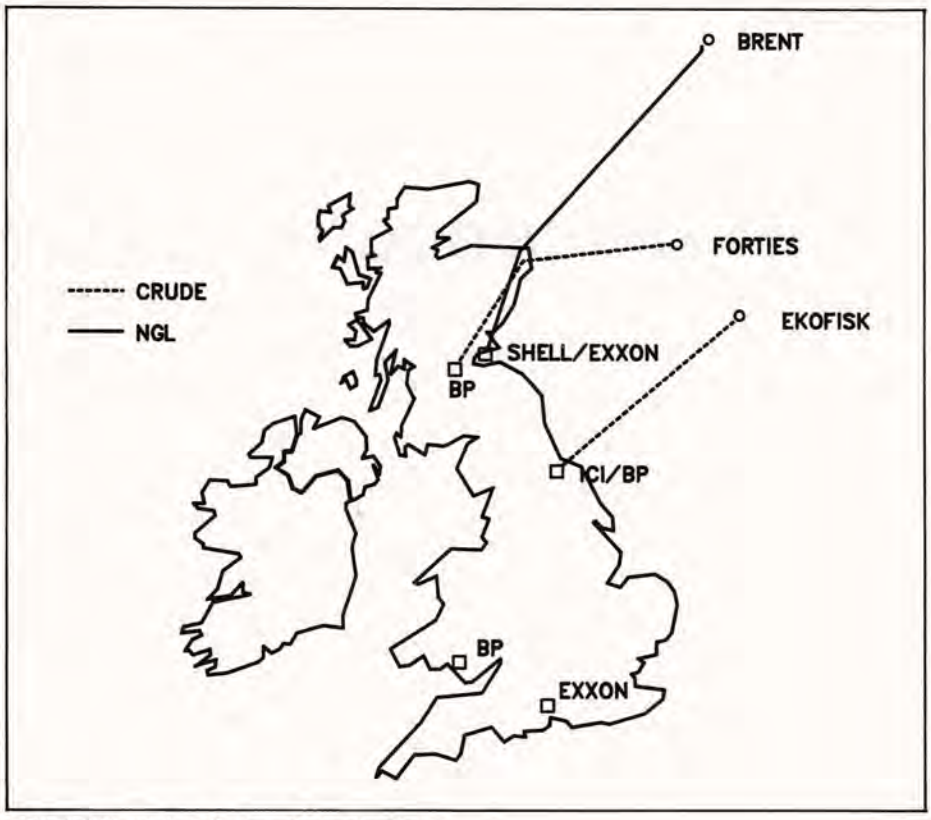


Fig 1: UK ethylene feedstocks by pipeline.

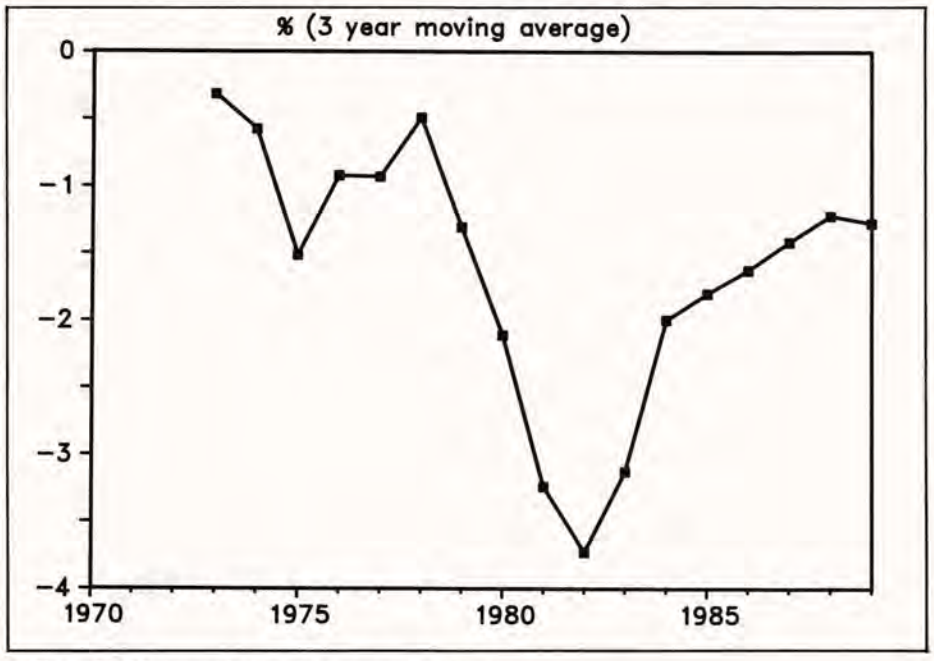


Fig 2: OECD: annual change in energy intensity.

An emerging refining capacity glut avoided any need to expand our own. Indeed, the growing glut of fuel oil meant that major expansion of the Teesside refinery was most unlikely to be profitable unless it was equipped with expensive upgrading plants. Although ICI was at that time a petrol retailer it had no ambitions to seek the increased market share that such investments necessitated. The unhappy experience of some other companies around the world proved this to be a wise decision.

Supply security is not top of our list of worries in the UK chemical industry today. Petrochemical companies are well placed; most have direct or indirect pipeline access to North Sea gas liquids and naphtha, covering at least a part of their needs (Fig 1).

The environment

If supply security was yesterday's problem, the environment is today's — and tomorrow's.

Last year the Government published its White Paper on the environment, following extensive consultation. Some decry the Paper for its alleged shortage of concrete proposals,

but it is reassuring to know that Whitehall recognises that there are very few 'quick fixes' in environmental improvement and significant pitfalls await the impatient legislator.

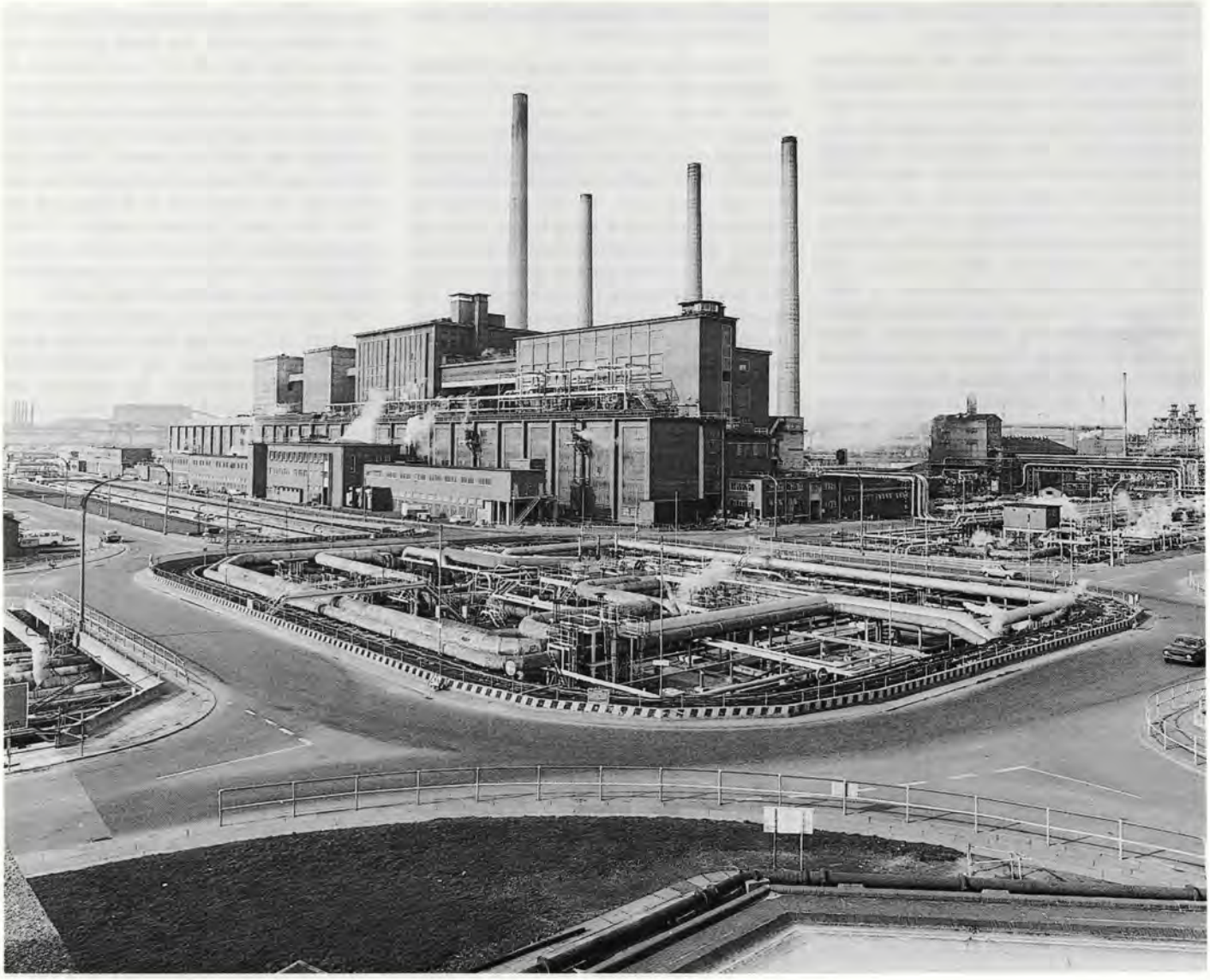
Seen from industry's viewpoint, some environmental issues are technically straightforward. For example, the European Community has a mandatory programme to reduce noxious emissions from large combustion plants (Table 1, page v). HM Inspectorate of Pollution is working to find the best means of implementation for the UK, but clearly power stations and industry will have to clean up stack gases or use higher quality fuels. I am concerned, however, to note that the Inspectorate is looking to industry to take on a disproportionate share of the task in the earlier years of the programme.

There are no such simple remedies for the alleged global warming threat from carbon dioxide emissions. Opportunities for displacing current fossil fuel use by renewable energy sources are limited and the nuclear option is under a cloud. Switching to gas can play only a marginal role at the global level, which is of course what the issue is all about. True, if all the world's oil and coal consumption could be replaced by gas the global CO_2 emission would fall by 30%. Large as gas reserves are, they could not sustain such a level of use and the realistic potential is probably more like 5%. So there is no policy option but to accelerate the energy conservation process, which has apparently been decelerating in recent years (Fig 2).

The EC has adopted the target of stabilising the Community's CO_2 emissions at the 1990 level by the end of this decade. This is a pretty tall order. If CO_2 output is not to grow, then energy consumption must remain constant too. This is because there will be no significant expansion in non-fossil fuel consumption and only limited substitution of oil and coal by gas. It follows that if GDP is to grow at an average of, say, 2.5% pa over the decade (and many would hope to do better), Community energy efficiency must improve by some 2.0 to 2.5% pa, more if GDP grows faster. For comparison, the EC achieved 2.0% pa over the period of high oil prices from 1979 to 1985, a figure even then boosted by structural changes in industry.

It is obvious that all energy-consuming sectors will have to be involved if the target is to be achieved. Industry is by no means the only contributor to CO_2 emissions, in the EC globally, even allowing for its indirect share of emissions from power stations and fossil fuel production. The main opportunities for society to cut emissions through conservation lie in making transport and homes more energy efficient, not just because they contribute the most now but also because there is so much untapped potential for reduction in the long term.

Figure 3 shows that industry has already done much to improve efficiency over the decades, under competitive pressure. However, many of the easy measures have been taken and industry needs confidence in future profitability so that it can implement the more fundamental technology changes that sustain its competitiveness. This confidence is vital; even minor investments will be scrutinised very closely if there is any suggestion of 'throwing good money after bad'. Moreover, it must not be imagined that the pace of improvement is infinitely sustainable. In chemicals manufacture particularly there is a defineable



The power station at ICI's Wilton site.

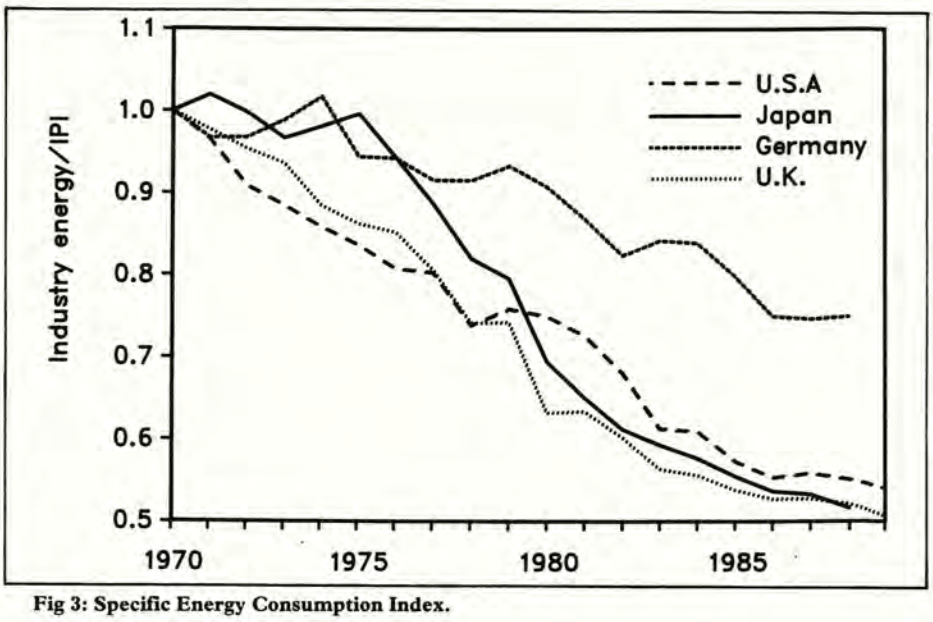


Fig 3: Specific Energy Consumption Index.

maximum efficiency for any operation, which is even now closely approached in some state-of-the-art technology. The ICI 'LCA' ammonia production process, for example, has achieved efficiencies very close to the stoichiometric ideal as I will explain later.

Without question, there are many areas where industry has to put its environmental house in order. We must do better and we will. Yet we do not always need governmental compulsion to act. The international chemical industry has tackled the urgent task of CFC elimination through voluntary international agreement and introducing safer substitutes, important examples of which are now in place. My own company is also pursuing some interesting technical opportunities in other directions. For example, we have developed a biologically-produced biodegradable plastic aimed at alleviating the plastic waste problem. More esoterically, very dilute aqueous effluent from one of our factories is being trickled through beds containing a variety of reed which has been found to thrive on and thereby remove the contaminants.

International competitiveness

The second oil crisis brought much higher energy costs and even bigger problems besides. By the early 1980s the chemical industry faced contracting markets, surplus new capacity built on the basis of 1970s growth expectations, and the imminent prospect of powerful low-cost competition from the Persian Gulf. The strategic aim swung dramatically from one of protecting growth potential to survival.

Energy cost competitiveness was tackled by extending fuel and feedstock supply flexibility and by redoubled attention to energy conservation. ICI achieved the first of these by the following means:

- partial or total conversion of CHP units at seven factories to burn coal
- providing facilities to import fuel oil on Merseyside and Teesside; national supplies had long been overpriced relative to Rotterdam, even though the UK was a net exporter
- providing facilities to import and store cargoes of propane on Teesside; propane is an alternative ethylene plant feedstock to naphtha with a seasonal price profile complementary to naphtha's.

In view of the former militancy of British coalminers the first of these measures required some courage; a final decision to partly reconvert the key Wilton power station to coal was only taken after the collapse of the NUM strike in 1985. Rather shortsightedly perhaps, we had taken out the idle coal-handling equipment only a few years before, when the miners' militancy seemed to pose as big a threat as OPEC. Coal now plays an important role in ICI, notwithstanding the development I will describe later, and we have adopted 'clean coal' technology for our most recent expansion at our Huddersfield organic intermediates factory.

In conjunction with other large electricity users we lobbied long and hard for an internationally competitive supply, reflecting international fuel costs rather than the Government's support for high-priced British coal which had at that time to be subsidised by British industry and the public consumers. The CEGB at last introduced its 'Qualified Industrial Consumers Scheme' (QUICS) in 1986. Scheme participants received supplies priced on the basis of a deemed internationally competitive coal cost to the CEGB.

By way of self-help, in 1979 the ICI Energy Conservation Coordinator set a target of 5% pa for efficiency improvement for the succeeding five years. This target was achieved. Progress was naturally dominated by the largest, most energy-intensive operations, where business rationalisation also played an important part in the end result. Three of the five largest hydrocarbons-processing plants on Teesside were closed in the early 1980s, principally to cut fixed costs and to contribute to a well-publicised attempt to reduce the industry's surplus capacity throughout Europe — but there was thereby a notable improvement in energy conservation. Concentrating production on the most efficient units, together with a programme of other retrofitting improvements, improved energy efficiency at Wilton by 30% between 1980 and 1986.

It is impossible to achieve 100% of the theoretical thermodynamic heat of reaction in any practical process, but much progress was made at this time in ICI and elsewhere to define, and design for, the practical minimum, where all heat flows in the plant are optimally arranged. A computer model of heat exchange networks was built to convert theory into practice and the company attempted to commercialise the know-how in Europe and the USA as a new business venture. Unfortunately, others did the same and the collapse of oil prices in 1986 greatly, but questionably, reduced interest among potential clients.

We put the theory to practical application ourselves. ICI has long been a leading world licensor of technology for manufacturing ammonia and methanol. By applying the theory to the feedstock reforming section of the processes, the energy efficiencies of both were raised by about 30% compared with the

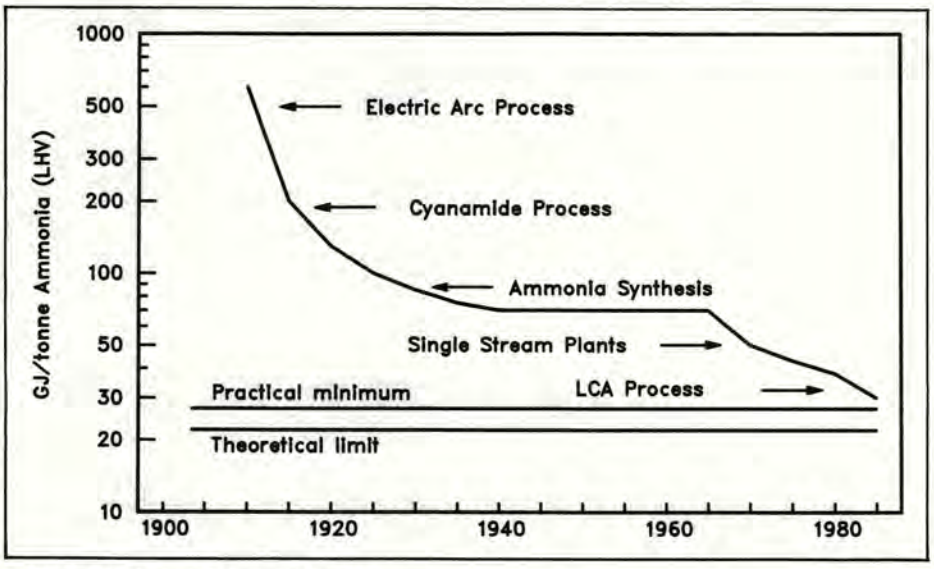


Fig 4: Efficiency of nitrogen fixation.

leading standards of the mid-1970s (Fig 4). Two such ammonia plants have been built at ICI's fertiliser factory near Bristol to replace older units. We call this design LCA (Leading Concept Ammonia), which is truly competitive internationally, and very environmentally friendly (Table 2). In fact, the process leads the world — as do ICI's methanol process and its membrane chlorine electrolysis process; not a bad trio for a mature industry operating out of a small UK base.

Thus, we have done a lot in recent years to improve our energy cost-competitiveness through higher user-efficiency and supply flexibility. No doubt our international competitors did much the same. Now, as recession once more tightens its grip, European manufacturers still face the challenge of powerful new Third World competitors.

Persian Gulf manufacturers are a particular case in point. Associated gas which was once flared provided those countries with the opportunity to move rapidly and massively into energy-intensive industries. Of course, they are handicapped to an extent by higher investment and product delivery costs and we have yet to see what impact the Gulf war will have on future investment.

We estimate that European petrochemicals producers were competitive with the Middle East while oil prices were below the old OPEC target level of $18 per barrel. The collapse of oil prices in 1986 brought relief to Europe's chemical makers, since reversed by higher prices. The challenge for Europe and other regions such as the Far East is how to remain competitive throughout future oil price cycles.

Duty-free imports of petrochemicals from the Persian Gulf States based on artificially low feedstock prices are subject to quotas. There is a substantial body of support within the European Commission for a free trade area with the Gulf Cooperation Council member states. The latter view unlimited duty-free imports of petrochemicals into the Community as an important ambition. Japan and the USA are not prepared to allow duty-free access to their markets. The European petrochemical industry has therefore tenaciously resisted the unilateral liberalisation of import terms, regarding GATT as the appropriate multilateral forum within which all such issues should be resolved.

That problem has been with us for a decade. However, we now face a new potential threat to competitiveness in the shape of environmental taxes, which is my fourth major theme.

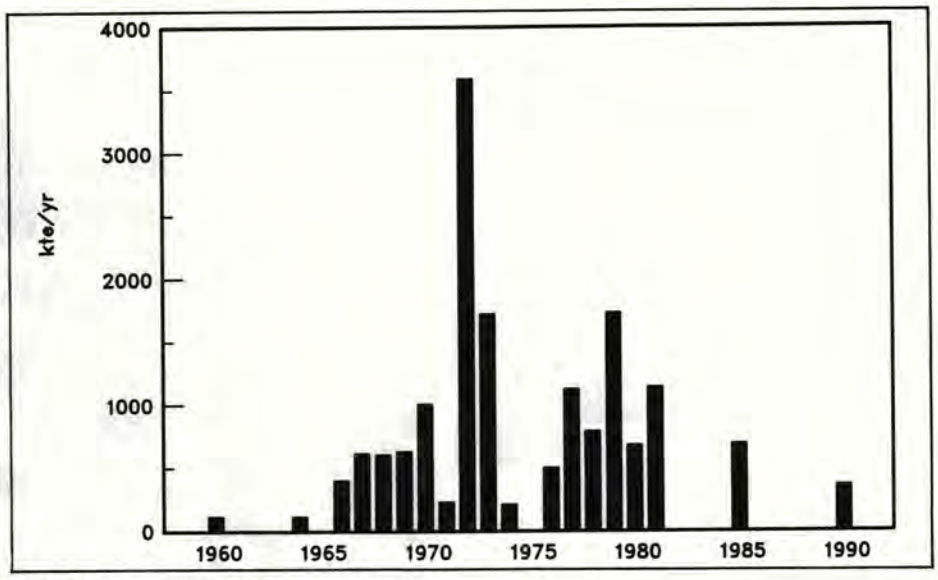


Fig 5: W. European cracker age profile.

Energy taxation

Many administrations are evaluating the role of fiscal instruments as an adjunct to market prices and regulatory measures in implementing environmental policy. For carbon dioxide, parts of the European Commission appear to favour the imposition of energy and/or carbon taxes to rejuvenate the conservation drive.

The case for energy/carbon taxes would seem to be:

- carbon taxes would motivate switching from coal and oil to gas
- energy demand is partially price-elastic, as evidenced by faster conservation during the oil crises, and
- they would be simple to administer as an extension to current excise duties.

The last point is deemed to be an apparent advantage compared with alternative fiscal instruments which have been considered. It at least openly acknowledges that what is being contemplated is a tax.

The other points need closer scrutiny. First, it is doubtful whether carbon taxes would significantly influence decisions because industry already has powerful motivation to switch to gas to comply with the requirements of the EC Large Combustion Plant Directive. Flue gas desulphurisation is an economic option for power stations but not for industry, which must therefore seek fuels containing less sulphur. Gas can be used more efficiently and is the likely first choice.

On the second point, there is a danger of overestimating price elasticity. The conservation record during and since the oil crises was not purely a response to prices. As already explained, industry's major achievements through rationalisation of productive capacity for chemicals, steel, and so on were made for lack of demand for the products under conditions of extreme competition. To illustrate with a further example, in similar market conditions the energy efficiency of ICI's polyamide chemicals production rose by 25% over the five years *prior* to the first oil crisis — no energy price stimulus was needed! If true price elasticity is relatively low, it follows that the energy or carbon taxes must be high to have any significant effect. The European Commission is said to be considering substantial taxes equivalent to $10 per barrel of oil — a 50% increase on current levels.

Taxes of this (or any) magnitude are unlikely to be adopted globally as they could have a profound impact on heavy industry's competitiveness, even to the point of enforcing closure. By way of further illustration of the complexity of this issue, methane-based businesses such as fertiliser manufacturers are particularly vulnerable because all the carbon in the feedstock is turned into CO_2, whereas most of the carbon contained in plastics feedstock is retained in the product.

The closure of energy-intensive industries would no doubt help individual European nations to meet their national CO_2 emission

Table 1: EC large combustion plant directive: Mimimum emissions reductions (1980 base)

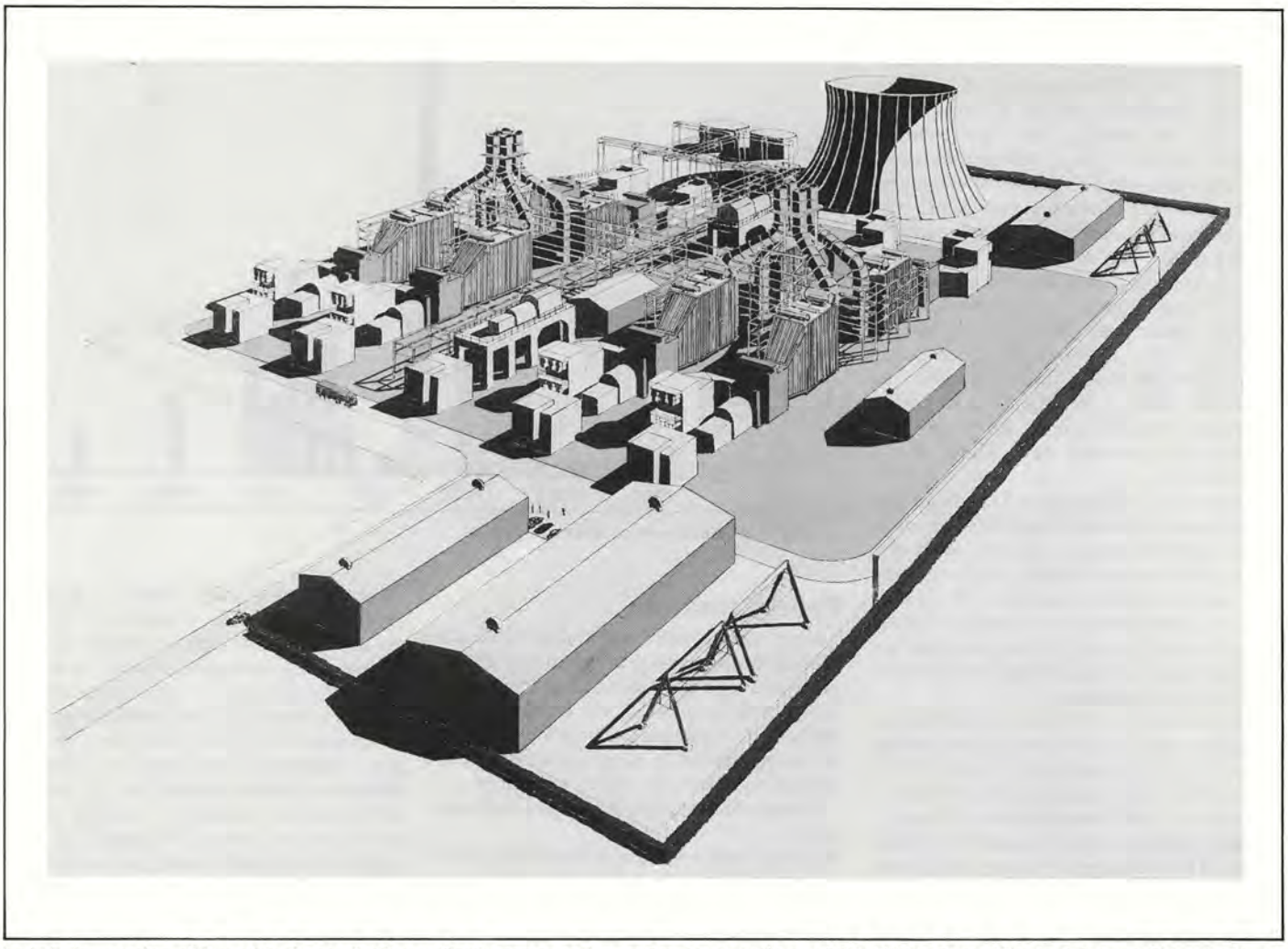
		%		
		1993	1998	2003
SO_2	UK	20	40	60
	EC12	23	42	57
NO_x	UK	15	30	—
	EC12	10	30	—

Source: Official Journal EC 7 Dec 88

Table 2: Ammonia manufacture: environmental emissions and resource requirements

	300,000 tes/year ammonia			
	1960	1970	1980	1990
SO_2 (tes/y)	36 000	1.6	1.3	1
NO_x (tes/y)	high	160	140	12
Solids (tes/y)	5000	—	—	—
Liquids	high	low	low	negl
Land area (acres)	60	6	5	3
Capital (£m of 1990)	400	120	120	80
Manpower	3000	75	60	30

Source: ICI Katalco



Artist's impression of Teesside Power Ltd's gas-fired power station under construction at ICI's Wilton Site. Photo courtesy of Enron Power Construction Ltd.

targets, but it is vital for policy-makers to recognise that this is folly on a global scale. There is a demand for energy-intensive products and, if plants producing them are forced to close, replacements will be built elsewhere — almost certainly in the Third World. Furthermore, it cannot be assumed that the new plants would emit any less CO_2. Thus, a clear distinction must be drawn between the 'energy-intensive' and the 'energy-inefficient'. It is to the latter that legislators must direct their attention.

Regulated efficiency standards have been successful in some consumer sectors, most spectacularly so with the fleet fuel efficiency of new American cars. The US Administration intends to extend regulated standards to other areas, notably household appliances. By contrast, it is hard to imagine any practical or fair use of regulated standards to increase industry's energy efficiency. They would be liable to penalise the energy-intensive rather than the energy-inefficient.

There is no panacea for this or any other environmental problem. Each requires a unique package of measures and this will take time to sort out. The chemical industry's attitude is to keep an open mind, to cooperate fully and constructively, and then to look carefully at proposals as they are made. On one point we are quite clear, however: that there must be no unilateral action by the UK or the EC which would seriously undermine international competitiveness. It is clear from the White Paper that the Government recognises the validity of this position. Let us hope that Brussels does too.

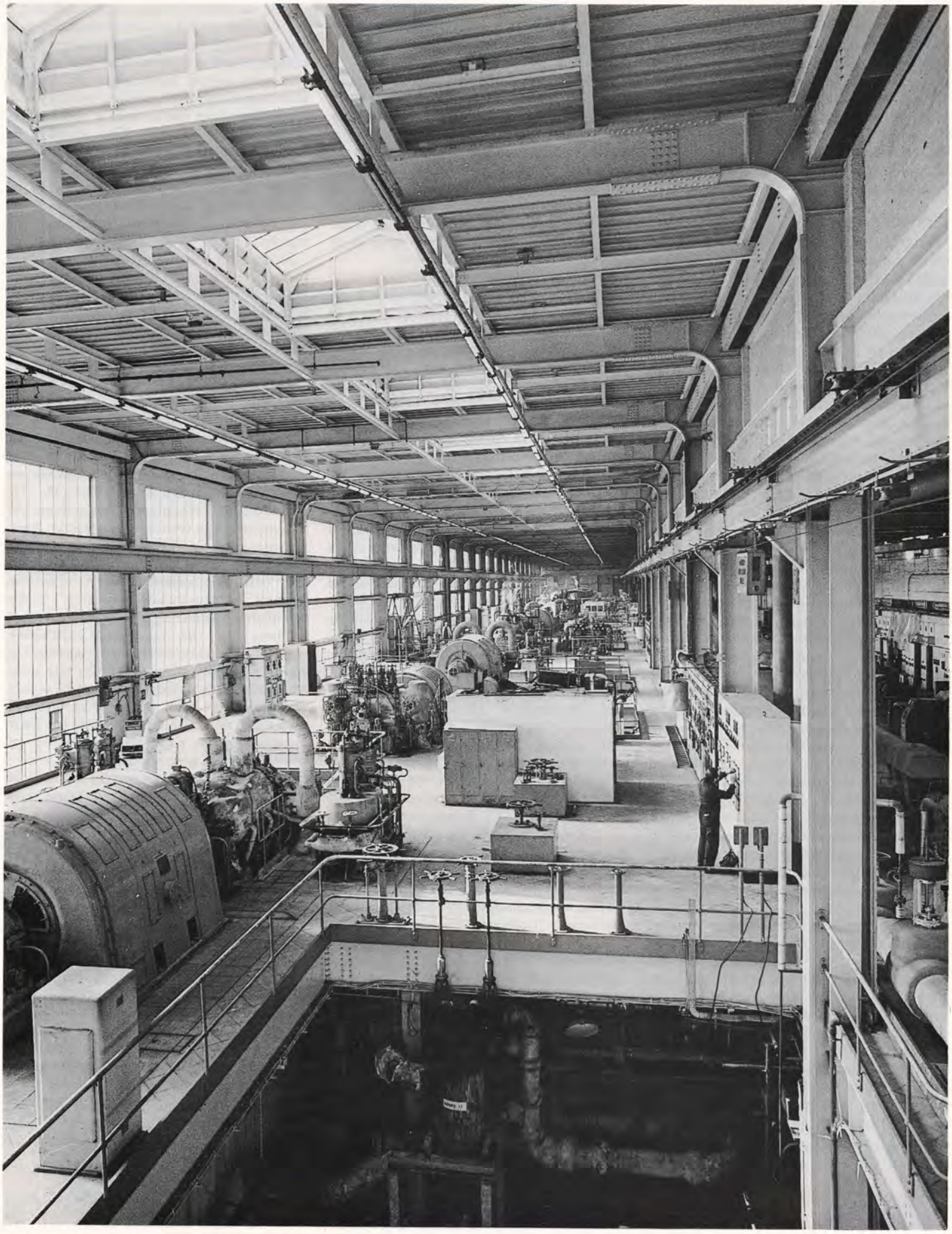
Reinvestment in the business

Remaining world-competitive and improving environmental performance require ongoing reinvestment. Major advances in energy efficiency will demand new plants that use the best available technology and that are designed for optimum thermodynamic performance, with modern heat network theory. This is not as easy as it sounds.

Consider one of the biggest energy consumers: olefines manufacture. The 1980s were devoted to rationalising capacity rather than replacing it; the same would be true of steel and other energy-intensive industries. Much of the capacity expansion which has occurred to meet rising demand has been achieved by the process of 'capacity creep'. The jointly-owned ICI/BP olefine plant at Wilton, for example, can now produce 60% more ethylene than its original nameplate capacity, and there are many other examples in the industry. Consequently, a large part of European capacity is now relatively aged and unless the ageing process is counteracted by a very clear rejuvenation strategy, these plants will become less and less reliable as time passes. The lifespan of such plants used to be considered as 10 years, yet over 85% of European olefine plant capacity is over 10 years old and nearly a quarter of it over 20 years old (Fig 5).

Looking to the future, we face the prospect of increased attention to product recycling having the effect of restricting future demand growth, while international competition intensifies. In these circumstances financing reinvestment in these capital-intensive businesses is a particularly serious challenge. These plants are not cheap — a new worldscale cracker costs Pds 500 million — and it will be impossible for the industry to finance a broad 'scrap and expand' policy. Few brand-new major plants will be built, and it seems that we will have to get by with 'progressive rebuilding' of the existing units.

Despite these many difficulties a few brave companies may still decide to reinvest but the difference between bravery and foolhardiness is proverbially small, and achieving an adequate financial return is very challenging unless a new competitive edge is available. This is the basis of the development of the LCA ammonia technology referred to earlier; many similar breakthroughs are essential for true competitiveness. It is exactly this technological leadership which is the hallmark of those companies who seek enhanced profitability. It requires a mindset which



The turbine hall of ICI's Wilton Site power station.

refuses to accept that nothing new is possible and that almost anything is achievable for the skilled and committed.

One such technological breakthrough is gas-fired combined cycle generation of electricity, with the construction of world-scale power stations completed in around two years rather than the ten needed for their outdated predecessors. This brings me back to Teesside Power; but first, some words about privatisation — because without that, nothing would have been possible.

Privatisation

The European Commission is trying to create a more level competitive playing field within the Community through the creation of the internal market. Progress towards '1992' has been slow, even on the simplest of items, the approximation of excise duties on fuels. For once, via its privatisation process, the UK is ahead of Continental Europe in removing legal impediments to vigorous, competitive gas and electricity industries, thereby bringing both environmental and economic benefits. In this key area the rest of Europe has much to learn from the UK, even though in my opinion Britain's privatisation process is only a brave beginning — which still has a long way to go to remove all the monopolistic trappings of the former supply-side-dominated state-owned utilities. However, it is already demonstrating what a powerful motivator competition can be.

The process began with natural gas. The Oil and Gas Enterprise Act of 1982 created the instruments for a competitive supply industry in the UK — the instruments, that is, but not the conditions or the means. Gas was privatised but monopolistic attitudes did not evaporate overnight. The subsequent Monopolies and Mergers Commission enquiry created the conditions and the appointment of a Director General of Gas Supply created the means; consumers had for the first time an independent champion that was prepared and able to take on the utility. This has, most importantly, ensured the availability of fair terms for contract carriage of privately-owned gas, and persuaded British Gas to relinquish a significant (10%) share of the industrial gas market by releasing gas supplies to competitors.

A competitive environment is as yet less evident from the recent record of electricity privatisation, as exemplified by its labyrinthine complexity. Internationally competitive prices for large industrial users achieved through load-management incentives and QUICS have not survived privatisation and the competitive position is deteriorating rapidly. Large users have lost the discounts for scale and for the load management they uniquely can provide. Such discounts are normal international practice, and reflect the true value to the supplier of certain types of large user. We believe that a high load-factor 40 MW supply will, for example, cost 25 to 30% more in the next tariff year than in the present one.

However, the competitive potential exists and ICI (C&P) intends to make full use of it. It has formed a subsidiary, Impkemix Energy, for this purpose and has obtained a second tier license to be able to purchase direct from the generators. It has, albeit with great difficulty, also overcome the colossal bureaucracy and joined the pool. Alone, these steps may not be sufficient and if no champion for the larger user emerges, other steps may have to be developed as was the case with gas.

There are, however, some encouraging prospects. For example, electricity and gas privatisation are together playing a part in promoting one very obvious opportunity for higher efficiency: combined heat and power. Some manufacturers will now feel able to adopt CHP, others to extend or improve upon CHP systems they already have. ICI is delighted to be involved with Enron Corporation and others in Teesside Power Ltd, which is constructing a very large CHP/CCGT power station on ICI land.

The new station, which will have its own gas supply from the North Sea, will have a capacity of 1725 MWe. ICI (C&P) will provide a substantial baseload outlet and will take steam to use as process heat within the immediately adjacent chemical complex. The bulk of the electricity will be sold to Regional Electricity Companies. The natural gas supply will be brought to land from the Everest and Lomond oil fields via a new pipeline direct to Teesside. The pipeline will have spare capacity and will provide a new transportation option for ICI and, potentially, for other industrial developers, landing gas considerably closer to Britain's industrial heartland than do the St Fergus pipelines.

This innovative project has the potential to deliver a number of substantial environmental benefits. For example, we estimate that it will cut UK sulphur dioxide emissions by 150000 tes per year, and carbon dioxide emissions by eight million tes per year. It is interesting to observe that the facility will have just a single cooling tower rejecting low-grade heat to the atmosphere (traditional stations of this size have six or eight) — a simplistic but very convincing illustration of its energy conservation potential.

As the project will be significantly more efficient in its use of fuel, it should therefore be more cost effective. But herein lie two major issues on which Government and our regulators are providing conflicting and contradictory signals.

First, the UK Government's support for CHP schemes is limited to those which export no more than 50% of what they generate, thereby excluding all large schemes, which are exactly those they should be encouraging — a classic example of small minds negating large economies and environmental benefits. The only conceivable justification for this is protection of existing suppliers, so it may be a brave beginning but is still a supply-side-driven distorted market. This stupidity is inhibiting the extension of the Teesside Power project to other potential UK applications — hardly the objective Government would or should wish if there is to be true competitiveness in electricity generation and supply.

Second, and related to the first issue, because nuclear generation is currently judged at least in the UK to be more expensive, a nuclear levy is imposed on all non-nuclear generation including the newer fuel-efficient and environmentally friendly schemes which society needs most. The levy appears moderate at about 11%, but it is 11% levied on all non-nuclear electricity which produces a ridiculous and unacceptable 55% subsidy for the 20% of nuclear production! If nuclear power is that expensive, even on a cradle-to-grave basis (a concept which no other means of generation has to address), then I do not believe the UK can afford it. Certainly not energy-intensive UK industries in toe-to-toe competition with, for example, the French industry, which enjoys very low-priced electricity, paradoxically nuclear-generated. This is a further example of supply-side-dominated, totally convoluted political dogma.

These are the impossibly confusing messages which I believe industry has a right to expect politicians to sort out. The directions we should all be following need to be logical and explainable even if some of us wouldn't start from where we are! The UK has great opportunities to make efficient use of its colossal energy potential and should ensure that it uses them. It may or may not need an energy policy, but it certainly requires a hefty dose of commercial common sense.

Conclusion

The emerging business climate of the 1990s will present opportunities as well as survival challenges and we must be ready to grasp them. To do so, industry needs clear logical and consistent directional messages from Government; international competitiveness from its own efforts, without artificial barriers or subsidies, and freedom to develop and then exploit competitive advantages by creating innovative technologies.

It is also to be hoped that environmental legislators will be guided by scientific reality and properly researched global policies, for if they are not, they can do much pointless damage. □

Taking power to the people

*Johanna Fender**

Biomass is a fuel which receives little attention in this country. Yet its impact on communities in developing countries can be almost revolutionary in economic, industrial and even social terms. The Natural Resources Institute is one of several bodies in this country aiming to help developing countries through their utilisation of fuels.

THE NATURAL Resources Institute (NRI), based in Chatham, Kent, is the scientific arm of the Overseas Development Administration (ODA). As an executive agency of the UK government, NRI is required to cover the costs of its operations through income. Consequently its services are offered under contract, and are usually financed under aid arrangements for developing countries: the UK aid programme administered by ODA being the principle source of these contracts. In addition NRI has worked for multilateral bodies such as the World Bank, the European Commission and the United Nations.

The work of NRI covers three major areas: resource assessment and farming systems; integrated pest management, and food science and crop utilisation. NRI's involvement in energy in developing countries comprises a small part of their total operations, but their energy involvement, mainly in biomass, makes an important contribution to the lives of those living in the so-called 'third world'.

NRI's staff is made up mainly of scientists, engineers and economists from a wide range of disciplines, from biogeography to food technology. Much of the Biomass Energy Section's work falls within the NRI's Forest Products Programme, managed by Georg Breag. The Biomass Energy Section is headed by Alan Robinson.

Economic slant

The Forest Products Programme constitutes a vital part of NRI's work. Not only are forests of great importance to both local and global environment, they are also an essential source of energy, building material and biochemical products. 80% of wood cut in developing countries is used for fuel, and NRI's programme aims to balance depletion with replenishment. In order to do this the programme tries to improve the efficiency of biomass fuel use, and to increase the range of fuels from forest sources. The programme also has an economic slant, aiming to reduce developing countries' dependence on imported fuels, generate additional foreign exchange and increase employment, generating income in forest areas.

The Forest Products Programme gives high priority to improving the design and operation of simple wood-fired furnaces to be used in small-scale rural industries, such as timber and crop drying. It has also done much to improve the efficiency of charcoal making, reducing wastage of both wood-fuel and labour, and introducing heat recovery and productive use of waste heat in traditional charcoal-making processes.

Pembroke, one of the former Royal Naval barracks buildings in Chatham, Kent, has been headquarters for NRI since July 1988.

Another area of work concentrates on finding alternatives to wood-fuel: residues such as sawdust, palm shell, coir fibre and other byproducts of agricultural activities. NRI tend to restrict this area of their operations to small to medium-scale industrial technology, leaving other vital areas, for example stove commercialisation, to organisations like Intermediate Technology, who have both experience and established contacts in this particular aspect of improving fuel utilisation.

Solar collector

NRI has also been involved in adapting solar technology to fit the special needs of developing countries, through its Process Development Section. Field trials in Indonesia completed in 1990, in collaboration with the Sukamandi Research Institute for Food Crops (SURIF), employed solar technology for use in drying paddy. A solar collector in the roof of a simple building replaces the old method of sun-drying paddy on floors. The solar collector gathers heat, channeling hot air to a fanhouse where a diesel-driven fan passes it evenly through the paddy contained in two drying bins. Waste heat produced by the engines enables the drying process to continue at night. The dryer can also operate in overcast weather conditions — important in Indonesia, as the main rice crop is harvested during the wet season.

Commissioning trials carried out by an NRI engineer showed that not only could the dryer operate continuously, but in comparative tests with sun-dried rice, the solar-drying process produces higher yields of better quality milled rice. A follow-up marketing survey also conducted by NRI showed the improved quality rice could fetch a higher price, thus allowing a miller to recoup the cost of his investment in three to four years. Other tests have shown that the NRI/SURIF system reduces fossil fuel consumption by 25%.

This Indonesian project demonstrates NRI's complete approach to their projects: from conception through to design, construction, initial operation and training. Once up-and-running, NRI conducts various follow-up checks, trials and surveys, to ensure that maximum benefit is reaped by the community involved, and to assess the suitability of the project in other areas. An NRI team will return to Indonesia during the next wet season to study the feasibility of converting existing mills to dryers. And in Britain, NRI technologists are investigating the possibility of scaling down the dryer to six and three tonne units for use in the large number of smaller mills in Indonesia.

Among a wide range of projects, the Biomass Energy Section is currently involved in a fluidised bed carbonisation programme. The section is developing, at pilot-plant scale, a system to carbonise particulate forestry and agricultural wastes, such as sawdust and rice husks.

Dutch oven

Trials are at present being conducted at Chatham into the suitability of an NRI-designed brick suspension burner, based on the design of a Dutch oven, for combusting sawdust. The burner, developed during an ODA-funded research project, is also undergoing field trials at a commercial rice mill in Sri Lanka. Using rice husks as fuel, the burner supplies heat to a steam boiler which parboils the rice. (Even the rice husk ash has the potential for use in cement or as a filler for rubber compounds). Tests are also planned to assess the possibility of adaption to burn other particulate residues such as coffee husks, groundnut shells and sunflower husks.

The environmental advantages of the suspension burner are clear: using waste from renewable crops helps slow the depletion of forest resources and solves the problem of disposal of agricultural wastes.

Because of NRI's policy of seeing projects through from conception to becoming working concerns, they are involved at all levels with many different projects at any one time, and with follow-up programmes lasting several

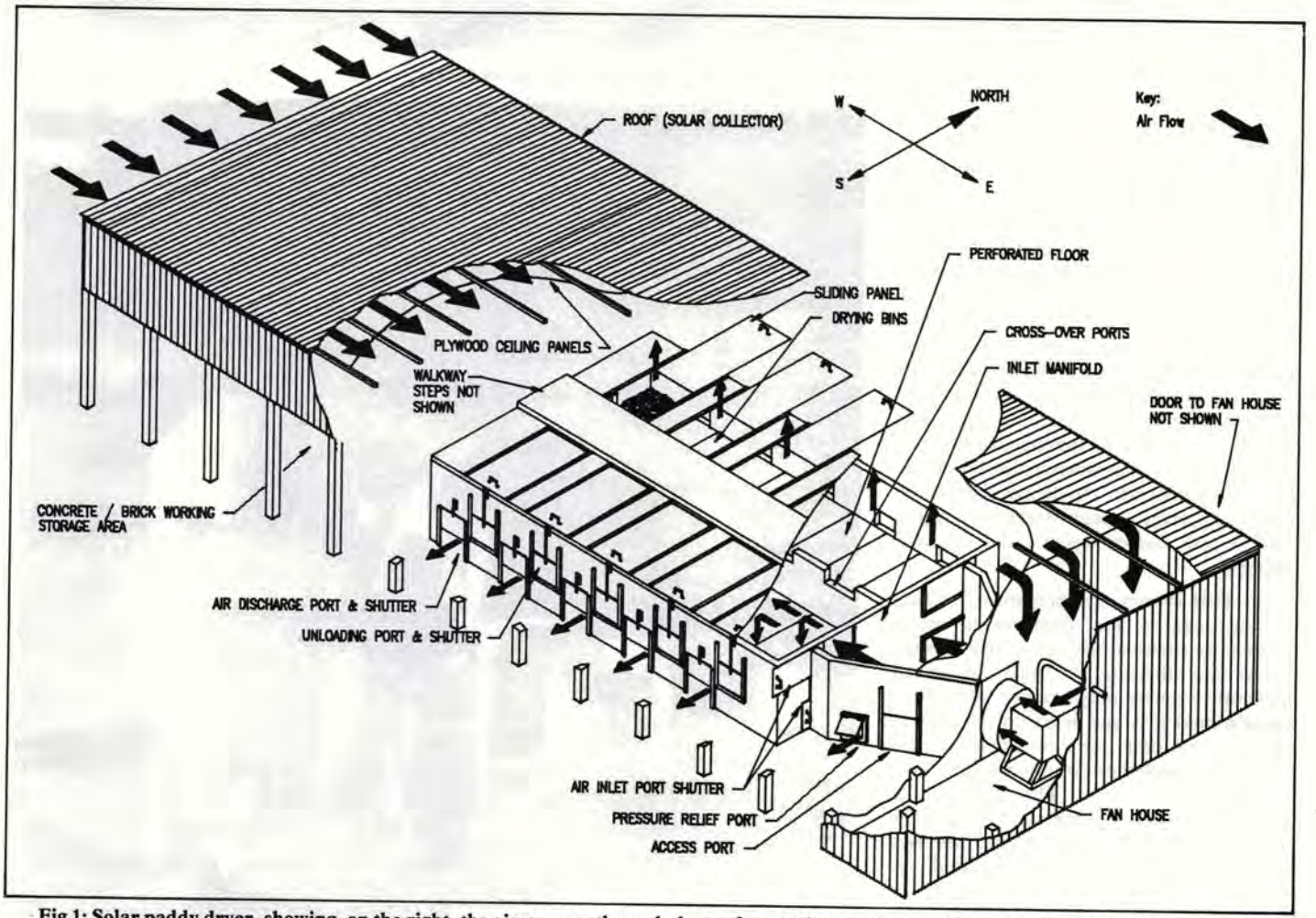


Fig 1: Solar paddy dryer, showing, on the right, the air passage through the perforated floor and the paddy which discharges to atmosphere via the top sliding panels. On the left, the air passage is shown through the paddy and perforated floor from above, before discharge to atmosphere via the lower discharge ports and control shutters.

years, a project is rarely considered 'finalised'. The Biomass Energy Section is currently involved in a total of eight projects.

A project which has passed through its initial stages and now awaits follow-up is the carbonisation of coconut shells with waste heat recovery. The unit designed for this purpose by NRI has an output of 270 kg of charcoal and 10×10^6 kJ of process heat per 10-hour batch operation. The local community in Sri Lanka, where the project is based, will benefit from a system which produces coconut shell charcoal without the usual polluting smoke, which is a particular problem with this process in its traditional form. The heat recovered, previously wasted during carbonisation, can be used through heat exchangers in agricultural processes such as drying and sterilisation.

NRI see their technology as playing a vital role in the up-grading of the coconut industry in developing countries and have plans to disseminate the technology through regional demonstration trials.

Benefiting the community

The Biomass Energy Section's approach reflects that of NRI as a whole in that it handles a project from conception through to operational follow-up, and approaches every project with an eye to its individual considerations. A project which has been successful in one country may well turn out to be unworkable in another, for reasons that a purely 'industrial' approach would fail to identify. Social and economic circumstances vary greatly, and the traditional culture of a community may have an important bearing upon the success or failure of a project. NRI does admit to having failures, but points out that these become a beneficial part of the learning process.

It is partly due to this approach that the benefits of NRI's work are experienced by the community as a whole. A recent project in Sri Lanka to fuel a boiler using rice husks has benefited the entire community, from the mill manager right through to local residents. A suspension burner, fuelled by rice husks, was coupled to an old Cochran boiler to raise steam for the parboiling process in a rice mill. Traditional methods were extremely smoky, with high levels of ash emissions (containing silica). This, combined with the danger from intermittent explosions, posed considerable health risks to both factory workers and the local residents.

The NRI system, by comparison, collects the ash produced, and eliminates the smoke problem. In addition, the new system uses the fuel far more efficiently. The mill manager had previously reported only a partial burn of the fuel of around 50%, and he was forced to bring in husks from other mills to supplement his supply. Operating the new system he no longer finds this is necessary. The advantage to workers and residents is the minimising of the health problems normally associated with rice husk combustion, such as silicosis from the silica present in the ash. □

Deputy Editor, Energy World

Constructing the rice husk furnace in Sri Lanka.

Trainee operator with NRI-designed suspension burner for a timber drying kiln in Belize.

Power generation from landfill gas

Eur Ing Derek Jones CEng MIMechE

The increasing trend for the disposal of refuse in landfill sites has resulted in considerable attention being given to the environmental controls required for the prevention of odours and migration of gas, a result of organic waste materials decaying. The 'landfill' gas produced is typically 50/60% methane by volume and as the quantities of gas involved in a large landfill are significant, there is a considerable incentive to harness the gas as a fuel.

WHILE there has been a number of landfill-based power generation projects, few of these have been adequately documented. However, the Shanks & McEwan (Southern) Ltd site at Stewartby in Bedfordshire was developed and monitored under the Government's Energy Technology Support Unit (ETSU) 'best practice programme'.

The final report on the project, produced in October 1990, is an excellent summary of the concept, implementation and practice of running a landfill-fuelled power plant. The report is encouraging in that it shows that the project overall has suffered little in the way of technical problems, that energy savings have been substantial, and that the pay-back period has been attractive.

Interestingly, relatively little pre-treatment of the gas was undertaken in this project prior to combustion; this appears to have had little, if any, detrimental effect in terms of wear or reliability on the generator engines.

This is an important finding, as it shows both the tolerance of the engines to the fuel type, and that it is possible to avoid the substantial costs of pre-treatment that can adversely affect the economics of such projects.

The Stewartby site was first developed in 1979, when the first wells were sunk. Since then, additional wells have been created and a gas extraction network developed.

Water removal is undertaken by passing the gas through chillers prior to the gas entering the compressor compound, where it is then passed through pre-filters. It is then compressed by a Hammond Engineering single constant displacement vein compressor, which is driven by a 45 kW electric motor.

Gas is supplied at approximately 0.75 bar to three Dorman 12STCWG spark ignition engines, installed in 1987. A fourth engine of similar type was installed in March 1989 as a result of the success of the initial three units.

These engines are each rated at 275 kW when running on a landfill gas. This is some 11% below their normal rating when measured on natural gas, and reflects the lower calorific value of the landfill fuel. The engines are directly coupled to air-cooled generators, manufactured by Newage at Stamford and rated at 350 kVa.

The London Brick site is the major consumer of electricity generated at Shanks & McEwan's Stewartby site.

Energy savings

Of the power generated, 13% is used internally at the Stewartby site. Of this internal consumption, approximately 23% is consumed in the adjacent offices; the gas compressor represents a constant load.

A further 73% of the electricity generated on the site is exported to the nearby London Brick Company Brickworks where it is used to power equipment. A further 14% of energy generated is exported to the Eastern Electricity Board Grid.

Given the rates that are achievable for the electricity generated, it is estimated that annual sales of electricity from Stewartby are worth £169 000. Even if the system was replicated elsewhere, where possibly less advantageous tariffs were available, savings of over £160 000 could be expected.

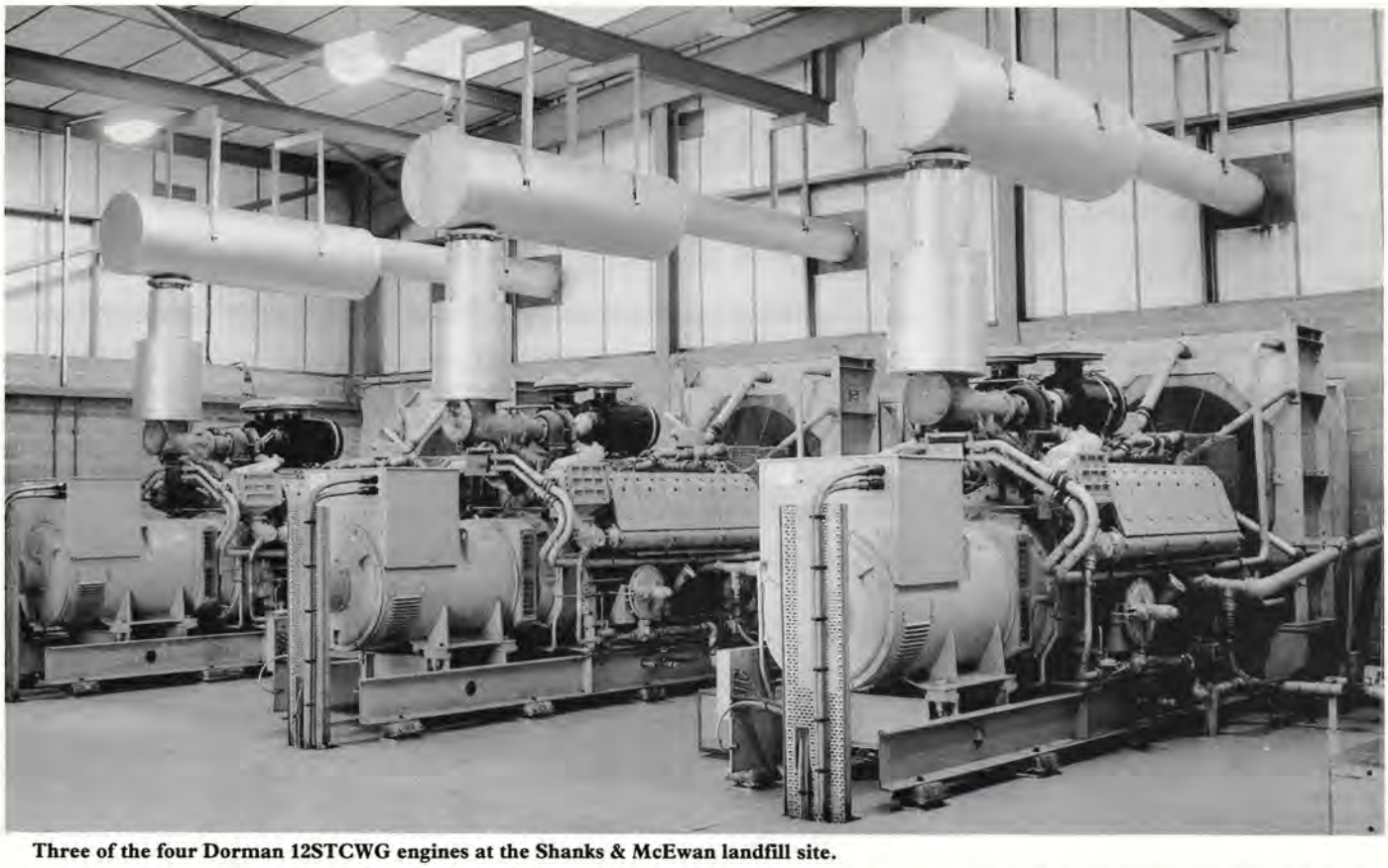
It is estimated that the Stewartby site has an overall pay-back period of about 2.4 years. Establishing the same facility as a replica, but discounting the beneficial effects of the Stewartby site, pay-back would be achieved between 3.2 and 4.7 years. However, the Stewartby engines operate purely as power generation units as there is no opportunity on the site for the use of waste heat that could be recovered from the plant. If the heat generated could have been utilised, a total project pay-back as low as 1.5 years would have been

The author

Derek Jones is manager of the Gas Engines division of Dorman Diesels Ltd, who are based in Stafford.

Mr Jones joined W H Dorman as a student apprentice 41 years ago, and is a recognised authority on gas engines.

This article is taken from a fuller report, copies of which can be obtained from the Energy Efficiency Enquiries Bureau at Harwell, telephone 0235 436747.



Three of the four Dorman 12STCWG engines at the Shanks & McEwan landfill site.

achievable, although this does not include the capital and O&M costs of adding a CHP package.

The Stewartby project, as currently operating, represents an annual energy saving to the nation of some 74 000 GJ. Had it been possible to utilise the waste heat available in the system, an additional energy saving of 29 750 GJ would have been possible.

In addition to the financial and linked energy benefits of the project, it is also considered that the impact on the environment is beneficial. Burning landfill gas converts methane, which would normally escape to the atmosphere, to carbon dioxide; while carbon monoxide emission levels were considered to be slightly high, emission technology has continued to progress since these engines were installed. New generation Minnox engines would now present a completely different and substantially improved emissions performance.

Reliable power

The initial three engines were commissioned in 1987. Previously, checks had been undertaken to test the quality and level of gas supply. All Dorman engines are extensively test-run and certified at the Dorman works, thereby minimising the amount of work that needs to be done on commissioning. However, it was necessary to adjust the carburettors to suit the specific landfill gas composition, as this is of a lower calorific value than the natural gas available in the factory environment.

Gas compressor failures occurred on several occasions, three such events occurring due to slugs of water getting through the water separation system. However, improvement to the de-watering facilities and corrective measures to prevent backflow eradicated these problems.

The generator units have been in almost continual service except for major shutdown/service shutdowns since commissioning. Minor faults occurred in the early stages, which were associated with adjustment to the electrical equipment and a damaged starter motor.

Generally, there have been few problems relating to the use of landfill gas as a fuel, apart from occasions when units have tripped due to the relatively low methane content in the fuel. Experience has shown that, with suitable carburettor settings, all units will run satisfactorily down to about 50% methane and that two of the units will continue to operate satisfactorily down to about 45% methane content. Initially, some of the tripping problems were attributed to a failure of the carburettor to maintain adjustment. However, it subsequently became apparent that this was not the cause of the problem but that there was an increasing leakage of air in the site gas collection system, resulting in a substantial reduction in the methane content of the gas.

During hot summer weather, the engines experienced higher operating temperatures which was overcome by cleaning the radiator cores to reduce radiator fouling. The problem was permanently overcome by a change of fan drive pulleys to improve cooling performance.

During the project considerable attention has been given to monitoring oil samples, as combustion of some of the trace compounds in landfill gas yields acid products which contaminate the oil and reduce its alkalinity. As the alkalinity falls, there is less reserve of alkalinity in the oil to prevent corrosion. Based on the early operating experience, the oil grade was changed to an oil with a higher total base number (higher alkalinity).

It was noted that when new gas wells were commissioned, the gas supply increased substantially in acidic content. This effect appears to decrease quite quickly with time but for this reason it is important that the oil change frequency is adhered to at 500-hour change periods.

The ETSU report summarises the experience of the first three units installed to the end of November 1989, at which time each of the three initial units had completed about 22 000 running hours. The units have shown a consistently high service factor, averaging 94%. At the time of writing, these initial engines have each achieved over 34 000 running hours. With a fourth unit installed in early 1989, the four units have now achieved a total running time in excess of 110 000 hours.

Engine wear is being carefully monitored and the engines are maintained in line with normal service recommendations. Engine vibration levels are being measured, and in practice the vibration levels have shown only a slight tendency to increase, suggesting that the engines are not suffering any ill-effects.

The Stewartby project is considered to be commercially attractive, environmentally desirable and energy efficient with estimated savings of 74 000 GJ/yr.

Despite the limited gas pre-treatment installed at Stewartby, there does not appear to be any adverse effect on engine performance or reliability and any problems experienced have been generally attributable to minor mechanical and electrical defects rather than problems associated with the use of landfill gas as a fuel. □

A 'must' for energy managers

'Energy Monitoring and Target Setting Using CUSUM'
by Peter Harris
Cheriton Technology Publications, 1989
106pp £22.50

IN his brief historical introduction, the author points out that CUSUM stands for CUmulative SUM deviation and that it is a statistical technique which measures bias in equal interval sequential data. A good appreciation of the general clarity of his approach is given immediately, as he comments: "In plain language this means that, where something is measured regularly at equal time intervals, if there is a deviation from a consistent pattern, CUSUM will measure it". CUSUM was initially discovered during the 1960s for interpreting experiments in biometry. In the 1970s it was extensively used for monitoring quality control in production management and, more recently, has been widely used in the pharmaceuticals industry for the statistical evaluation of drugs. Its first use in energy management was reported some 10 years ago.

The first chapter discusses energy monitoring and the time series problem. Here the reader is warned that many of the energy monitoring systems set up during periods of high energy costs have already been abandoned because they failed to recognise an essential point: it is not the collection of information that brings benefits, it is its analysis and interpretation. In this chapter, and throughout the text, the use of simple case studies from real data helps to illustrate the methods being described. CUSUM is discussed in more detail in the second chapter, followed by chapters on applications in buildings, processes, and "Errors, tips and tricks". The sixth chapter describes how to set up CUSUM on a spreadsheet and this is followed by a chapter on targets. The final chapter describes a number of applications of results from CUSUM. Five appendices include information on how to establish formulae from a graph, degree days and the measurement of heat loss in degree day units (therms per square metre per 1000 degree days), but there is no index. Among many interesting points, the author draws a parallel between money management and energy management, and another between the analysis of marathon running data and energy data (some energy managers may already feel that they are running in a marathon on most working days, so they will not be surprised at this!).

Unlike many more theoretical energy management texts, this book will be of considerable practical use, enabling the practising energy manager to set up his own data analysis system. The text is easy to follow and illustrated with many clear diagrams. The author has drawn on many years experience in the field to produce this text which can be thoroughly recommended. It will be particularly useful for energy management training courses.

Dr Cleland McVeigh

Market pressure

'UK Industrial Coal: A Competitive Tussle Ahead'
McCloskey Coal Information Service, 1990
125pp £275.00 (incl p&p)

THE UK industrial coal market is usually considered as something of a backwater. However, with annual demand currently running at 7.5 million tonnes and customers paying out over £300 million, British Coal now appears to be under major pressure from other fuels (especially gas) and coal imports.

The authors of the report investigate British Coal's pricing policy. Details revealed in the text may come as a shock to many industrial customers. They show that some pay 50% more than others for the same quality of coal.

Much of the coal sold by British Coal to cement manufacturers, paper mills and other companies appears to be sold at a loss. Typically, large industrial customers pay £32.50 to £35 a tonne at the pithead. By comparison, PowerGen and National Power, the two main electricity generators, pay £39 to £43 a tonne.

British Coal dominates the industrial market. Its 6.5 million tonnes of sales in 1989 accounted for 85% of purchases by industrial customers. The authors of the report believe that its industrial sales will slump to just 1 million tonnes a year by the end of the decade. The market itself will decline, mainly because of the need to reduce sulphur dioxide emissions.

This publication should, I believe, be read by anyone who is involved or merely interested in the UK industrial coal market.

Dr Andrew W Cox

A beginning

'The New Energy Markets of the Soviet Union and East Europe'
by Paul K Lyons
FT Business Information, 1990
119pp £172.00 (UK); £182.00 (overseas)

ALTHOUGH energy policies in Western Europe are in many respects misguided, mistakes by policy-makers appear insignificant when set alongside those made in the Soviet Union and Eastern Europe in the post-war period up to 1989. Centralised decisions about energy resulted in arbitrary output targets and inflexible prices which bore no relation to costs of production. Consequently, incentives to produce and consume energy efficiently were lacking and technology lagged behind the 'capitalist' nations. The concentration on achieving or over-achieving output goals resulted in pollution from energy production, transportation and consumption far more serious than anything seen in Western Europe and a lack of attention to safety (for instance in the construction of pipelines and nuclear power plant). At the same time, the countries of Eastern Europe became over-dependent on the Soviet Union for their supplies of energy.

How the Soviet Union and Eastern Europe can move from where they are to where they would like to be is far from clear. It is not just a matter of dictating new, higher energy prices from the centre. If they wish to move towards market economies, they need to establish the flexible response mechanisms which market systems are supposed to provide (though not all so-called 'market economies' do so). Prices of energy products will need to be allowed to find their own levels, modified to incorporate 'external' effects, and a degree of decentralisation of decision-making will be required which is unlikely to be to the taste of those in central government.

An initial essential step towards any kind of reform is to establish the nature of the starting point — to define, as far as it is possible to do so, the existing states of the energy sectors of these economies. As Mr Lyons remarks in his survey, energy statistics for the Soviet Union and especially for its Eastern European neighbours, are sparse and often out of date. He has, however, provided a useful compilation of such data as are available.

For the Soviet Union, Bulgaria, Czechoslovakia, the former East Germany, Hungary, Poland and Romania, Mr Lyons has gathered information from a variety of sources (relying principally on government and International Energy Agency statistics). The information is listed in tables for each country which are accompanied by a commentary on the energy industries in that country. This deals separately with oil, coal, gas and primary sources of electricity and provides some information on future plans. Given the pace of change in the area, some of the information on plans will inevitably date quickly — for example, it is already clear that the emergence of widespread opposition to nuclear power will result in a cutback in nuclear programmes compared with recent plans. Nevertheless, Mr Lyons's survey is a good starting point for businessmen contemplating investment in Eastern Europe who wish to take a preliminary view of the opportunities.

Prof Colin Robinson

Recently published

'Energy Audits and Surveys'
The Chartered Institution of Building Services Engineers, 1991, 92pp, £34.00 (CIBSE members £17.00).

'European Marketing Data and Statistics 1991' (26th edition)
Euromonitor, 1990, 463pp, £130.00.

'The Engineering Profession 1991'
Edited by Linda Parkin
The Ivanhoe Press in association with The Engineering Council, 1991, 186pp, £6.95.

'Regulation of the Privatised British Gas Industry'
by Francis McGowan, Gordon MacKerron and John Surrey
Science Policy Research Unit, 1991, 61pp, £15.00 (incl p&p).

A new era in energy strategy at odds with historical attitudes

Energy strategy

Sir,

One accepts that denationalisation of the electricity industry has, as one of its main aims, removal of the many undesirable facets of monopoly. Introduction of competition is indeed welcome if, at first, this is limited only to generation.

The undoubted success of the Institute's *'Electricity from Gas'* meeting last October has shown how a vigorous new spirit in the gas industry can rise to the opportunity. Robert Evan's determined assault on power generation at all levels is more than welcome. In his references to combined heat and power (CHP), in projects of all dimensions 'including district heating' (a phrase that many will remember was added to his script), he offered finance, virtually unlimited encouragement and assistance. This appeared to open a new era of energy strategy, unencumbered by previous reservations of the energy industries, determined to prevent competition from distributed heat.

This whole new policy was so unexpected and so completely at variance with previously expressed policy it would have been no surprise to many to see the letter published by the Financial Times on 20 December — pointing to a complete BG *volte face.* It is more in keeping with historical BG attitudes to CHP that an even more recent announcement in March now penalises CHP generation by specifically increased tariffs. To claim that supplies of gas must be safeguarded for the users of individual appliances is an insult to all of us with any pretention of understanding the meaning of energy strategy.

To perpetuate the waste inherent in a multiplicity of individual appliances, specifically for space and water heating, and penalise a vastly greater efficiency in the use of fuel by the CHP route, is unfortunately reminiscent of the propaganda principle 'the bigger the lie the more will believe it'.

For those unfamiliar with this background let me explain. Where the process of power generation deliberately reduces the amount of electricity produced and maximises for use the otherwise wasted heat (via the familiar cooling towers that are no longer needed) the net result, in cities that enjoy the joint service, there is complete absence of national suppliers of either gas or electricity for space and water heating. This is the only route to satisfy the current demand for maximising energy efficiency and minimising harmful emissions.

The Five Cities Seminar, held in London in May, addressed this problem and introduced for the first time in the UK the now widespread continental example of Energywerke and Stadwerke — where municipal engineering services are comprehensively operated by limited liability companies in each town or city independently. This introduces a new concept of competition, not between incompatible suppliers trying to meet the same need (space and water heating), but between cities matching records for pollution elimination, maximising energy efficiency and achieving lower energy tariffs simultaneously.

It works well elsewhere, it must be made to work here; with central government responsible for overall energy strategy not energy industries, concerned as they must be otherwise with their own commercial prosperity and progress.

Norman Jenkins
Farnham, Surrey

The editors welcomes letters for publication from readers. However, correspondents are requested to keep their letters as short as possible, up to a maximum of 500 words. This will enable the views of as many readers as possible to be published.

Efficiency and the combustion bagasse

Sir,

The article by Brian Locke, *Worldwide Biomass Initiative* (*Energy World* No 186, March 1991) includes in the list of proposed projects to make better use of biomass: "Clean and efficient combustion of bagasse and rice husk. (SE Asia)." The article covers a wide range of subjects concerned primarily with a need for technological development and in a relatively short article Mr Locke was obviously not able to describe each subject in great detail. One might erroneously suppose that the failure to achieve clean and efficient combustion of bagasse and rice husk is because suitable technology is not available.

Bagasse, the woody fibrous residue left after extracting sugar from sugar cane, is burned by the sugar mills to supply their energy requirements. The greatest accumulated bulk of agricultural waste to be found anywhere in the world is that of bagasse and this project probably has the greatest potential importance of those listed in Mr Locke's article.

Sugar mills have had a financial incentive to install updated equipment giving higher sugar yields with less energy consumption. They continue, however, to burn bagasse in old inefficient and outdated boilers which emit clouds of black grit-laden smoke. The installation of modern boilers already available from a number of suppliers, which are able to achieve clean and efficient combustion, would simply create a problem disposing of a huge mound of surplus bagasse which would accumulate by the end of a campaign (an annual period of up to six months during which cane is harvested and processed by the sugar mills).

The sugar mills could be forced to install modern boilers by legislation governing emissions to the atmosphere but they will only willingly replace old but still serviceable boilers when they are able to sell surplus bagasse on terms favourable to themselves.

The only outlet for surplus bagasse of any significance at present is to bagasse paper pulp mills. Bagasse is depithed before pulping and modern boilers exist which are able to burn pith satisfactorily. There is no reason to suppose that rice husk could not also be burned satisfactorily. The pulp mills have found to their cost that inducing the sugar mills to produce and release surplus bagasse on terms fair to both sides has for various reasons proved to be far more difficult than one might imagine. The trend of the 1970s to expand bagasse pulping has been brought to a halt largely as a result of this difficulty.

In the meantime the sugar mills continue to burn a valuable resource inefficiently, emitting more than necessary amounts of CO_2 and grits to the atmosphere.

G D Daniels *(Member)*
Sevenoaks, Kent

Tax relief welcomed but 'still not enough'

THE Engineering Council and the Engineering Employers' Federation (EEF) have welcomed the income tax relief given in the Budget to individuals who pay for training that leads to most National Vocational Qualifications. They will, nevertheless, be pressing the Chancellor for more comprehensive arrangements.

The new tax relief applies only to study and examination fees. It needs to be extended to include books and equipment plus travel and subsistence.

The Engineering Council, with 290 000 engineers and technicians on its register, and the EEF, representing 5000 companies, have been campaigning jointly for a tax relief concession on education and training. They will now be asking for the concession to be extended to professional people who were not included in the Chancellor's statement and will also be pressing for income tax relief for individuals who pay for their own continuing professional development (CPD), or continuing education and training (CET).

The new training allowances announced in the Budget will help people achieving Levels 1-4 of the National Council for Vocational Qualifications (NCVQ), but not the higher levels or CPD/CET.

Mr Denis E Filer FEng, Director General of The Engineering Council, said: "The Chancellor's new rules will help two of our categories — Incorporated Engineers (IEng) and Engineering Technicians (EngTech) — because when National Vocational Qualifications are fully in force, they may well count towards the achievement of those two titles, but the new rules will exclude the Chartered Engineers (CEng), which NCVQ have been saying would equate Level 5.

"We will, together with the EEF, be making a strong plea to the Chancellor not only to extend the benefits to the higher NVQ levels but also to individuals paying for their own continuing education and training along CPD or CET lines.

"It is important for the Government to remember that once a person is qualified, there is a great need for that person to keep up to date in one's job because of very rapidly changing technology. In our view individuals who do so should be encouraged by extra income tax benefits."

Key features of the Budget statement include:

- relief given for training leading to National Vocational Qualifications and Scottish Vocational Qualifications up to Level 4
- basic rate tax relief given by deduction from qualifying study and examination fees paid by trainees
- available relief even if the trainee has no taxable income, or where the course is unrelated to the trainee's present work
- the new relief to start on 6 April, 1992.

Continuing professional development launch

THE Engineering Council has announced plans for a national system to promote and encourage continuing professional development (CPD) for engineers and technicians.

Mr Tim Eggar MP, Minister of State at the Department of Education and Science, launched the Council's plans in March at a conference in London organised by the Careers Research and Advisory Centre (CRAC), in association with The Engineering Council and with support from BP.

The system calls on engineers and technicians, in partnership with their employers, to carry out a planned programme of continuing education and training. It will enable individuals to update and develop their knowledge and skills and help industrial companies to improve their performance.

A document, *A national system for continuing professional development — framework for action*, outlines the responsibilities of all partners involved in CPD.

The Engineering Council aims to promote CPD so that it contributes to business performance, individual career advancement, the image of the profession, and international competitiveness.

CPD's aims for engineers and technicians include: updating their technical competence; gaining awareness of commercial subjects, and developing communication and management skills.

Support for the Council's initiative has included £450 000 funding from the Department of Education and Science Professional Industrial and Commercial Updating (PICKUP) initiative.

The system, which also aims to ensure coordination among CPD schemes, will be developed over the next three years. A team of regional officers will encourage companies and organisations to give greater priority to the continuing development of their engineers.

The Engineering Council will develop and promote codes of practice and the system will involve close collaboration between the Council, the professional engineering institutions, the engineering industry — particularly the 260 companies affiliated to the Council — and the providers of training for CPD.

The core partnership in continuing professional development is between the individual and his or her employer. The Engineering Council is recommending that engineers and technicians carry out a minimum of 35 hours a year of CPD — a figure based on existing international practice, but which is exceeded by current best practice.

A planner-style 'Career Manager' book has been designed to help engineers and technicians examine the further learning they need to do to improve their current job performances, to define their ambitions for two to five years ahead and to draw up a Career Action Plan of how to realise them.

A variety of learning methods can be built in, including open learning, in-house training, work experience, professional institutions' learned society activities, and courses at further and higher education institutions.

A three-year pilot scheme was supported by more than 70 companies and had more than 1000 engineers and technicians participating. The findings of the pilot scheme indicated that individuals were interested in progressing their professional development; they could only do so with the encouragement and support of their employers and professional institutions.

Copies of *A national system for continuing professional development — framework for action*, are available (please send A4 sae) from The Engineering Council, 10 Maltravers Street, London WC2R 3ER.

EVENTS

June 1991

TUC Forum Energy Policy 2000
17 June, Congress House, Gr. Russell Street, London WC1B 3LS. Details from Jim Hanna, tel: 071 636 4030.

European Conference on New Fuels and Clean Air
18-19 June, Antwerp, Belgium.
Details from New Fuels Report, PO Box 7167, Ben Franklin Station, Washington, DC 20044, USA. Tel: 703 892 8505, fax: 703 685 2606.

European Refining Conference
24-25 June, Florence, Italy.
Details from Mireia Mangual, WEFA Energy, 60/62 Margaret Street, London W1N 7FJ. Tel: 071 631 0757, fax: 071 631 0754.

Safety of Electrical Equipment in Potentially Explosive Atmospheres
Three courses, 25-28 June, Chislehurst, Kent.
Details from Sira Communications Ltd, South Hill, Chislehurst, Kent BR7 5EH. Tel: 081 467 2636, fax: 081 467 7258.

EPA 1990 — Monitoring Releases and their Impact
Conference and exhibition, 26-27 June, London.
Details from Katie Lye, IBC Technical Services Ltd, Bath House, 56 Holborn Viaduct, London EC1A 2EX. Tel: 071 236 4080, fax: 071 489 0949.

July 1991

Energy Management and the Working Environment
Advanced short course, 2-3 July, University of Cambridge.
Details from Pam Whitfield, University of Cambridge, Dept of Engineering, Trumpington Street, Cambridge CB2 1PZ. Tel: 0223 332712, fax: 0223 332662.

Ninth International Conference of Women Engineers and Scientists
14-20 July, University of Warwick.
Details from Sherrie Simpson, Conference Services, ICWES9, 55 New Cavendish Street, London W1M 7RE. Tel: 071 486 0531, fax: 071 935 7559.

August 1991

Solar World Exhibition 1991
18-22 August, Denver, Colorado, USA.
Details from American Solar Energy Society, 2400 Central Ave, B-1, Boulder, CO 80301. Fax: 303 443 3212.

Building Simulation '91
20-22 August, Nice, France.
Details from SCSI, Philippe Geril, Coupure Links 653, B-9000 Ghent, Belgium. Tel/fax: 32 91 23 49 41.

1991 International Symposium on Energy and Environment
25-28 August, Espoo, Finland.
Details from Kaleva Travel Agency/Congress Service, Mikonkatu 6 C, SF-00100 Helsinki, Finland.

September 1991

Introduction of English Law of Contract (HVACR Manufacturing Industry)
Federation of Environmental Trade Associations commercial seminar, 26 September, Esher, Surrey.
Details from Bob Wilkinson, FETA, Sterling House, 6 Furlong Road, Bourne End, Bucks SL8 5DG. Tel: 06285 31186, fax: 0628 810423.

10th CERI International Oil and Gas Markets Conference
29 September-1 October, Calgary, Alberta, Canada.
Details from Conference Division, Canadian Energy Research Institute, 3512 33 Street NW, Calgary, Alberta. Tel: 403 282 1231, fax: 403 284 4181.

October 1991

Design Engineering Show & Environmental Technology Show
7-10 October, NEC, Birmingham.
Details from Sally German, Reed Exhibitions, Oriel House, 26 The Quadrant, Richmond, Surrey TW9 1DL. Tel: 081 948 9862, fax: 081 940 2171.

Gas for Europe in the 1990s
23-24 October, RAI Congress Centre, Amsterdam, The Netherlands.
Details from RAI, Europaplein, 1078 GZ Amsterdam. Tel: 020 549 12 12, fax: 020 46 44 69.

HIMATEC/ACIMTEC Exhibitions
23-25 October, Valencia, Spain.
Details from Anna Small, Engineering Industries Association, 16 Dartmouth Street, Westminster, London SW1H 9BL. Tel: 071 222 2367.

International Trade Fair for Environmental & Safety Technologies
Exhibition, 22-25 October, Ostend.
Details from John Haigh Exhibition Services, 14 Station Way, Peckham, London SE15 4RX. Tel: 071 639 7265.

8th Pittsburgh Coal Conference
14-18 October, Pittsburgh, USA.
Details from The Pittsburgh Coal Conference, University of Pittsburgh, 1140 Benedum Hall, Pittsburgh, PA 15261. Tel: (412) 724 7440.

November 1991

Interwire '91
Exhibition, 4-8 November, Atlanta, USA.
Details from EIA, 16 Dartmouth Street, London SW1H 9BL. Tel: 071 222 2367.

Subtech '91 'Back to the Future'
Conference and exhibition, 7-9 November, Aberdeen.
Details from SUT, 10 Farburn Terrace, Dyce, Aberdeen AB2 0DT. Tel: 0224 770533.

Interbuild '91
Exhibition, 24-29 November, Birmingham.
Details from Interbuild '91, tel: 071 487 5831/486 1951.

World Clean Energy Conference
4-7 November, Geneva, Switzerland.
Details from CMDC Secretariat, Kellerweg 38, CH-8055 Zurich. Tel: 44 1 463 02 26, fax: 41 1 463 02 26.

Alluvial Mining
International Conference, 11-13 November, London.
Details from Liz Cock, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR. Tel: 071 580 3802, fax: 071 436 5388.

International Symposium on Alcohol Fuels
12-15 November, Florence, Italy.
Details from Symposium Secretariat, ISAF Firenze '91, Ecofuel SpA, Viale Brenta 15, 20139 Milan, Italy. Tel: 02 520 21 923, fax: 02 520 21 960.

Adding Value to Natural Resources
UN-backed conference, Adelaide, South Australia.
Details from Geoff Walls, Agent General, South Australia House, 50 Strand, London WC2. Tel: 071 930 7471, fax: 071 930 1660.

Modern Technology in Pipelaying and its Associated Works
Seminar, 5 November, London.
Details from the Executive Officer, Offshore Engineering Group, tel: 071 973 1243 or 071 222 7899, ext 243.

December 1991

1991 SO_2 Control Symposium
3-6 December, Washington DC, USA.
Details from Pam Turner, Symposium Coordinator, PO Box 10412, Palo Alto, CA 94303-9743, USA.

Power-Gen '91
Conference and exhibition, 4-6 December, Tampa Convention Center, Tampa, Florida, USA.
Details from Pennwell Conferences & Exhibitions, 3050 Post Oak Blvd, Suite 200, Houston, Texas 77056-6525. Tel: 713 621 9720.

INSTITUTE OF ENERGY CONFERENCES

The following programme is currently being organised by The Institute of Energy.

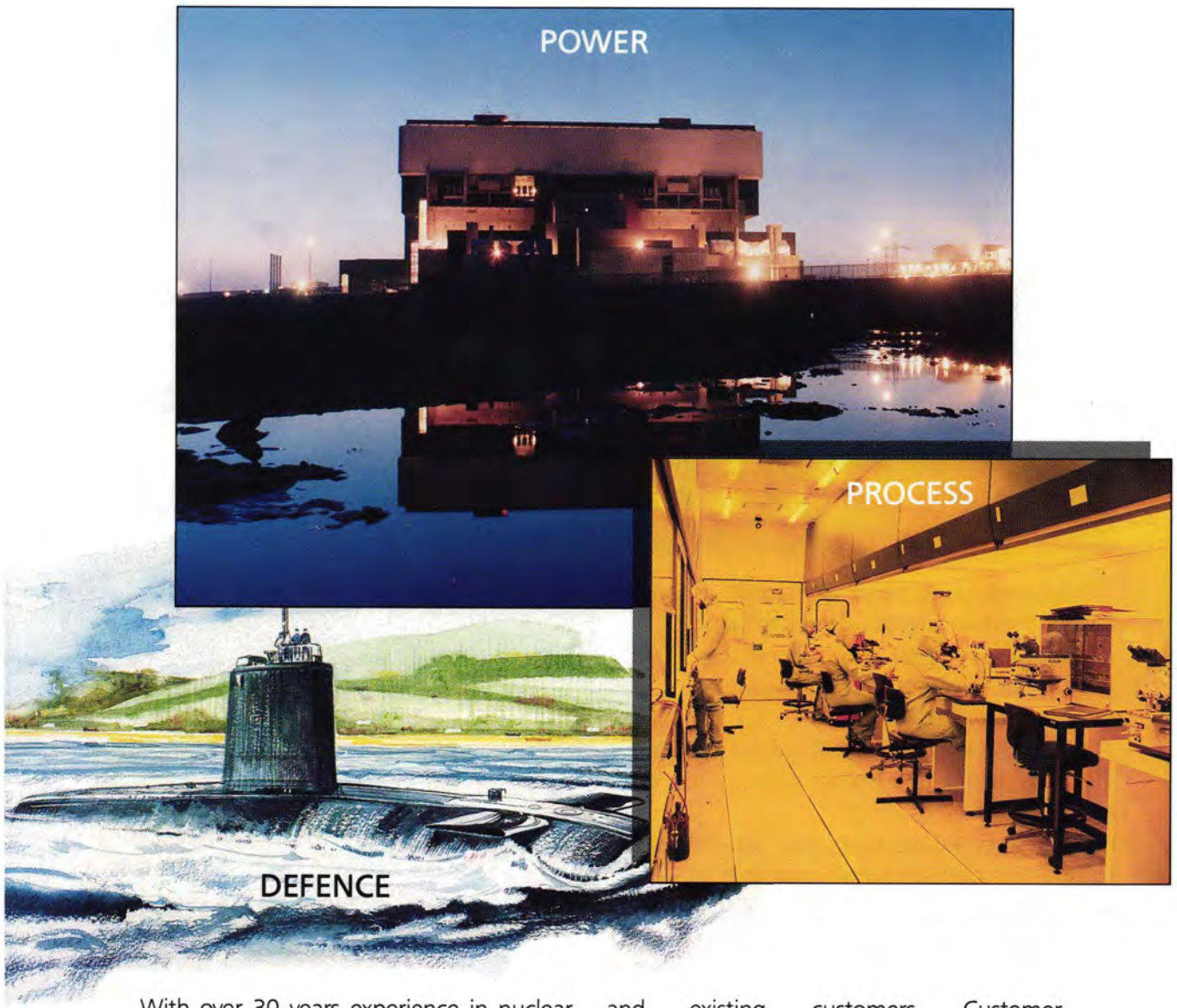
For further details please contact Judith Higgins or Jill Leigh on 071-580 0008.

24 June	**ENERGY INVESTMENT: LIMITING THE RISK** **Venue:** CBI Conference Centre, London WC1 **Chairman:** Mr D M Willis (Institute of Energy)
9 October	**ENERGY FROM WASTE — Green, Clean & Profitable** **Venue:** CBI Conference Centre, London WC1 **Chairman:** Mr B Lees (Institute of Energy)
12 November	**2nd Conference on ENERGY STATISTICS** **Venue:** The Royal Society, London SW1 **Chairman:** Dr A W Cox
9-11 December	**5th International Fluidised Bed Combustion Conference** **FBC TECHNOLOGY & THE ENVIRONMENTAL CHALLENGE** **Venue:** The Mount Royal Hotel, London W1 **Chairman:** Mr J S Harrison (British Coal)

Conferences co-sponsored by The Institute of Energy

4-6 June	**25th UNICHAL Congress, Budapest, Hungary** **Contact:** MCI Travel/UNICHAL Congress (Switzerland) +41 1252 50 30
5 June	**Developments in Self-Tuning Control** **Contact:** The Institute of Measurement and Control on 071-387 4949
18 June	**Practical Solar Energy — New Opportunities in Europe** **Contact:** The Solar Energy Society on 071-333 4314
2-4 July	**3rd International Congress on Condition Monitoring and Diagnostic Engineering Management** **Contact:** Dr Raj BKN Rao on 0703 229381
15-18 July	**5th International Conference on Liquid Atomisation and Spray Systems** **Contact:** Dr W Balachandran on 0483 571281

Engineering & Project Management



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Bradwell
Bradwell-on-Sea, Southminster, Essex CM0 7HP Tel: Maldon (0621) 76331

Dungeness Power Stations Visitor Centre
Romney Marsh, Kent TN29 9PP Tel: Lydd (0679) 21815/20461

Hartlepool Power Station and Visitor Centre
Tees Road, Hartlepool, Cleveland TS25 2BZ Tel: Hartlepool (0429) 869201

Heysham Power Stations Visitor Centre
PO Box 17, Morecambe, Lancashire LA3 2YB Tel: Heysham (0524) 55624

Hinkley Point 'A' & Hinkley Point 'B'
Nr. Bridgwater, Somerset TA5 1UD Tel: Bridgwater (0278) 652461
Visitor Centre Tel: Bridgwater (0278) 653492

Oldbury-on-Severn
Oldbury Naite, Thornbury, Bristol BS12 1RQ Tel: Thornbury (0454) 416631

Sizewell 'A'
Leiston, Suffolk IP16 4UE Tel: Leiston (0728) 830444
Visitor Centre Tel: Leiston (0728) 642139

Trawsfynydd
Blaenau Ffestiniog, Gwynedd LL41 4DT Tel: Trawsfynydd (076687) 331

Wylfa Power Station Visitor Centre
Cemaes Bay, Anglesey, Gwynedd LL67 0DH Tel: Cemaes Bay (0407) 710471

We are unable to accommodate very young children.

Nuclear Electric

ENERGY FOR THE 21ST CENTURY

Practical Solar Energy - New Business Opportunities

From detergents to foods, from cars to buildings - many items are now marketed as environmentally benign "green products".

Now there is a fresh public awareness and market pull for solar energy products and services.

Solar energy products and services are many and various. They range from the design of passive solar buildings and the installation of wind energy turbines to the export of solar water heaters. Such activities form the basis for viable businesses in the U.K. now.

The developing policy implications of measures to reduce global climate change have led to a resurgence of commercial interest in solar energy products and services. This timely conference will focus on the business opportunities provided in the U.K., West and East Europe, and in the developing world. Insights will be given of how best to realise these opportunities.

Who should attend:

- Potential solar energy entrepreneurs
- Solar energy product manufacturers
- Venture capital investors.

The Conference

The day will commence with an overview of the issues and implications of the "Greening of Business".

This will be followed by a assessment of the available technologies. Perspectives will then be provided by financiers on pertinent aspects of venture capital and loans for projects.

The afternoon speakers will include experts on trends internationally in the markets for solar energy products and services.

The meeting will conclude with the views and experiences of successful solar entrepreneurs.

The conference will commence at 09.30 hrs and conclude at 17.30 hrs.

Conference Fees

Registration fees include attendance at the meeting, a copy of the proceedings, coffee, tea and lunch and VAT. A list of hotels will be supplied upon request.

SOLAR ENERGY society and Institute of Energy members	**£70.00**
Non-members	**£90.00**
Students (* see overleaf)	**£55.00**

Places for this conference are limited. Register now to avoid disappointment.

The SOLAR ENERGY society Membership Benefits and Subscription Fees

The SOLAR ENERGY society, which was established in 1972, has close links with other renewable energy organisations and government bodies, and is thus able to promote solar energy in all its aspects. It has remained independent and self-financing. The Society has organised over 50 national and international conferences on selected specialist topics as well as the widely acclaimed 1981 "Solar World Forum". It has also published technical books on solar energy and provides information through its newsletter and other documentation to its members, decision-makers and the general public.

New members with an interest in solar energy are welcomed.

All members are eligible for
- Reduced fees to I.S.E.S. and S.E.S. Conferences
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All members receive the Members Handbook and "SOLAR NEWS" which appears in February, June and October.

(Note: Overseas members please add £6 and E.E.C. members £4 to all categories)

1.	**National**	**£15.00**	**(retired)**	**£10.00**
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International members also receive ISES journal "SOLAR ENERGY" (monthly - technical), ISES magazine "SUN WORLD" (quarterly - popular articles), ISES newsletter "ISES NEWS" (quarterly news and views).

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The Institute of Energy

Interested in applying for membership of the Institute of Energy?
Please send for further details and an application form to:

Membership Department
The Institute of Energy
18 Devonshire Street
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Registration Form

Apply to: The Administrator, the SOLAR ENERGY society, King's College London, Campden Hill Road, LONDON W8 7AH. Tel: 071-333 4314, Facsimile: 071-333 7783
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