ENERGY WORLD

Bulletin of the Institute of Energy

MONERGY '86
1986 ENERGY EFFICIENCY YEAR

January 1986 Number 132

The Institute of Energy

Presidential officers and honorary officers 1986/87

The undermentioned have been elected by council to take office following the annual general meeting on 27 May 1986:

PROF J SWITHENBANK to become president

DR E G MASDIN to become president-elect

C E PUGH to become a vice-president

PROF A WILLIAMS — honorary secretary

DR W A SIMMONDS — honorary treasurer

Election of council 1986-87

Following the AGM, the undermentioned will retire:

DR N J D LUCAS

The undermentioned will retire but are eligible for re-election:

C R COLEMAN

B LUBERT

W TIPLER

The undermentioned have been nominated by council:

C R COLEMAN

B G GILLS

THE REVD DR J H HARKER

C R E HILLYER

B LUBERT

W TIPLER

Nominations have been made but any 10 corporate members may nominate in writing any duly qualified person to serve on council. Such nominations, together with the written consent of the nominee to serve, should reach the secretary of the Institute not later than eight weeks before the AGM, but preferably earlier. (Members are not, however, permitted to join in the nomination of more than three persons in any one year).

nstitute of Energy
uture conferences

ranch: 1986

erseyside

/19 Mar (T/W). Two-day seminar: *Fuel nds: economics and utilization.* verpool Polytechnic.

orkshire

Apr (W). One-day symposium: *mbined heat and power.* University of effield. Joint symposium with hemE. *See loose insertion (UK copies).*

986 February meetings

ottish

eb (Tu). Review of renewable energy, Dr J Twidell (University of athclyde). Royal Scottish Automobile ub, Blythswood Square, Glasgow at 30 h (tea/coffee and sandwiches at 00 h).

uth Wales and West of England

Feb (W). Half-day meeting: *Unusual oblems and applications in combustion.* iversity College, Cardiff from 1330 to 00 h. Joint meeting with IChemE (S ales section).

idlands

Feb (Th). New concepts in gas-fired ra-red process heating, by D E Smith tordy Combustion Engineering). iversity of Aston in Birmingham at 00 h.

ast Midlands

Feb (Tu). The prospects for renewable ergy sources in the UK, by Dr R H ylor (CEGB). Broadmarsh Centre, ottingham at 1900 h (tea and biscuits om 1830 h).

orth Western

Feb (W). Energy Efficiency Year and e building services engineer, by Robin ardner (Energy Efficiency Office, NW egion). School of Architecture, iversity of Manchester at 1800 for 1830 Joint meeting with NW Branch, IBSE.

ENERGY WORLD

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Contents: January 1986

South Coast

12 Feb (W). Electricity tariffs, by M Severs (Southern Electricity). Electroheating, by a speaker from Southern Electricity. Room A2/1, Anglesea Road Building, Portsmouth Polytechnic at 1400 h. *Solent Energy Managers' group meeting to which South Coast branch members are cordially invited.*

South Coast

13 Feb (Th). The second generation reciprocating engine, by J P Pirault (Ford Motor Company). Lecture Theatre AB011, Architecture/Biology Block, Portsmouth Polytechnic, St. Michael's Road, Portsmouth at 1900 h.

South Coast

17 Feb (M). Open meeting, Engineering Council Regional Organization (Southern Branch): *What happened at Regional Assembly.* Building 34, Lecture Theatre, Education Department, University of Southampton at 18.45 h.

North-Eastern

18 Feb (Tu). Problems encountered in North Sea operations, by A Gerrity (platform manager, Shell Exploration and Production, Aberdeen). Lecture Theatre, British Gas Corporation's Engineering Research Station, Killingworth at 1700 h (tea and biscuits before meeting). Joint with IGasE.

Scottish

18 Feb (Tu). Water treatment for shell boilers. Legionnaires disease, cooling and a/c plants. By D H Kelly (Houseman (UK)). Royal Scottish Automobile Club at **1600 h.** Joint meeting with CIBSE.

North-Western

19 Feb (W). Annual dinner. Manor Hey Hotel, Urmston, Manchester.

Yorkshire

19 Feb (W). Fuel requirement for the smaller modern coal-fired boiler, by M Pittwood (senior fuel technologist, Marketing Dept, NCB, Yorks). AHED House, Ossett at 1430 h.

Loose insertions this issue: (1) Annual Luncheon ticket application; (2) CHP — one-day symposium; (3) CICC conference, Nottingham; (4) E Midlands meeting

Wind energy conversion

Proceedings of the 1985 Seventh British Wind Energy Association Conference
Edited by A D Garrad
Mechanical Engineering, London
314pp. £41.00 UK £51.00 Overseas

The subject material covered by the 40 papers is comprehensive and by and large the papers have been well selected. Nineteen papers describe some of the latest theoretical and experimental developments of wind turbines with emphasis being on British work. Some of the papers however, are update reports on current work programmes and should be read with reference to previous conference proceedings.

Wider aspects of wind energy are addressed by six papers covering meteorology, climatology, material and electrical aspects and six papers covering applications and wind energy conversion system operation.

The technical content of the book is balanced by nine papers on the national wind energy programmes of the UK (2), Sweden, Canada, Belgium, Algeria, Romania, Denmark and the USA. These are informative and provide a useful amount of background material, and are not without an injection here and there of national and commercial point-scoring.

Whilst in themselves informative, the understandably limited selection of overseas papers may give a reader unfamiliar with wind energy R and D, the wrong impression that it is an accurate reflection of overseas work. The wind energy programmes in, for example, Ireland, Australia, New Zealand, India, China, are not covered. It is not clear why, apart from the UK review, these particular overseas papers were selected.

For anyone who is active or maintains close interest in wind energy R and D in the UK, the book is virtually obligatory and will undoubtedly be obtained by them, even if only to maintain the set. The book is not intended to be a textbook on wind energy but nevertheless, it would be a valuable first purchase to anyone active in engineering R and D who wishes to explore the subject areas. The delegates list is a veritable who's who in w[illegible] energy and the references quoted in [illegible] papers contain many of the classic bo[illegible] and papers on wind energy. The rea[illegible] therefore has no difficulty in identify[illegible] further important publications.

Since the book is the seventh volume [illegible] a continuing set it is not a stand alo[illegible] text. Therefore, although it is not us[illegible] policy for BWEA proceedings, [illegible] reviewer would have liked to have see[illegible] preface written by the editors giving so[illegible] introduction and putting it into cont[illegible] with previous conferences.

The book adopts the usual procedu[illegible] of reproducing the author's typescripts [illegible] their original forms. This has l[illegible] inevitably to a number of typographi[illegible] errors. These however are not distracti[illegible] although reference to the 'Organzir[illegible] Committee and the British Wind 'Enge[illegible] Association, and the fact that the title [illegible] one paper bears no resemblance to th[illegible] given in the index are irritating in a bo[illegible] of this class.

Dr Robert Johnson

Economic potential of coal-water mixtures

J R Siemon
IEA Coal Research
100pp. £100 (non-member countries)
£50 (member countries)

Since the oil crisis, started by the Yom Kippur war, there has been increased interest in finding economic alternatives to oil as an energy source. One alternative that is frequently discussed is the addition of finely ground coal to water, known as coal-water mixture (CWM) as replacement for heavy or residual fuel oil.

This publication which is part of an excellent series produced by the International Energy Agency gives a good discussion both on the technological and economics of CWM. A credit worthy feature is the detailed cost analysis that is given broken down into capital, working capital and operating costs. The focus of the report is on the economic issues relevant to the emergence of this new liquid fuel. The discussion ranges from full-scale plants, potential markets, equipment required to burn CWM efficiently and the conversion costs of existing facilities.

There is a review of the use of CWM in boilers, diesel engines, in the iron and steel industry, as well as other applications such as rotary kilns. The economics of CWM use is particularly highlighted in industrial boilers as well as in electric power generation. Also, there are market case studies in selected countries including the United Kingdom and the United States.

The report is clearly illustrated and is precisely written. It includes an excellent bibliography as well as very interesting appendices to support the document on such topics as emission standards in IEA/OECD countries, exchange rates and consumer price indices, and a process description for a CWM preparation plant.

There is much to interest both technological economists and fuel and energy technologists within this report on an area of considerable potential both as a replacement for oil and a means of making coal a more transportable commodity.

Dr Alan Stainer

Resource recovery project studies

Brown, Vence & Associates
Ann Arbor Science, USA, 1983
165pp. £30.00

This report was commissioned by the California Waste Management Board who have been actively supporting the development of domestic waste utilization projects within the state. The Board commissioned studies of four operating 'waste to energy' projects in the states of Maine, Wisconsin, Massachusetts and Ohio.

A range of issues are considered in each case study — project financing and risk assessment, the control of air pollution, the management of ash residues, and local community acceptability of ash residues, and local community acceptability. Solutions to these problems are necessary if the technology is to be adapted to the needs of California and other states that are apparently facing a 'garbage crisis'.

In several crucial areas this book is seriously flawed. Because it was produced for the United States market it only contains non-SI units. The case studies, while interesting, are only of limited val[illegible] to readers in the UK and Europe.

I would have enjoyed a long[illegible] introduction (certainly more than tv[illegible] pages), some general conclusions and [illegible] bibliography. An index could also ha[illegible] been included. These missing elemen[illegible] would have helped to weld together t[illegible] four case studies into a really cohere[illegible] and useful text.

The book could be of academic inter[illegible] to those readers who are investigating t[illegible] United States regulatory system. As w[illegible] as federal legislation, the four projec[illegible] also had to accommodate state and loc[illegible] environmental regulations on pollutic[illegible] control and site planning.

The subject of refuse derived fuel h[illegible] attracted considerable interest in the la[illegible] couple of years. Several recent seminar[illegible] conferences and books have reflected t[illegible] growing importance of this source [illegible] materials and energy

In conclusion I think that it would b[illegible] wise for those wishing to discover mo[illegible] about this topic to avoid this book and [illegible] contact ETSU or other speciali[illegible] companies who have produced more u[illegible] to date literature which is relevant to th[illegible] UK.

Andrew W Cox

The economics of coal fo[illegible] steam raising in industry

Robert S Holcomb and Mike Prior
IEA Coal Research, London, April 19[illegible]
99pp. £50.00.

This publication examines the status [illegible] coal utilization for industrial boilers a[illegible] the economic prospects for an increas[illegible] use of coal to displace oil/gas fired stea[illegible] pacity in several IEA countries. It takes o account the environmental restraints hich exist and the technical options hich are available.

In addition there is a status review of veral 'advanced' coal-based chnologies, which are recently available options for fuelling industrial boilers. ie report comments on their likely tractiveness.

Five countries were chosen for study: enmark, the Federal Republic of ermany, the Netherlands, United ingdom and the United States. These untries offer contrasting situations for ample, in size of plant, fuel pricing and vironmental standards — which ustrate why prospects for increasing al use depend on circumstances within country.

The chapter on the United Kingdom ntains a detailed examination of the onomics of the conversion of oil and s-fired boilers to coal-firing. The main ctors that influence such conversions — iler plant capital costs, fuel costs, erating labour costs and annual labour ctors are shown for four typical boiler ants (sizes ranging from 5 to 60 MW).

One of the principal conclusions of the port is that at current prices of oil, gas d coal, coal firing in industrial boilers usually economic in those sectors of dustry which have high lead factors. is applies both to retrofit conversion of isting oil burners, where this is possible, d to new replacement coal-fired boilers. 15% movement of fuel prices in favour coal was also thought likely to make nversion attractive in a much greater rt of industry.

This valuable study compliments the rlier reports produced by Cheshire and obson at the Science Policy Research nit, Sussex University.

I recommend that anyone who is volved in the field of coal utilization d is interested in converting to coal specially the industrial sectors) should ad this report.

ndrew W Cox

Tomorrow's world — nergy

lalcolm Brinkworth
ritish Broadcasting Corporation, 1985
28 pp. £5.95

omorrow's World is a television series hich has been running for 20 years and one of the few programmes which ublicises technical subjects in a way that akes them interesting or even in some ases exciting to the television viewer.

This book on energy has the style of a poken commentary from a television resentation. It is not clear whether the aterial was in fact a televison series lthough I cannot recall one. The book an therefore be generally welcomed as it nakes energy topics both readable and nteresting.

The scheme of the book is to present ome material about the main current ource of energy in the world — fossil fuels, dwelling particularly on their problems, exhaustion of supplies in the not too distant future and pollution from the oxides of nitrogen, sulphur and carbon. There is a short section on the difficulties of effluent cleaning. The first alternative, nuclear is described but here the breeder reactor is associated with a 'plutonium economy', by implication undesirable and a chapter entitled 'A radioactive future?' gives basically a media view of the effluents from nuclear power.

So, both of the main sources of power have their problems which can make their long term use unacceptable. The rest of the book covers the alternatives: solar, in the chapter 'A ray of sunshine'; biomass, 'Power from plants'; wind power, 'Blowing in the wind'; geothermal energy, 'Power from the sea'.

Dealing with so many topics in a short book with many illustrations cannot produce a comprehensive analysis of the relative merits or roles of so many alternatives and one would not expect this in a book aimed at the general reader or viewer. However, as well as the main advantages, the fundamental and mechanical problems of each development are presented. Many schemes which are not widely publicised in Britain are mentioned such as the solar air collector which drives the turbine at the base of a high chimney with the air heated by the sun, solar powered satellites beaming energy to earth receiver stations, a tropical island scheme where the larger ocean waves top up a lagoon which drives a turbine as the water flows back to the ocean, and the tidal current devices which could use the high velocities as the tide surges through narrow channels.

The energy engineer would therefore find the book useful as a reasonably fair summary and listing of most of the important current renewable energy work and thinking. To such a reader, the reviews of fossil and nuclear energy which take up about half of the book may be less useful.

There are several editing and printing errors which are probably inevitable in a book of this type. Most will be evident to engineering readers. Perhaps the most worrying is on the title page where a picture showing mainly harmless water vapour from power station cooling towers is entitled 'The environmental cost of fossil fuels'. The section on acid rain cannot be regarded as technically balanced. The situation is complicated and conclusions not as clear as those given here. Spent nuclear fuel is not 'one of the most dangerous substances known to man' particularly when handled in a responsible way.

With these reservations, which I suppose are always to be expected in 'popular' presentations of these subjects and even here the balance is better than in most television and newspaper material, the book is to be welcomed. It would be particularly good for school libraries and students who should be encouraged to read it, not for its technical excellence but to make energy engineering appear what it is for many of us, as a fascinating field with a wide range of alternatives each one with its characteristics, advantages and disadvantages.

N G Worley

Natural gas trade in North America and Asia

Jonathan P Stern
Joint Energy Programme — Energy paper No 15
Gower Publishing Company, 1985
272 pp. £21.95

This is the second part of a two-volume study of the international gas trade which concentrates on the policies of countries which currently import and export natural gas and those which may do so in the future.

The first volume was concerned with the trade in Western Europe. This volume considers the trade in North America and Asia, plus the policies of the various countries.

While the text deals with the development of domestic gas markets and industries in exporting and importing countries, it also manages to illuminate the options and motivations behind the international trade of this fuel.

The study is not primarily model-orientated. The authors have provided the context in which the economic, commercial, political and strategic factors involved in the trade can be understood, from the perspective of both the exporter and importer.

North America and Asia are covered in the same volume, but they are examined in two separate parts. While there are strong trade links between the two continents the reader will notice that the differences between the North American and the Japanese markets emerge more strongly than the similarities.

The study concentrates on the natural gas trading policies of the two continents and deals only briefly with the demand situations in each market. To overcome this deficiency there are numerous references to earlier studies.

There is also an emphasis on the political aspects of the trade, setting these against the better known commercial elements. It becomes apparent that while the business environment is constantly changing, certain political realities recur again and again.

Given the wealth of literature in the field of energy, it is surprising how little has been written about natural gas, and especially about the international trade in gas. The trade in natural gas was relatively small until the 1980s, when major projects, such as the Soviet gas pipeline and the expansion of the trade between the United States and Canada and Mexico, forced analysts and governments to examine the subject in greater depth.

This study is a useful contribution to the literature on the international trade in

natural gas. Anyone interested in regional foreign trade and foreign policy issues should find it useful.
Andrew W Cox

The cost and availability of Colombian Coal

Eric D Jamieson with Kathleen Jamieson
IEA Coal Research, London, March 1985
75pp. £50.00

This study of Colombian coal prospects, which was commissioned by IEA Coal Research, overviews the potential impact of Colombian coal exports on the world thermal coal trade over the next 15 years.

The report examines the physical, technical, economic, political and financial constraints and other imperatives that are shaping the emerging modern coal industry in Colombia. The reasons for the relatively sudden and large scale entry of Colombian thermal coal exports into the world market are assessed and their commercial prospects evaluated.

The important contributions of foreign developers, and foreign investment in new developers, are analysed in relation to the Colombian balance of payments record and creditworthiness with international lending institutions.

The conclusions are drawn on projected production of coal for internal use in Colombia and on projected levels of commercially viable thermal coal production that will be able to enter the world market of competitive prices.

The principal conclusions from the study are that up to 35Mt/y of Colombian thermal coal could be marketed at prices close to current world levels. However, because of present depressed world demand and apparent hesitation by international financial institutions to advance capital for projects beyond the two now under development at El Cerrejon, the amount of Colombian coal entering the world market is unlikely to exceed 16Mt/y until the 1990s.

The authors of this report have apparently conducted a lengthy investigation in Colombia of the large volume of related literature, most of which was in Spanish.

They have produced an extremely well structured report packed full of diagrams, tables and a selection of colour illustrations. It should be essential reading for anyone interested in the international coal trade and the development of a major mining project.

This is the first of a series of reports being prepared by IEA Coal Research analysing the availability and cost of coal in all the world's significant coal exporting countries. The aim of these reports is to produce a comprehensive view of factors which will determine quantities, qualities and prices of coal in international trade over the next twenty years. Future reports will shortly be published on the United States, Canada, South Africa, Australia, the communist countries and also minor coal exporters. I hope they prove to be of the same high standard as this report on Colombia.
Andrew W Cox

A 1983 view of non-conventional energy sources

Editors: G Furlan, N A Mancini and A A M Sayigh
World Scientific Publishing Company, USA, 1985
826 pp. £68.80

This large volume contains the papers presented at the 1983 international conference and workshop on the *Physics of non-conventional energy sources* which were held at the International Centre for Theoretical Physics, Trieste.

A large number of topics are covered by the 30 papers which are divided into seven sections. Useful utilization (thermal, electrical, chemical, economics, planning and storage areas) plus wi energy, biomass conversion ai hydrogen energy.

An examination of the list participants showed that the conferen contained representatives from ma developed and developing countries.

The UK was well represented wi interesting papers from Richard Ed *(Energy planning with special reference developing countries),* David Ha *(Photobiological production of fuels ai chemicals)* and Geoff Watson *(Small wi systems for remote locations,* and *Wi energy conversion systems — horizon and vertical axis machines).*

The papers from the conference ai workshops allow the reader to make a assessment of the development status several technologies, however, I do n feel they will appeal to the specialis Many of the papers are little more tha introductions to the various topics, wi some authors appearing to hav revamped earlier standard papers.

It must be said, however, that many the papers are of a practical nature ar contain a large number of references fo anyone wishing to carry out furth reading and research.

This volume should provide a excellent starting point for students wh are seeking reliable reading material c these 'non-conventional energy sources It should prove a useful addition to th libraries of universities and colleges c further education.
Andrew W Cox

Publications received an noted

CIBSE
The calculation of glare indices (technic memorandum no 10)
Department of Energy
Digest of United Kingdom energ statistics 1985
Filtration Society
Filtration dictionary and glossary

he management and disposal of radioactive vaste*

. E Ginniff† and I M Blair PhD**

Introduction

sposing of society's waste has never been a popular or morous activity. It is one of those things that, although realize it is necessary, we would rather not know about and we would rather someone else did it. In local vernment circles there is no shortage of council airmen wishing to have their names associated with a w school, an elegant public park or a library building. hen it comes to a similar association, however, with a ich-needed drainage system or waste disposal site, lunteers seem to be rather thin on the ground.

Nevertheless, modern industrial society produces large antities of wastes, some of it very toxic, some less so, t all of it, if not disposed of satisfactorily, capable of oducing an adverse environmental impact.

The nuclear generation of electricity and the use of dioactivity and radiation techniques for a wide variety medical and industrial applications inevitably leads to e production of various categories of radioactive wastes, ich must be managed and ultimately disposed of in a sponsible manner. The purpose of this paper is to scribe the various categories of radioactive wastes, how ey arise and what are the current practices and future oposals for its management and disposal.

Radioactivity and radiation: How can they harm ?

dioactive material emits radiation, and radiation can use harm to man and other living things. It is essential erefore to appreciate the nature and extent of this tential risk in order to understand the techniques used d proposed for the handling of radioactive waste.

Certain atoms are inherently unstable, and transform emselves into a more stable form by emitting a small cket of energy. The process of transformation is called dioactivity, and the stream of packets of energy is ferred to collectively as radiation. The emitted energy ssipates itself in the material surrounding the radioactive bstance. If this material is living tissue, the energy ssipation can lead to cell damage. This is not necessarily rious as living organisms have, over their evolutionary story, developed a mechanism for repairing and placing cells that have become damaged or killed by a riety of agents, of which radiation is only one.

If, however, the organism is subjected to a very large se of radiation, the amount of damage can overwhelm e repair mechanisms and the organism will die. At lower ses it becomes ill, but eventually recovers. At yet lower ses there are no immediately observable effects; the pair mechanism takes care of the cell damage without e organism ever being aware of it. Long term effects ight occur however, as the repair mechanism is not perfect, and cancers may develop at the site of any imperfections in later years. At lower doses still even these long term effects are of no significance. This does not prove that there is no effect at these lower levels; merely that if there are any effects they are completely swamped by the many other causes that can give rise to these diseases.

The relationship between radiation dose to the human body and consequential biological harm has been extensively studied; there have been more than 80 000 relevant papers in the published literature over the past 70 years or so. In fact it must be the most thoroughly researched and best understood of all the environmental hazards, both natural and man-made, to which man is subject. In the regime of no significant long-term effects, for radiological protection purposes a linear extrapolation down from the region of observable effects is used, which in the professional opinion of the overwhelming majority of radiobiologists gives a generous over-estimate of the possible effect. It is in this regime of no significant long-term effects that radiation doses to workers in the nuclear industry occur, and this is confirmed by their excellent health record. Radiation doses to the public arising from the activities of the industry are of course much lower still.

One can gain confidence that this picture is essentially correct by a study of the effect of the natural radiation background. This arises from a variety of sources and Man has been subject to it throughout his evolutionary history. The doses received are in almost all cases greater than those anyone receives from man-made activities (indeed in the case of members of the public even the *variation* in this background dose in different parts of the world far exceed any man-made dose) and yet no adverse health effects resulting from these doses have ever been observed.

3. What is radioactive waste?

Radioactive waste falls conveniently into three categories depending on its specific activity. The most radioactive arises exclusively in the spent nuclear fuel from a reactor and is, in effect, the 'ash' from the energy-producing process itself. It comprises the fragments resulting from the break-up of the fissile uranium isotope, (^{235}U), together with transuranic elements formed by the successive neutron capture in the other uranium isotope (^{238}U), known respectively as fission products and actinides. This is the high-level waste (HLW). It is intensely radioactive; so much so that it generates heat and, when in storage, has to be continuously cooled.

Since the start of the nuclear programme in the late 1940s about 1000 m^3 of HLW had accumulated and this is presently stored in liquid form in water-cooled tanks at Windscale in Cumbria, and a further 1000 m^3 is expected to be produced by 2000 AD. A plant is under construction at Windscale to solidify this waste which will then continue to be stored in solid form in concrete vaults cooled by natural convection of air for a further period of at least 50 years. By that time the heat emission will

aper originally presented at the 92nd Environmental Health nference, Bournemouth, Sept 1985, organized by the Institution Environmental Health Officers, by whose kind permission the per is published here
lead, Nuclear Industry Radioactive Waste Executive (NIREX)
NIREX Scientific Adviser on Public Affairs

have fallen to a negligible level, and ultimate disposal in a deep repository will be less difficult.

Intermediate-level waste (ILW) arises principally from the intense bombardment by neutrons in the core of a reactor of originally non-active material close to the fuel; such items are the cans containing the fuel and their supporting structures. About 40 000 m^3 of ILW have arisen to date and a further 40 000 m^3 are to be expected by 2000 AD. It is presently stored in silos at the establishments where it is produced. Roughly speaking its specific activity is about a thousand times less than that of HLW, and hence it does not generate any significant amount of heat.

Low-level waste (LLW) is the heterogeneous rubbish that arises from any workshop or laboratory in which radioactive material is handled. It composes such things as overalls, rubber gloves, tissues etc, which are — or could have been — slightly contaminated with radioactivity by contact with such materials. Traditionally LLW has been disposed of as it arises on a year-by-year basis either at a shallow landfill site at Drigg in Cumbria, or until 1982 at sea at a site over a deep abyssal plain in the NE Atlantic. About 250 000 m^3 of LLW has been produced and disposed of to date, and a similar quantity is expected to be produced by 2000 AD. Its specific activity is typically about a thousand times less than ILW and generally speaking this means that no special precautions are needed when handling it.

For completeness one should mention a fourth category of radioactive waste whose specific activity is even lower than that of LLW. If in liquid or gaseous form this is diluted and discharged to the environment; and if solid disposed of on regular domestic disposal tips; both activities requiring authorization from the Department of the Environment.

So, compared to the quantities involved in the disposal of industrial and domestic waste, those of radioactive waste are relatively modest. There is a further advantage in that radioactivity decays away with time at an entirely predictable rate whereas some toxic wastes from industry retain their hazard at a constant level in perpetuity.

4. NIREX and its role

We have seen that because of its heat emission there are sound technical reasons for continuing to store HLW. There are no such reasons for continuing to store ILW, and because of the quantities accumulated so far and those to be expected over the next few decades it seems that the time is now right to start making definite plans for its ultimate disposal.

As most of this waste arises from the nuclear generation of electricity it is entirely appropriate that those organizations comprising this sector of industry should take the lead in disposing of it. This is in accord with the 'polluter pays' principle, and it is also the case that they employ the staff with the appropriate expertise to do the job properly.

Consequently, the Nuclear Industry Radioactive Waste Executive (NIREX) was set up in 1982 as a partnership between the Central Electricity Generating Board (CEGB), the United Kingdom Atomic Energy Authority (UKAEA), British Nuclear Fuels (BNFL) and the South of Scotland Electricity Board (SSEB). Each of the partners provides staff for the Executive and shares its funding on an agreed basis. NIREX is located in accommodation close to the Atomic Energy Research Establishment at Harwell.

NIREX has the task of making proposals for the packaging, transportation and disposal of ILW. and. if approved by the Department of the Environment, manage their implementation. NIREX has taken o responsibility for some aspects of the LLW dispo programme. It also maintains an up-to-date inventory radioactive waste arisings in this country and h embarked upon a programme to keep the pub informed, both directly and through their elect representatives as to what it is doing and proposing shou be done. NIREX will also assume responsibility on contract basis, for the disposal of the smaller quantit of LLW and ILW produced by organizations other th the partners.

5. The NIREX proposals

Adequate packaging of radioactive waste prior to dispo is the first prerequisite. NIREX proposes that ILW shou be immersed in a matrix of concrete. This enables it be cast into convenient sized blocks for handling a transportation, then fixes the waste in place and inhib the ingress of groundwater when placed in a reposito One important question is the longevity of concrete. W can all recount instances of concrete structures whi collapsed or have shown serious signs of deteriorati after only a few years. On the other hand specimens concrete are known to have survived from Greek a Roman times. It depends on the composition of t concrete and the quality control during its preparatic and with the present state of knowledge of the propert of materials the production of concrete capable surviving even in a hostile environment for periods w in excess of a thousand years presents no particul difficulties. For the packaging of LLW, compaction in steel drums, possibly with a concrete lining, is consider adequate.

Transportation of the packaged waste from the site which it arises to a repository has to meet the very str regulations covering the transport of all radioacti material laid down by the Department of Transpo These are designed to ensure that both the work involved and also members of the public receive no mc than negligible doses of radiation either under norm operation or even in the event of an accident. In ord to comply with the regulations NIREX has produc several designs of containers which are currently bei tested and evaluated. Transport will be predominantly rail, but in some cases by road. Given the quantities waste arising, and the packaging and containerizatio necessary to satisfy the regulations, we are planning terms of about two to three trains, or equivalently 30 40 lorries per week arriving at the repository.

The preferred local geology and detailed engineeri design of a repository depends on the category radioactive waste to be disposed of in it. For practic purposes ILW can be divided into two sub-categori depending upon the half-lives of the radioactive elemer they contain. Short-lived ILW is defined as th component containing material whose half-lives do n exceed 30 years or so. Long-lived ILW can conta material, though in some cases only in trace amounts, wi half-lives of thousands or even tens of thousands of yea As a convenient rule-of-thumb one can take a period ten times the half-life as the time taken for tl radioactivity in the waste to decay to negligible levels. Th for short-lived ILW the objective is to design a reposito which by incorporating engineering design and geologic features will contain the waste for more than 300 year Man-made structures are known to have survived for ve much longer than this, so one can have confidence th the objective is in principle achievable. However, or not realistically expect such a structure to last for the y much longer period of time needed for long-lived V to decay to negligible levels. Here one must in the g-term depend on the local geology either to contain waste indefinitely or more realistically to allow it to perse at such a low rate that no harm will arise.

\ good medium in which to construct a short-lived V repository is clay. The only credible mechanism ereby radioactive material can move out of a ository, apart from human intrusion, is through undwater movement. Clay is known to be virtually pervious to water flow, possesses an 'ion exchange' perty which enables it to extract dissolved material m such water that does pass through, and because of plasticity, is able to mould itself round buried material, s further preventing the ingress of water. We would pose to cut trenches into the clay to a depth of between e and 15 m, line them with concrete and emplace the kaged waste within them. When full, each trench will covered with rolled clay, capped with an anti-intrusion rier of reinforced concrete about one metre thick, on of which will be placed further clay and finally the will be landscaped. There will be no detectable liation above natural background on top of the npleted trench, and we will be required to demonstrate the regulatory authorities that any diffusion of lioactivity from the site is so low that the radiation doses uing will not subject even the most exposed individual his or in any future generation to a risk of greater than e in a million per year. We know of no domestic or lustrial waste disposal operation that is subject to such ngent safety requirements.

As a further repository will soon be required for LLW supplement the facility already existing at Drigg, and clay would again be suitable, it would make sense to ate this on the same site as that for the short-lived ILW. enches of only 6 m depth would be required, and studies in hand to see if concrete lining is necessary.

NIREX has identified the Elstow Storage Depot in dfordshire as a site worthy of further investigation as ossible location for a repository for short-lived ILW d LLW. The Government has asked us to name two three similar sites so that a comparison can be made, d has said that it will place a Special Development Order fore the House to enable us to carry out detailed ological and engineering studies on all of them. These dies should take a year or two, and would enable us come up with a practical design on the best site, which uld then be examined through a Public Inquiry, would quire a site licence from the Nuclear Installations pectorate, and finally would require approval from the cretary of State for the Environment.

We are presently searching for these extra sites, and hope to announce them later this year. Our selection procedure is designed to be as thorough and vigorous as possible.

Taking a map of the country we plot out the areas with suitable geology. From these we exclude areas of high population density and those of outstanding natural beauty, or special scientific interest. Then we take account of accessibility, as we wish to minimize the distance from the sources of the waste and to ensure that the repository is reasonably close to the existing rail or road system. We then search for available sites in the defined areas. We would prefer a site to be sufficiently large (the Elstow Storage Depot is about 450 acres) that it could take the nation's production of waste in these categories for at least 50 years.

For the disposal of long-lived ILW, a much deeper repository is required, preferably in excess of 100 metres, in a formation such as anhydrite which is known to have been dry and stable over geological periods of time. We had identified a potentially suitable site at Billingham in Cleveland, but this is no longer available. We plan to search for other sites, and we will also be investigating the possibility of disposing of this type of waste under the sea bed on the Continental Shelf, either by using established oil exploration technology, or by tunnelling out from the coastline.

The deep ocean disposal of LLW has been temporarily suspended while further international studies are done on its environmental acceptability. These studies should be completed later this year and if they prove satisfactory we hope that option can be re-opened, as we believe that for certain categories of LLW, for example tritium contaminated waste, this is the best environmental route for disposal.

6. Public acceptance

We are convinced that the design, construction and operation of a repository for the disposal of ILW and LLW is not technically difficult, and can be achieved comfortably within the limits of existing technology. However, because of the emotive reaction to all things radioactive, obtaining public acceptance to our proposals is proving to be a major obstacle. We have gone to considerable lengths to explain what we are proposing to do, for example we have held about 30 public meetings in the Elstow area and trust that in the long term a more thorough understanding of the position by members of the public will lead to a better appreciation and even acceptance of the strategy being proposed.

The sympathetic understanding of our task by those professionally responsible for environmental health would of course be of considerable assistance in achieving this.

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*Idris Jones memorial lecture**

Natural gas — current trends and future prospects

W R Probert†

The gas industry is 170 years old but the natural gas industry is in fact just coming of age. It is just 18 years, since, in 1967, natural gas was first landed from the West Sole field in the southern basin of the North Sea at Easington. It has just reached its majority, but the impact on the overall energy market has been very, very significant, (Fig 1). The figure shows the relative share of natural gas compared with other fuels.

It is not surprising that gas is dominant in the domestic market and that this has been progressively building up over the last 15 years. It is also not very surprising that we are a close second in the commercial market to oil — by commercial market I mean business, hospitals, schools, offices, etc. What is perhaps slightly surprising is that we are the largest supplier of energy on a heat supplied basis to the industrial market. The recession has dominated this particular market more than anything else over the last five or six years and there have been enormous downturns in the use of energy in industry, far outweighing any considerations of improved efficiency.

It so happens that as far as natural gas is concerned, by virtue of its particular applications, the downturn as a result of that recession has been less marked. We did suffer something in the order of a 12-15% reduction in gas sales to industry but the net result is, with this reduction of 15% in sales, our market share has actually increased because everybody else's sales have dropped by even greater proportions. We are now the largest supplier of energy to the industrial market. If one looks at the total, gas supplies 43% of the market and it would be naive to pretend that any single energy source providing 43%, compared with the next highest proportion of 21%, is going to be independent and free from interference or influence, whether political, social, economic or anything else. We have had to become used to this situation.

Fig 2 indicates how the situation has changed since natural gas first came on the scene in 1968. A dramatic increase has been achieved in the domestic sector largely as a result of the development of the growth of the central heating market in which gas dominates. Commercial sector — a steady growth but you can see a quite significant increase in the share in the industrial market. Town gas had the disadvantage of price and, to some extent, quality in terms of its ability to compete in the industrial market. We only really got cracking when natural gas came ashore. So what is the secret behind this success story? I think really there are three key areas.

Why is natural gas successful?

This lecture is not intended in any way as a sales pitch but clearly the inherent nature of the fuel, its controllability, its cleanliness, flexibility and so on clearly enables the method of heat application to be designed to the particular process. It also enables the maximum heat recovery from combustion with few problems, and so we have a produ[ct] which ought, to be at the top of the tree and there wou[ld] be something wrong with British Gas as an organizati[on] if it wasn't.

Fig 1 Heat supplied market shares % (1984)

	Gas	Oil	Solid fuel	Electricit[y]
Domestic	58	6	18	18
Industrial	35	28	22	15
Commercial	31	34	8	27
Total	43	21	18	18

Fig 2 UK gas market

	1968	1984
Domestic	19	58
Industrial	4	35
Commercial	11	31
Total	10	43

(a) Market share of heat supplied %

	Customers (thousands)	Million Therms
Domestic	15638	9128
Industrial	82	5753
Commercial	494	2400
Total	16214	17281

(b) Customer numbers and gas sales

Appliance Sales	1.2 M pa
Customer Service workload	14.4 M pa
New and relaid mains	3500 miles pa

(c) other activities

The second aspect is the sales organization devoted t[o] efficient use. This isn't new in the gas industry. With th[e] more expensive product of town gas we had to be highl[y] selective, in terms of its use, to get it into the market a[t] all. We therefore carried that on with natural gas and w[e] have always concentrated on increasing the utilizatio[n] efficiency of the product. The devoted sales organizatio[n] may strike one as being a little bit odd but what that reall[y] reflects is the fact that this is a single integrated industr[y] which is responsible for all aspects of the gas busines[s]. This is unique in the world because, for the most par[t] other countries have separate and independen[t] organizations, some supplying gas, some transmitting and distributing it, some retailing and others dealing wit[h] day to day safety matters. British Gas happened, throug[h] historic reasons, to be a totally integrated industry an[d] therefore, from the top right down to regional level, the[r]

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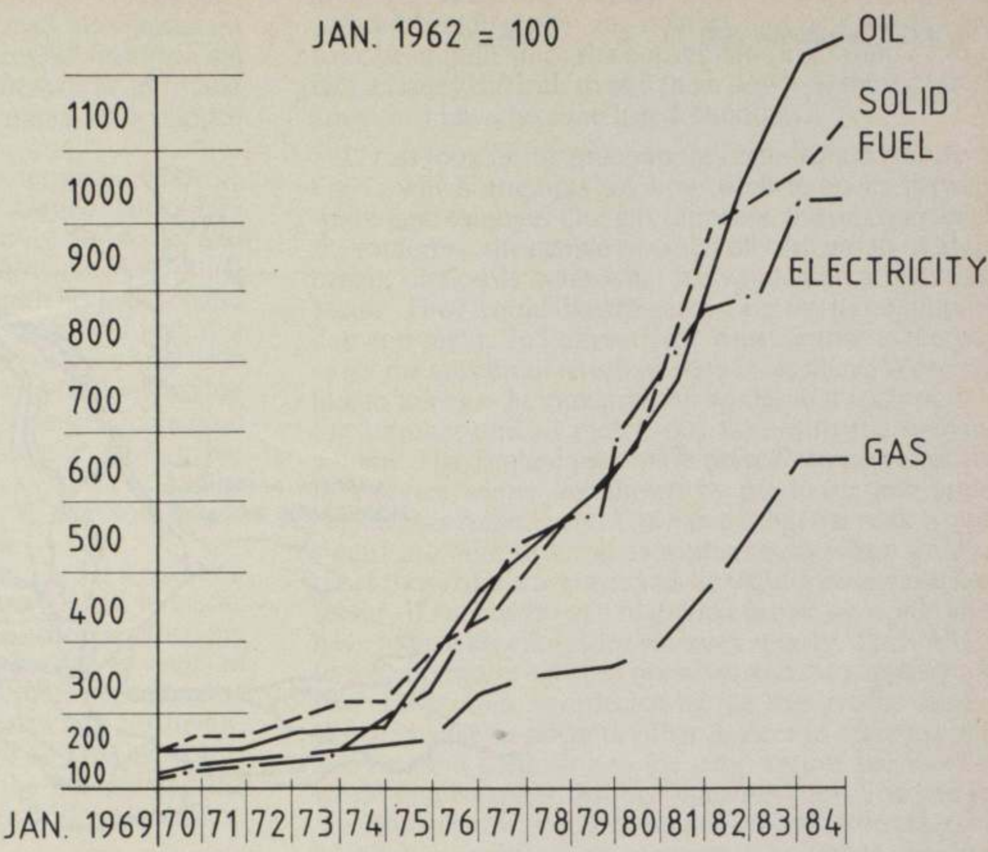
Fig 3 Retail price indices



a single dedicated interest in providing an efficient urce of energy to the final user. There are no ermediate points at which profit or any other nsideration is allowed to interfere with that major ocess. A devoted sales organization is therefore clearly ry important because it is single-minded of purpose.

The third aspect is price which of course, irrespective whether you get the first two right or not, is doubtedly extremely important. Fig 3 shows the relative ovements in average prices between the various fuels and es back to before the first oil price crisis in 1972/73. find this fascinating because it is quite clear what ppened as far as oil is concerned — there have been two ajor crises in 1973 and again in 1979, sparked off by e Iranian revolution. But why did solid fuel move almost actly in line? There are many theories but there is no vious reason why it should have done except that maybe ere were elements within the industry that thought there is headroom, market forces applied within that industry d that headroom was taken up. For whatever reason, lid fuel moved and could, I guess, do so again and with of course, it inevitably dragged electricity screaming o the same situation. It left gas, which was not in any y related to the other three — coal, oil or electricity. ere was no feedstock relationship. There was no causal ationship why gas should move in the same proportion all. What Fig 3 indicates, of course, is that gas fulfilled e promise made at the time ie that the decision was taken convert from town gas to natural gas, that gas would fact be cheaper or at least be held in price. In fact, if u take into account inflation over that period of time, s has remained at about the same price, in real terms, it was in the late 1960's, as compared with the general ergy economy in this country which is significantly gher in real terms. Fundamentally that is why gas has proved its market position over the years in all market ctors but I will come back to pricing a little later on.

Perhaps a little more perspective referring back to Fig 2. We are involved in supplying gas to 15.6 M domestic customers, that is about 75% of the households in the country and they take just over half the total throughput of gas. 53% of the total consumption is in the domestic market. In some respects that is the ultimate long term market because it is made up of 15 M individual decision makers, each of whom is 'locked-in' to decisions in terms of hardware purchases and even if some other energy source comes along and you can show that you can get some economic advantage over the next 15 years you are quite likely to continue with your hardware until you have had the use out of it. 16 M people think like that, so once you have got a dominating position in the domestic market you tend to stay there and it tends to be resilient to changes in relative price movements. For the long term ability of this industry to function with £9000 M investment in its transmission system it is vitally important that the domestic market is in fact held to gas over a long period and in the long term.

The industrial scale of course is completely different in terms of 82 000 users, but using 5.7 billion therms, and the commercial market, as you would expect, is somewhat lower in quantity but a larger number, nearly half a million, of customers in total.

The other activities which are very intensive in resources, human resources particularly, are appliance sales and servicing. We sell, directly, something in the order of just over 1 M appliances each year. We employ 30 000 service engineers nationally and we virtually carry out one job per customer per annum. The scale of the operation in terms of new mains and replacement mains, or replacement programmes, is 3500 miles each year. They are all in support of the gas business. We are only in appliance retailing in support of the gas business. We are only in customer service in terms of ensuring safety in utilization and to ensure that when people come to the end of the useful life of one particular piece of plant or equipment that they buy gas a second time. Safety in

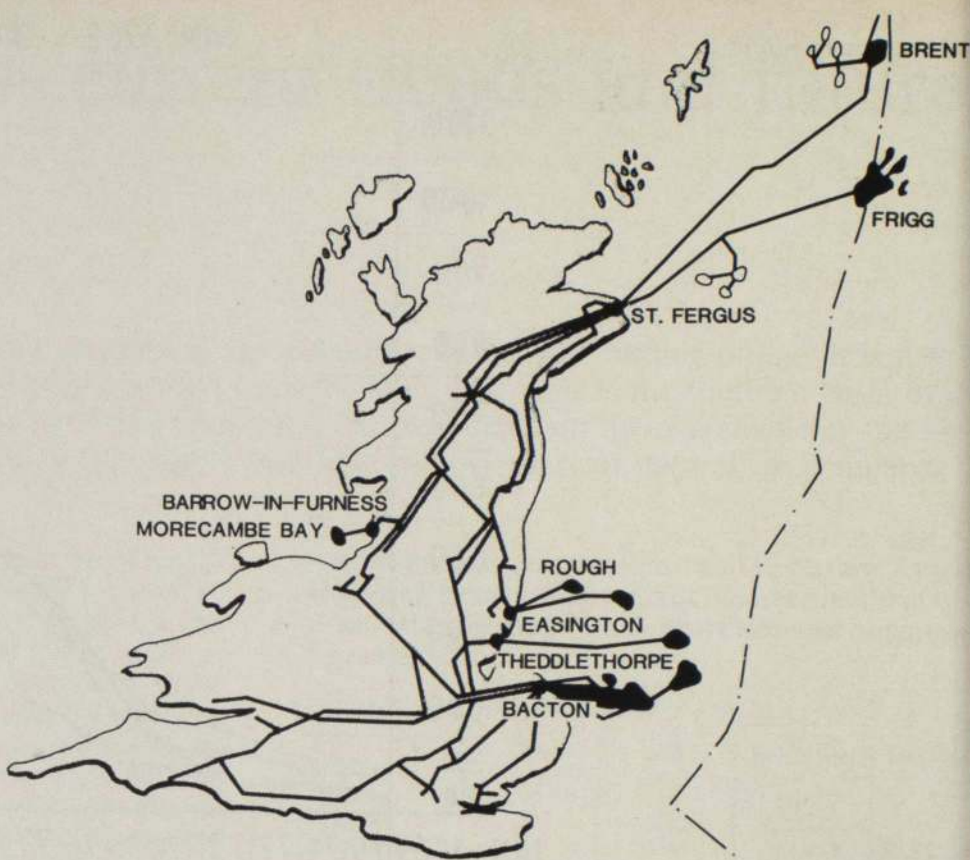


Fig 4 Gas distribution 1985

utilization is paramount and that is why we are in the service business in support of the gas supply business.

Finance

The turnover of the industry is nearly £7 billion per year and our profit at the moment is running between £500-600 M. This is a source of concern in certain quarters, who consider that the profit is excessive and in some way ought to be redistributed to the main users. What I hope to show is that the level of profit which this industry earns is absolutely vital for the continuing functioning of the industry and its continued investment programme. We have a series of targets which we agreed with government and, I emphasize agreed with government. They are not superimposed. These determine the financial framework in which the industry operates. The first target is a 4% return on net current assets. This is in current cost accounting terms, it would probably be about 12% return on historic assets so it is fair target — 4% pa on current net assets which requires between £500 and 600 M profit. The next target is a net trading cost reduction, that is an efficiency improvement target. Take away the cost of the gas bought and take away the profit from the revenue from the gas sold and what you are left with is the net trading cost. We have a target agreed with government of 12% reduction over four years and we are on target to do that, but it is a stringent target and one which requires very careful manpower resource control. We also have a target in terms of cash flow. The so-called EFL (external financing limits) is designed so that public sector authorities would be limited in their borrowing capabilities from the national loan fund. The Gas Corporation has repaid all its previous debts, and therefore its cash target is expressed in terms of a surplus rather than in terms of a borrowing requirement. Perhaps the most important target of all, which is self-imposed, is self-financing. In other words we believe that the current generation of customers should pay for the current generation of investment. We do not believe that the next generation of customers should have to be burdened by enormo interest debts to pay for expenditure at the present tin We will be spending something in the order of £5000 in capital investment over the next five years and if had to borrow that money, the cost in terms of inter charges on gas bills would be astronomic and therefo one of the key functional factors is that we remain se sufficient. You will see from what I have said that people who are concerned with funding and financ control in the industry have moved away from t traditional role of the accountant being the abac operator or the scorer — the traditional role of t accountant was the man who went on to the field of bat to count the dead and bayonet the wounded. Today t accountant has an enormous impact on our marketi ability into the future.

Gas supply

Perhaps I could now turn to the question of gas suppli We currently obtain gas through five terminals as show in Fig 4. It is virtually all coming from offshore. The m shows how international boundaries are drawn up in t most embarrassing situations — Frigg straddles t boundary line between British and Norwegian wate Brent just manages to scrape into British waters and the are others just on the Norwegian side of the line. But t whole thing started with the southern basin fields whe the gas was brought ashore at Bacton, at Theddlethorp and, of course, at Easington and our major supplies a still in fact coming from there but supplemented now l the four feeders from Aberdeen. The terminal at Fergus, which was commissioned in 1976 initially receive the Anglo-Norwegian gas from the Frigg field, a subsequently to receive the Shell-Esso associated gas fro the Brent field, is the terminal that we expect and ho will be the reception point for other sources of ga hopefully on the left hand side of that median line b also in respect of fields known to exist on the right har side, notably Sleipner. But there are other major sourc there as well in the Troll area, and we have reasonable ectations that, in the future, we shall be negotiating substantial supplies although of course there is a big stion mark as to how much gas lies to the left hand of the line. That is where the big argument developed ut the need for Sleipner.

So we have five major reception terminals and are ectly involved through wholly owned subsidiary npanies. We have an interest in over 50 blocks and ne 24 on-shore licences and we participate in drilling nething like 20 wells a year. The ninth licensing round been announced and I think it is something of a appointment to the gas industry that we have only been arded two out of 23 applications and 90 licences that e actually been awarded. There seems to have been move this time to issue in favour of smaller glomerates rather than the majors and there may be d reasons for that. However, we are still major lorers in our own right.

Just to put the thing into perspective. Fig 5 is a platform wn to scale with Nelson's column tucked in at the ttom. It is just an indication of the actual engineering le which you keep reading about but never seems to ne across. That structure is five times the height of lson's Column, and five times the weight of the QE It has to survive wave swings of 90 ft. This incredible ce of engineering is repeated all the way around the ast and more latterly, of course, in Morecambe Bay.

5

riations in demand — storage

might be worth just for a moment looking at the way which we have to deal as an industry with variations demand. Fig 6 is a simplistic representation of what ppens on a daily basis. It is interesting that the diurnal ing which can move anything up to 50% away from average is dominated by considerations of heating and t water. If that chart had been drawn 20 years ago it uld have been dominated by the lunch time cooking riod. Cooking is now 10% of the total domestic gas siness. Central heating now accounts for about 60%, u can see the impact of that. It means that demand is uch more temperature sensitive than it used to be which eans, of course, much more investment in storage to eet the fluctuations. However, on a daily basis we meet at kind of variation through the ability of the system elf which is pressurized. Most of the transmission stems are pressurized to 1000 psi, what we call 'line-ck'. In effect it is a large number of long, thin derground gas holders which have enabled us to maintain sufficient storage to meet diurnal patterns without building new gas holders. No new gas holders have been built since the conversion programme and in fact it is very difficult to pull them down — most of them appear to have become listed buildings.

Let us look at the much more complicated picture of Fig 7, which attempts to show what happens between winter and summer. Our gas suppliers, the oil companies, the explorers, the people who actually sell gas to us at the beach, obviously want what we would call a high load factor. They would like the same quantity to be supplied day and night, 365 days a year because that is the way to get the maximum return on their investment. We would like to take gas at maximum in winter and minimum in the summer and to match our take with the demand pattern. The demand patterns at normal temperatures and in a severe winter are shown by the lower and upper curved lines respectively. You can see that the peak is quite significant with demand at winter peaks which are five times those of the average and we require a very low load factor. If we bought at a high load factor we would then have to provide enormous storage capacity. There has to be a compromise between ourselves and the suppliers and that compromise is reflected by the step profile shown. We then have to resort to other devices to match supply and demand according to the temperature and the way we do that is largely through interruptibles. You can see the shoulder at which interruptible contracts are taken off which then enables us to concentrate available resources on meeting the firm demand, that is the domestic, commercial and the firm industrial markets — those customers who pay for gas on a 365 day basis. But there are other things as well that we can do, and they are listed on the figure. We have LNG, LPG/Air (although this is being phased out now). There are also seasonal supplies which we are now developing from the Morecambe Bay field. This is possible because Morecambe Bay is wholly owned by British Gas — curiously enough after an oil company abandoned it as being unsuitable for exploration. As it is wholly owned by the Corporation we do not have to provide a return to the supplier so we can exploit and deplete it at a rate which suits us best. If we want to draw gas out five days a year instead of 365 days a year we can so do and that is what I mean by seasonal store — a gigantic under-sea gas holder which will probably be in use for at least 40 years — whereas a gas field would probably be depleted in anything between 15 and 20 years. This actually came on stream in January of this year.

The location of Morecambe Bay is shown in Fig 4 with the piped supply coming ashore to Barrow which then links into the North Western region, with a transmission main coming down the left hand side of the figure. Also shown is the other seasonal store which is the Rough field — one of the earlier southern basin fields that was bought in its entirety from the suppliers in a partially depleted condition. The Rough field is again connected into the transmission network and gas taken from the Frigg Norwegian field is pumped south from St Fergus for anything up to 300 days in the year and is then re-injected into the Rough porous sandstone from which the gas originally came — re-injected under pressure through a fairly small line, 18 in diameter — and then for the 60 days of the year when the gas is wanted to assist in peak supplies, we take it out through a 36 in pipe and it supplies a major proportion of peak supplies, mainly in the southern half of the country. A seasonal store in that situation using a partially depleted field is an extemely exciting development and one which means we no longer

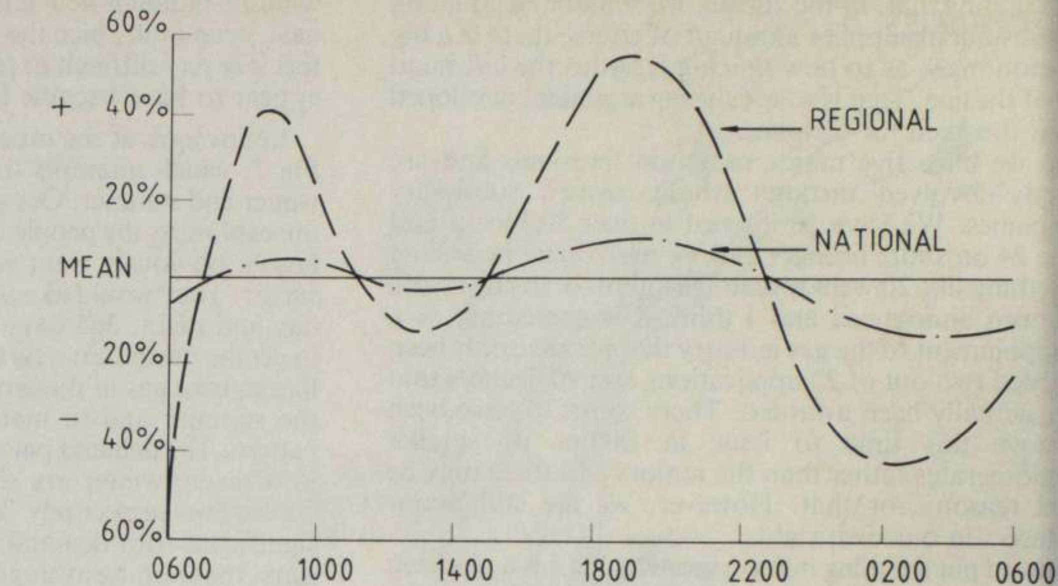


Fig 6 Pattern of daily gas demand

need to develop above ground LNG tank storage with all the environmental considerations. Morecambe, of course, is not partially depleted, it is full but once it has been depleted it could then serve exactly the same role as Rough with gas being injected from the grid into Morecambe and held there until it needs to be taken out on the coldest days. To give an impression of the scale of operations, Fig 8 puts it into perspective. It is the central processing platform and accommodation platform of Morecambe Bay — 15 miles out from Blackpool. The equivalent structure is being built for the Rough storage project.

These are investments which have been funded out of the profits of the Gas Corporation. No money has been borrowed from the government or any other source to do it. For these structures we are talking about £1 billion and that is why, when I said that self-sufficiency is important, we need to ensure that we are not putting an interest burden on future generations of customers, otherwise they will rue the day that we invested in this equipment.

A further development is in leached salt cavities as at Hornsey. Gas is stored at up to 3000 psi. The above ground installation could be almost anything but it i far cry from the conventional holder stations.

Finally LNG, liquefied natural gas, Fig 9 shows t Avonmouth installation. We have six of these but i unlikely that we will build any more as they a environmentally difficult. Those tanks contain t equivalent of 600 conventional gas holders. The gas compressed and refrigerated to 1/600 of its norm occupancy under normal atmospheric pressure and t capacity, therefore, is enormous although the size of t tank is no bigger than the larger gas holders. Fr environmental and safety points of view, we believe t answer now lies much more in terms of seasonal stora rather than above ground installations but the six that have will continue in use indefinitely.

Gas usage

First of all the domestic market. About 75% of all t households in this country actually use gas in significa amounts and it is interesting to compare that with t experience overseas. I think the figure in the States is abo 41% and in Germany and France only about 60% ha

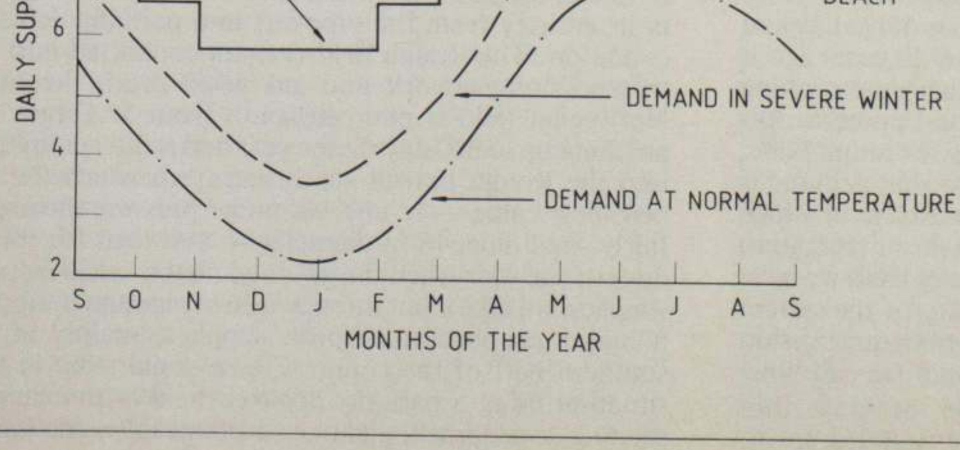
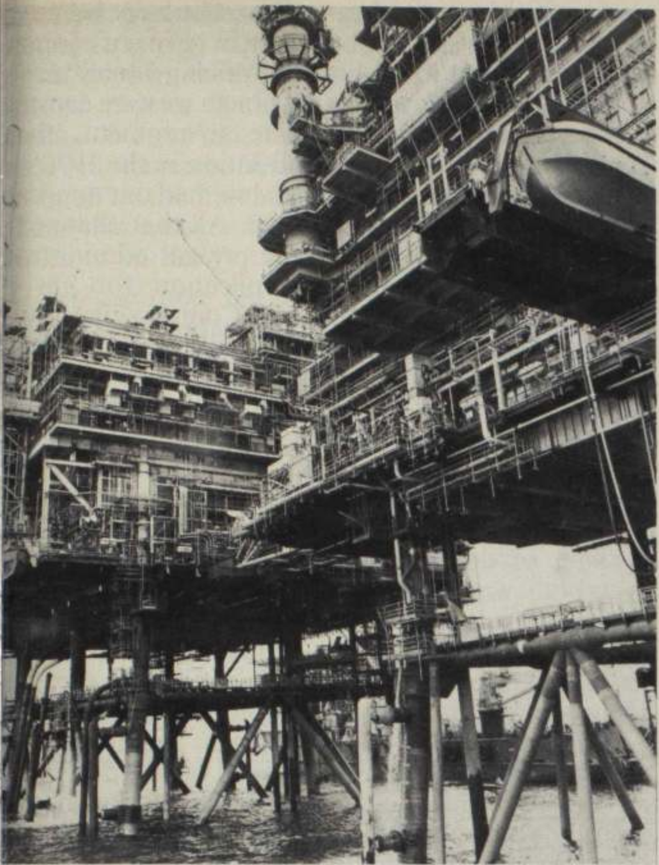


Fig 7 Winter-summer demand variation



8 *Central processing platform and accommodation of Morecambe Bay*

;as supply available to them. We have a much more nprehensive system in this country. We make gas ilable to more people for more of the time, which of urse is one of the elements for the success of the lustry. The only country with a higher density, a higher netration, is Holland and of course there are special cumstances there as it virtually became national policy every house to have a gas supply and gas heating. In t, natural gas has, since 1959, been virtually the only ligenous resource so the penetration is not really due market forces in that sense. So we have a very high level penetration in the domestic market. In Fig 1 the market ire of 58% is slightly out of date, the market share is w 60%. In fact if you take out the exclusive use of ctricity for hi-fi, freezers, lighting and power in the me with which gas cannot compete, then we have an % share and virtual saturation. In new housing there upwards of 200 000 new houses being built each year. ost of these are in gas supply areas and 80% of them ve gas fired central heating and probably another 10% l get it at a later stage. Emphasis is placed on keeping sts down so some proportion of buildings is built thout central heating as standard.

Fig 10a shows the regional proportions for the way in ich gas is used in industry. It is obviously used mainly ere its particular attributes offer advantages in terms its flexibility, etc, as I explained earlier. You can see it despite the change in the industrial structure, the ger proportions are still in the heavy end, very much the chemical and steel industries, but of course those ures are much lower than they used to be. There were ne very high proportions until a few years ago but these now levelling out with more gas being used in the vice industries, and the food, drink and tobacco sector now coming up level with chemicals. This is the trend the changes in the industrial society and industrial onomy of this country and is very much reflected in tterns of gas consumption. The commercial market in Fig 10b reflects the proportion of buildings devoted to those particular sectors of the market place because in this market we are essentially talking about gas for space heating, water heating and catering. The commercial market has probably got the biggest growth potential left to us and I will come to this a little later on.

Price

At this point it would be worthwhile to say something about price because it seems that you cannot move very far away from considerations of energy, gas in particular, without talking about price. There is a lot of confusion, to my way of thinking, about what prices ought to be and what it is that everybody is trying to do. The fact is that from the time natural gas first came ashore in the 1960's, through to the early 1970's we developed the concept of market relationship. In other words, gas had to be put into the market place and the only way you could put it into the market place was to relate it to the price at which its competitors were being sold. If you recognized a premium value figure, then that could be added to the cost of the alternative fuel. If there wasn't a premium value for gas then you had to slide in under the price of the competitive fuel. This is what is meant by market relationship. You sell at the highest price which is consistent with getting the business. It was, in fact, the only way we could meet the contractual commitments that we had entered into with the southern basin suppliers. These meant that a rapid phase of growth and market related pricing was the only way and so we sold firm gas, which was market related against gas oil and interruptible gas which was market related against heavy fuel oil, not against coal as some people seem to believe. We believed that the qualities of gas were such that it should be in competition in those sectors of the market which were dominted by oil, rather than the lower premium usage occupied by coal. However, there were some interchanges because oil was taking some business from coal at the time and we came in and took the business from oil, which of course the coal industry probably think ought to go back to coal and some of it probably will over time. We don't expect a price war.

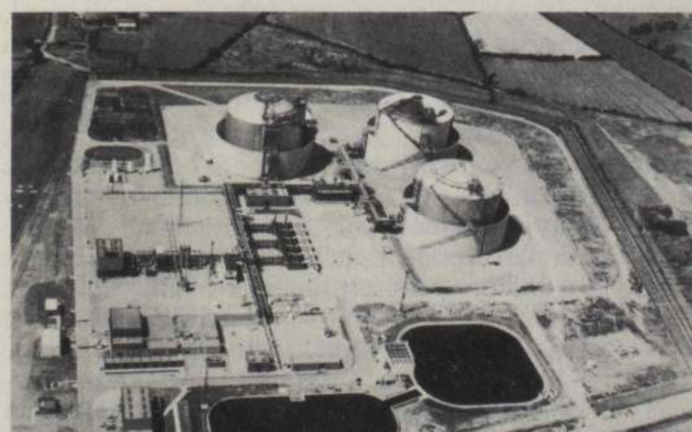


Fig 9 Avonmouth

Market relationship then continued through to the early 1970's but as the market share for gas grew there was obviously a much greater dependence, on the part of customers, on a continuing gas supply. It is a curious thing that everybody strives to be a monopoly, whether in the private sector or not. In the private sector you strive and strive and strive to become a monopoly by killing off the opposition. So everybody's aim is to be a monopolist and you can do all the wicked things monopolies like to do. But, being a monopolist as far as gas is concerned does not have the advantages because you are in competition with other fuels anyway. You are only a monopoly as far as gas is concerned and that is not unique because nowhere in the world is there anything other than a monopoly as far as gas is concerned. You don't get alternative gas supplies, its a simple fact of life, gas is a natural monopoly in any one particular locality.

Fig 10 Sector analysis of regional gas sales

Sector	% of total
Building Materials	11
Chemicals	14
Ferrous	10
Non-ferrous	4
Mechanical Engineering	7
Electrical Engineering	5
Vehicles	7
Other metal goods	6
Textiles	5
Food, drink, tobacco	14
Paper and printing	7
Other industries	10

(a) Industrial

Sector	% of total
Education	18
Hospitals and Medical	14
Hotels	8
Restaurants & Pubs	9
Distribution	8
Government	13
Insurance, Banks, Offices	9
Transport	5
Other	16

(b) Commercial

There are responsibilities for a monopolist. One is, of course, that he is responsible at the end of the day, if he dominates the industrial scene, for keeping industry in business and not just simply increasing his prices. It is all very well in theory saying that the market place can contend with it because you are 30% cheaper than oil, or 25% cheaper than electricity, or you are on a par with coal, and you have advantages in terms of utilization characteristics, so you will take advantage of that by putting the price up and going for maximum profit, but in the process your customer goes bankrupt. He has no other supply to turn to, so there is a responsibility, a heavy responsibility on the monopolist in that situation. We have felt that, rather strongly right the way through since the mid 1970's and progressively the price of gas fell behind that which could properly be described as market relationship. Then, of course, there was the oil price escalation occurring in the two crises of 1973 and 1979. Gas could not hope to keep pace with the escalation in oil. In the first place, industry could not take it. At that time we had a 30% market share and at the time of the second crisis we had a recession on our hands as well, industry was closing down left, right and centre and not only could it not take it but the British Gas Corporation did not need it. We were not in the profit maximization business and therefore prices became constrained. However, prices had still moved on faster to industry than they had to the domestic market and we had the strange phenomenon where the managing director would go home and discover that the price he was paying for large scale usage of gas in his factory was dearer than that he was paying for his central heating installation at home wh does not make any kind of sense in terms of econom We actually got to an inverted pricing situation.

The cause of this was that although we were constrai on our contract pricing. The government, thro successive moves to counter inflation in the 1970's w constraining domestic prices and we had our applicati for price increases turned down. All that changed v dramatically in 1979 when the present administrati having gunned down an application for gas p increases, referred us to the Price Commission. It was last act of the Price Commission and it recommended there should be significant increases in domestic and n domestic tariffs for gas, at that stage the domestic mai was barely breaking even. That was a move which we not appreciate at the time but in fact was a very cor move, a very courageous move on the part of government which was courting political unpopularit a result of doing it, because, by that time, virtu everybody was using gas for space heating at home. would not have gone for increases quite as high as the c the Government imposed — three by 10% pa, in terms that meant doubling the price of gas in three ye Increases were needed to maintain self-financing.

Well that was, if you like, Probert looking back v a bit of hindsight. I was very much opposed to the p increases at the time but, in fact, it has worked out to industry's advantage and the competitive position has been disadvantaged in any way, shape or form. Bu least we have now got comparability back betw domestic and industrial prices.

What makes the gas industry tick then in terms pricing? First of all we have achieved comparability profit between the various market sectors. We should derive a bigger profit per therm on gas to industry t we do to the home, or *vice versa*. Similarly between to education and gas to commerce. We endeavour to s an equivalence of profit per therm into each mai sector.

Fig 11 European industrial gas price ranges (CBI). Prices fro October 1984 (Load sizes 1 to 10 Mth/y)

Country	Representative price p/th
Great Britain	27.3
Belgium	35.0
France	30.0
West Germany	33.5
Netherlands	not applicable
Italy	35.2

(a) Interruptible supply

Country	Price range p/th
Great Britain	31.8 - 32.1
Belgium	35.1 - 37.7
France	29.9 - 32.5
West Germany	(a) 34.1 - 39.5 (b) 42.5
Netherlands	32.2 - 33.7
Italy	37.0 - 39.9

(b) Firm supplies

The second factor is obviously a question of mai opportunity. You have to know what the competitio doing, what the scope is for further change-over, w the scope is for potential loss to other fuels, so mar opportunities are vitally important. But, there is also business and the economic climate. We could quic scotch industrial recovery if we went to maximize pr in the short term and we started to hit hard at n veloping businesses who are just in the process of vesting in energy equipment for the first time, or for e first time in several years. It is a major constraint. ien, of course, there are the financial needs of the isiness. We are not tax collectors and therefore we ould only generate from gas users sufficient revenue as irranted by the financial needs of the business. It is to at end that we agreed the targets with government that described earlier.

Of course there are other influences as well. More cently there has been a tremendous pressure from CBI urces who have been advocating that there should be instraints on the prices which the British Gas orporation charge to industry and commerce, but irticularly to industry, because of the competitive isition that British manufacturers face *vis-a-vis* EEC irtners' prices. For the last three years we have been volved in detailed investigations to show that our istomers are not disadvantaged *vis-a-vis* their European impetitors. Fig 11 shows the situation from the CBI port of October last year. It shows the price range of rm contract gas, 365 day gas, to industry, in Britain in fairly narrow range 31.8 — 32.1p per therm, as impared with prices running generally throughout urope and you can see that the only one that is really iywhere near in terms of price is France, and in this case iere was a price increase in October which came just after ie deadline for the production of the price comparison. o there is no disadvantage to British manufacturers *vis-vis* Europe. When it comes to interruptible gas prices hich are geared much more closely to heavy fuel oil, iere are quite considerable advantages here in that the verage representative price we sell to interruptible gas istomers, 27.3p per therm, is considerably lower than ie price of gas generally through the continent.

Perhaps the biggest single factor, however, is the cost gas to the Corporation. Clearly we bought gas at a price hich, with the widsom of hindsight was extremely vourable. Going back to 1964, we bought gas at the irrent market price which gave the oil companies, the kploiters, a satisfactory rate of return on which immercial contracts were signed through the 1960's. The rice was pre-oil escalation in 1972/73 and 1979 and of ourse in today's terms, when you are now talking about atural gas being traded internationally the price that we ay for southern basin gas looks very, very low — but hy should we pay any more for it? Why should the ippliers receive any more for it when they have already ceived their return on their investment? This argument as been raging for the last 10 years and will probably go n for the next 10 but the fact is that we have turned the dvantage of lower buying prices to the advantage of our istomers. This is reflected in our prices and in the charts iown here. Of course there aren't any new southern basin as fields to be bought at those prices and we are rogressively paying the world international traded market rice for gas, both within the UK continental shelf and f course externally, from Norway. Progressively the ontract buying price of gas is going to go up, and we are etermined to maintain a professional buying approach hich minimizes the rate at which it goes up and utilize, o maximum advantage, the lower cost gas which we lend with it and work in on an average cost basis. Now will come as no surprise to you, I am sure, to learn that ome people do not like this. There are economic theorists round who believe that in the absence of competition, mean no competition with anybody else supplying gas, ou have to have some device to put in its place and that evice is called 'long-run marginal cost'. What this means is that we should think of the most expensive gas that we are likely to buy in the next 20 years and then charge everybody that price for it now, so that we will guarantee to make a profit for the gas we bring ashore in 20 years time. That is long-run marginal cost pricing. Actually nobody has actually tried it yet because it seems to me that it is a passport to business bankruptcy which might be good from a conservation point of view, assuming that the market was not picked up by other fuels. In actual fact it makes economic nonsense as far as we are concerned.

The coal industry is very much in favour of British Gas charging prices based on long-run marginal cost. The electricians would dearly like British Gas to adopt long-run marginal costing because clearly it would enhance their competitive situation in the market place. Even our suppliers have this sneaking, intuitive feeling for long-run marginal costing because the word is that if we could sell it at 50% more expensive than the price we sell it at now, we could probably pay 50% more for it in the first place. We will base our pricing on average costs as long as we can into the future because it does not make any sense to us or to our end users to do anything else.

Fig 12 Forecast growth in regional gas sales (M therms)

	1983/84	1989/90	Growth	%
Domestic	9132	10565	1433	16
Commercial	2404	3110	706	29
Industrial	3947	5043	1096	28
Total	15483	18718	3235	21

Fig 13 Gas market share (forecast %): Heat supplied

	1968	1984	1990
Domestic	19	58	65
Industrial	4	35	41
Commercial	11	31	36
Total	10	43	48

The future

Perhaps we should now turn with trepidation to the future. Where do we think we are going? For 1983/84 looking forward over the next five or six years, which is our current corporation plan, Fig 12 shows the picture that we are forecasting. A further 16% growth in the domestic market, a 29% growth in the commercial market and 28% growth in industrial. To be fair, a lot of the growth in the industrial market is getting back to where we were prior to recession as we are starting from a low point. Nevertheless there are significant continuing growth elements in the programme and all that is related to the gas that we have currently contracted to buy. There is no uncertainty at all about the gas availability to meet that. Indeed we must make that level of expansion in the markets in order to sell the gas for which we are contracted and committed to buy and if we do not take it we pay for it anyway, so that is in fact going to happen — so says the forecaster. What does it mean in terms of market share? Well, as shown in Fig 13, domestic will go to 65%, not dramatic but in real terms that is 85% and is virtual saturation. The industrial sector does not leap up enormously but goes to 41%, recovery of a lot of lost ground, and the biggest increase in some respects, occurring with change-over largely from gas-oil, in the commercial market, giving a total market share of 48% by the end of the 1980's. That is the position we expect to be in and that is the position for which we are buying gas.

Turning briefly to the world situation as far as reserves

Fig 14 Proven gas reserves

	Trillion cubic feet	
Asia	166	Malaysia 50, Indonesia 40
Western Europe	207	Norway 89, Netherlands 68, UK 28
Middle East	870	Iran 479, Quatar 150, S Arabia 123
Africa	187	Algeria 109, Nigeria 36
Western Hemisphere	475	USA 198, Canada 92*, Mexico 77, Venezuela 55, Argentina 25
Communist Areas	1497	USSR 1450*, China 31
	3402	

*USSR and Canada figures include 'possible'

(a) World

	Trillion cu ft	Change from 1984
Proven	25.6	+0.5
Probable	21.2	+5.7
Possible	22.7	+3.6
Total	69.5	+9.8

Source: Government Brown Book Estimates, 1985

(b) UK

are concerned, Fig 14 gives some kind of perspective of where the gas is. 10^{12} cu ft is the normal measure for comparative purposes. You can see tucked away on the right hand side that the UK has got 28 trillion, Norway 89, Netherlands 68. Now look at Russia with 1450, they are not going to be able to use all of that gas. It is going to come out for currency. There will be a lot of competition between various elements within the Middle East also.

From the point of view of the world's resources of natural gas there is no shortage as compared with the doom and gloom that was being pronounced only three or four years ago, based on entirely different demand projections. Expressed slightly differently Fig 15 shows considered views in those years. In 1970 we had something like 30 years of gas left worldwide and say 30 years of oil. By 1980, 56 years for gas at the 1980 take levels, 30 years for oil. The latest view — 63 years for gas and going up. In other words a culmination of revised demand forecasts and further exploration and exploitation indicates that for both hydrocarbons, particularly gas but also oil, the proven and expected reserves are growing at a faster rate than depletion, so let us not get too worried about the future of the energy business. This is also reflected of course in the so-called *Brown Book*, the '85 version as compared with '84 and you can see in Fig 14b there h been some significant moves, particularly in the proba reserves, within the United Kingdom continental shelf that of course is yet another factor affecting Government's decision to postpone the decision to al the Corporation to buy Sleipner gas.

Conservation

I was going to talk about the fifth fuel — conservati Time really prevents me from saying too much abou but I think it is just worthwhile making one distincti The government, over the last couple of years, h moved away from emphasis on conservation and conservation division has been converted into the Ene Efficiency Office, something which we applaud. The industry has always been exhorted to conserve ener Indeed it has been advocated in some sources that should conserve energy to the point where we go a insulate everybody's house and we deliberat encouraged people to use less or, perhaps, none of product and then we don't need to buy Sleipner or a other gas at all. The only snag is this, it seems to me that we go out of business in the process which isn' particularly attractive philosophy but it does have appeal in certain quarters.

What does conservation mean? If we conserve gas the point where the gas industry no longer survives a we use all the coal up or we go over to nuclear then wh are we striving to do? Surely the answer is efficiency. T answer is to maximize your sales efficiently to impro the efficiency of utilization of your fuel. By doing th you will then retain your market for longer, and that the philosophy for the British Gas Corporation.

In support of that we are moving very quickly into n generations of hardware in terms of condensi equipment, Fig 16, for the commercial and the domes market where we are taking advantage of the fact th combustion products can be cooled below dew point a the condensate drained away instead of having to ha a minimum temperature in the flue to vacate the produc This results in an increase in efficiency from 75% somewhere in the order of 95%. This illustrates the st changes that can be developed in terms of boil efficiencies.

I ought also to mention the enormously important wo that is conducted on behalf of British Gas Corporatic by the Midlands Research Station at Solihull. Fig 17 a diagramatic representation of the self-recuperati burner. This, and the regenerative burner, are makir enormous strides, not only in terms of improvement i

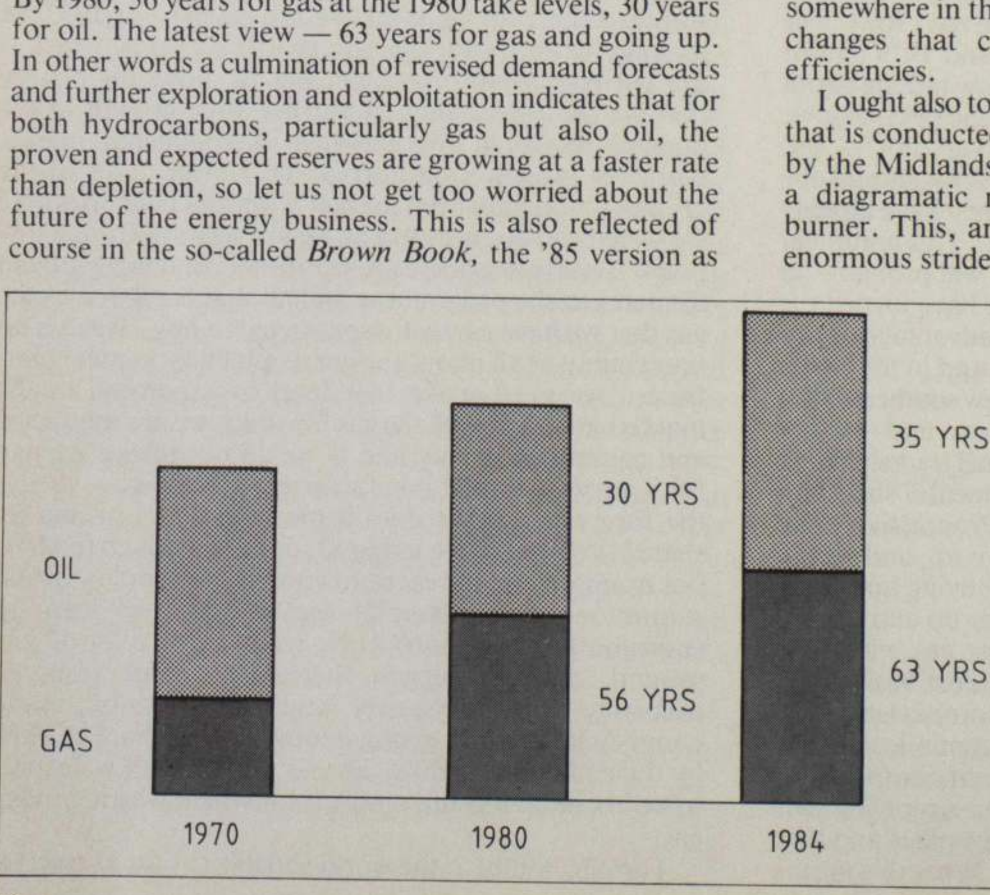
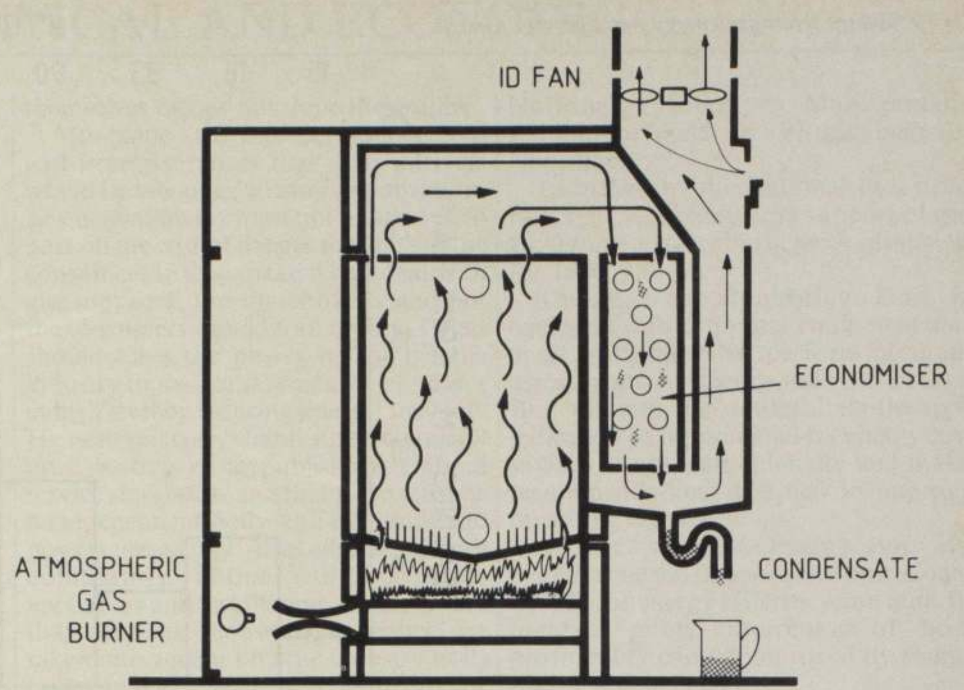


Fig 15 Proven hydrocarbon reserves

ig 16 Schematic diagram of boiler*

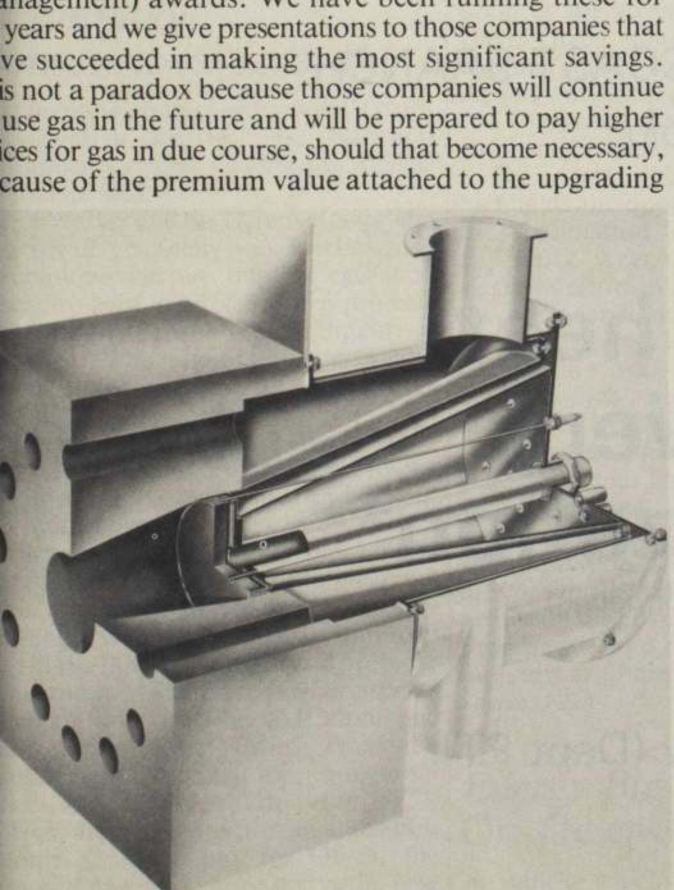


ergy efficiency but also as a marketing means for gas upgrade processes and build a premium value for gas o the future even in a higher priced gas purchase regime.
In Fig 18 you can see the application in the Llanwern el plant, coil heating furnaces using regenerative rners. The efficiency improvement compared with an iginal furnace is something like 50% in terms of lization. Work at MRS on vat and tank liquid heating s also produced large efficiency improvements as a ult of replacing steam complexes by high efficiency, int of use equipment on the production line.
All this culminates in the GEM (gas energy anagement) awards. We have been running these for years and we give presentations to those companies that ve succeeded in making the most significant savings. is not a paradox because those companies will continue use gas in the future and will be prepared to pay higher ices for gas in due course, should that become necessary, cause of the premium value attached to the upgrading of the processes that have been undertaken through the GEM scheme. We have the support of the Secretary of State for Energy for improvement of energy efficiency by our technical consultancy work and our GEM award promotions.

The savings that we have actually achieved from the entrants in GEM over the last 10 years are shown in Fig 19. That is the extent to which savings have been generated and there is a lot more to be done but it requires energy resources human resources and expertise. We have been able to do much of the technical development work that is necessary thanks to MRS. We now have to learn to market it more effectively — that is the challenge over the next five years, but it is the secret for retaining the industrial market in the long term.

Privatization

It would seem odd if I said nothing at all about privatization. The government has decided to denationalize the British Gas Corporation and that is a political decision about which the Corporation takes an entirely neutral stance, because we are not involved in politics — we are involved in the energy supply business. What can one say about it? Very little, except perhaps this. The key thing as far as the gas industry is concerned is not the ownership, but the structure of the industry. The



17 Self-recuperative burner

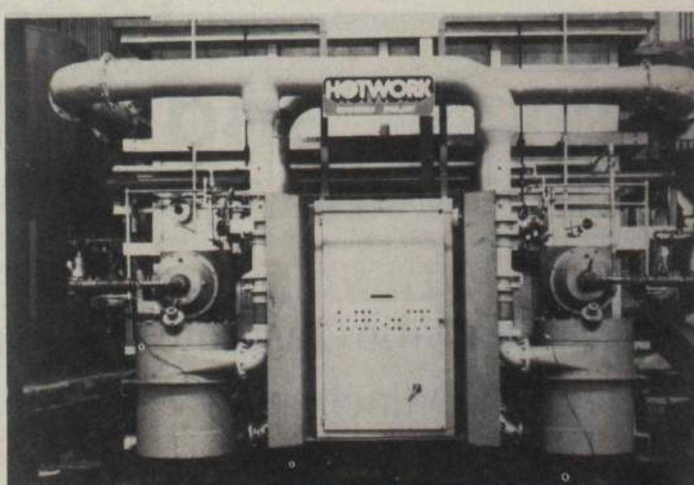


Fig 18 A coil heating furnace at the Llanwern steel plant

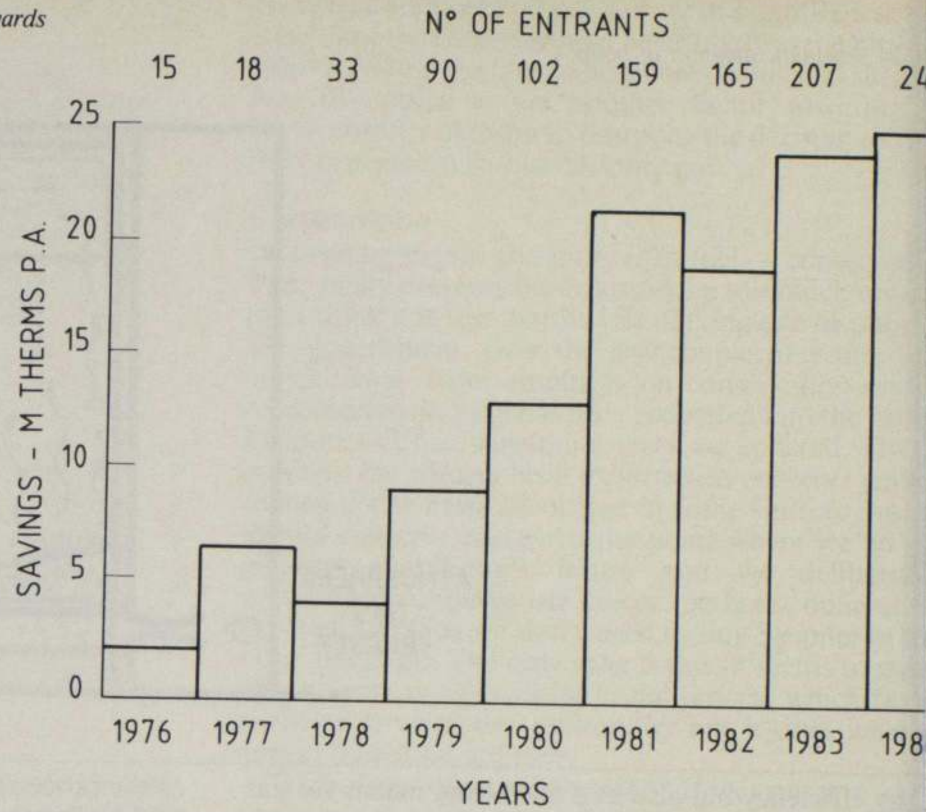


Fig 19 Savings from gas energy management awards

gas industry is totally integrated from the point of view of buying the gas at one end, transmitting it, storing it, distributing it, marketing it and all the associated activities. The Government's decision is to privatize the Corporation in total means that the structure is safeguarded. It means that the private company which is the successor of the British Gas Corporation can, and should, have the opportunity of continuing the tradition of the gas indust which is to maintain, as indeed it has to do by law ar I am sure it will not change, a safe, economic ar continuous supply of gas to the maximum number users in Great Britain. I personally believe that tl objective will be maintained whether it be within tl private sector or the public sector. □

urope
ncouraging engineers

ly 27 young people out of every ndred in the UK go on to higher ucation, compared with 73% in the A, 87% in Japan and 70% in Sweden, ports *E P News*.

Other EC states do not do much better: s only 22% in Germany and 28% in ance, though it does rise to 38% in ly.

The number of engineering graduates million people in the European mmunity as a whole is only 260 — mpared with 350 in the USA and 630 Japan.

The Commission's response is the OMETT programme: the action ogramme of the Community in ucation and Training for Technology. has several aims: to set up a network of rtnerships between universities and lustry to promote training; to promote e exchange of students and industrial d academic personnel between member ates; to launch joint training projects volving firms in different EC states; to velop European distance learning stems and to promote the exchange of perience gained.

The programme will cover seven years 986-92) and cost around 81M ECU 46 M, £Irl 59 M).

urce: European Parliament News

'rivatization
Consumer safeguards

ommenting on the Government's plans privatize British gas, National onsumer Council Chairman Michael ontague said:

'eter Walker and Sir Dennis Rooke' did believed 'genuinely possess a heart for e consumer interest. But that legislation eded to exist in a form which protects e consumer from the sentiment of dividuals who might not be personally owerful or personally consumer-iendly.'

'The published Bill is not encouraging. verything turns on the still to be ublished licence, the nature of which will etermine consumer safeguards.'

Michael Montague asks the Energy ecretary, Peter Walker, to explain to the ublic why the proposed new director of as supply is not being given a statutory uty in the Bill 'to maintain and promote ompetition'. 'There are further aspects hich are worrying,' he said. Montague oints out that Oftel, British Telecom's egulatory body, which has no regional ffices, is costing £3.1 M this year (1985).

'How are we to interpret an allocation f only £2 M to pay for Ofgas, the roposed new regulatory body, the new as consumers' council and regional ffices? Somebody is either deluding themselves or has not done their sums'.

Montague said that consumers need cast-iron assurances that their interests would be safeguarded after privatization. The new company must not be allowed to pass on the cost of the gas they buy to the consumer. If they make a bad deal with gas suppliers, the shareholders and not the consumers should foot the bill. Ofgas should have the power to compel the industry to maintain standards of service at high level by reducing prices if they fall. He went on to say that the new company must be obliged to publish facts about service standards, and that there must be an independent body with the funds and powers necessary to deal adequately with complaints about bills, services appliances and installation, and to ensure that domestic consumers' wishes are taken into account by the industry in its policy-making. The new company or other suppliers must also be obliged to maintain strict safety standards.

Source: National Consumer Council

Neighbourhood energy action
Commons report approved

'Britain's cold homes could be significantly warmer and more energy efficient if the recommendations of the Commons Energy Committee are acted upon by the government'. Commented David Green, honorary secretary of the national charity Neighbourhood Energy Action* in response to the publication of the Commons Report on the Energy Efficiency Office.

The report, published in November, highlights the opportunity presented by the designation of 1986 as Energy Efficiency Year to embark upon a vigorous effort to improve the homes of the poor, and move beyond exclusive dependence upon local voluntary groups to do such work.

NEA has also welcomed the committee's call to introduce a specific grant to help poor households become better insulated. The Government's social security review would, at present, specifically abolish special DHSS help with insulation costs, hence threatening the continued employment of over 2000 people on the government's Community Programme who make extensive use of this current financial support.

Source: NEA

Energy Bus
On-site energy audits

A vehicle which can perform on-site energy audits for industry, commerce and local government was on view at the National Energy Management Exhibition, held in Birmingham in November.

Launched by the National Industrial Fuel Efficiency Service in support of the Government energy efficiency campaign for 1986.

The Energy Monitoring Unit is equipped with computer equipment and audit instruments to perform accurate assessments of energy use, the Energy Bus will provide a useful on-the-spot indication of the potential for energy cost savings at any particular site and make recommendations designed to improve operating efficiency.

In this way, the Energy Bus will demonstrate the financial and operational benefits of energy efficiency and aims to increase public awareness of how profitability can be improved by sound energy management.

A special suite of computer programs will carry out analysis and formulation of energy data and a small office area within the bus will allow for an interactive presentation of audit findings to the energy user.

By establishing this mobile service, NIFES has joined the European Commission's Energy Bus programme, which has led to the introduction of similar ventures in Italy, Germany, Belgium, Holland and Ireland.

This link with Common Market partners should enable the Energy Bus to provide comparisons with energy efficiency levels in the EEC.

Source: NIFES

British Standards
Promoting energy efficiency

BS 8207 is the first British Standard to be produced to promote energy efficiency in buildings†. It provides a basis on which designers of buildings and their clients can work to achieve this aim, reported Energy Management recently.

BS 8207 concentrates on how to make buildings energy-efficient, through good design practices and by careful management and use.

Energy conservation is, however, only one of the requirements which a building need satisfy. The function for which it is used and its appearance and general economics have also to be taken into account. The designer has to produce a

*Neighbourhood Energy Action is a national charity chaired by Lord Ezra, that works to ensure that practical action is taken to improve the heating conditions of the poor

†Copies of BS 8207 may be obtained from the sales department, British Standards Institution, Linford Wood, Milton Keynes MK14 6LE. Price: £22.00 (£8.80 to BSI subscribing members).

balanced solution of which energy conservation measures are an integral part, but with a higher priority than previously because of the increased cost of fuel and power relative to other building charges.
Source: Energy Management

Oil from refuse
New company set up

The *oil from refuse* process, developed by chemists at the University of Manchester Institute of Science and Technology with cash backing from Greater Manchester County Council has launched a new company, MANOIL, in a bid to win vital funds to take the scheme from laboratory to full pilot plant production.

The new company's key role is to ensure that the huge scientific and management advances already achieved in developing the process will not be lost when the GMC is abolished next April.

The process, developed by a UMIST laboratory team headed by Roger Benn and Prof Noel McAuliffe, achieves in minutes what nature takes millions of years to do — the conversion of organic waste material and biomass into energy-rich, non-polluting fuel oil.

In simple terms, the process, which has been tested over the last six years by the UMIST team, turns everyday household rubbish and biomass products like plant life and vegetation into oil nearly as good as that coming out of the best North Sea offshore fields.

The treated cellulosic feedstock is fed in at one end of the process and emerges at the other ten minutes later as oil. But this major breakthrough has only been proved on a relatively small scale in the laboratory. The process must be sold to the hard-nosed commercial world.

The cash backers needed for the pilot plant could see handsome returns on their investment by the early 1990s, by which time the project should be operating commercially at full scale.

The University has already concluded that a full scale plant costing about £6 M to set up and processing 200 t of treated refuse derived material a day would yield 20 000 gal of oil. The financial return would be over 40% within two and a half years of the plant starting up.
Source: GMC

Energy use
Provisional statistics

Provisional statistics showing energy production and consumption in the three months July to September 1985 show that consumption of primary fuels in the period July to September 1985 was equivalent to 67.2 Mt of coal. This was 7.4% more than in the same period a year earlier. Figures in both periods were distorted by the impact of the dispute in the coal industry. Coal consumption (including restocking) rose by 94.9%, natural gas consumption by 7.2%, and nuclear and hydro electricity by 22.2%. Consumption of petroleum fell by 27.5%.

Production of indigenous primary fuels in the same period rose by 25.1% to 91.2 Mt of coal equivalent, 18.3 Mt more than in the same period a year earlier. Production of petroleum fell by 0.3%, whilst production of natural gas rose by 15.6% and nuclear and hydro electricity by 22.2%. Coal production increased significantly, to 25.5 Mt, although this was one million tonnes less than in the same months of 1983.

Total petroleum production in the three months July to September 1985 was 30.3 Mt. This includes 1.1 Mt of natural gas liquids. Peroleum product deliveries for energy uses during July to September 1985 were down by 28.3% compared with the same three months a year earlier. Deliveries for non-energy use were up by 8.8%. Deliveries of motor spirit rose by 2.4%.

Total use of petroleum, including non-energy use, during this period was 17.5 Mt, a fall of 5.1 Mt or 22.7% compared with same period a year earlier, while total use in July to September 1983 was 17.3 Mt.
Source: Dept of Energy

Sellafield
Personnel safety

New radiation detection equipment has been installed in BNFL Sellafield's new centralized changing room facility*. Altogether 14 walk through monitors and 32 personnel contamination monitors have been installed.

The walk through monitors (often referred to as portal monitors) measure contamination on the protective clothing of workers before they enter the changeroom. This screening is carried out whilst the individual is walking at normal speed.

After removing their protective clothing but before leaving the changeroom all personnel must pass through the personnel monitors, type IPM7, where they are checked for any trace of radioactive contamination.

The IPM7 is a microprocessor based personnel monitoring system. It provides for sensitive measurements of contamination to be carried out on the hands, feet, body and head of personnel using the apparatus.

The monitor contains three vertical banks of detectors each 2m tall for the body, two detectors for each hand, two for the feet and one for the top of the head. For good all-round response and maximum efficiency the body is measured in two parts — first the front and then the back. In this way nearly all thicknesses of body from the thin to the very stout can be monitored with little loss of efficiency.

Fingertip sensors and infra-red beams ensure that hands and feet are correctly positioned during the monitor sequence. Should a hand or foot moved out of position during measurement a warning will sound monitoring will be suspended until b hands and both feet are once m correctly positioned.

The microprocessor looks at e detector separately as well as the sum adjacent detectors. It subtra background automatically, deci whether contamination is present or and controls the entire sequence of eve from start to finish. Separate indicat of hand and foot contamination w alpha and beta indication wh appropriate is provided.
Source: Nuclear Enterprises

USSR
Integrated power grid

A new energy bridge, part of the so cal 'peace powergrid' is planned to link banks of the Danube in the area of Soviet-Romanian border. The 750 power transmission line is a joint proj involving Bulgaria, Romania and Soviet Union.

The biggest supplies of energy throu the power grid, which is said to be cl to completion, will go to Roman Bulgaria has a stake in the f completion of the line, which will link with a rhythmic and uninterrupt operation of the first 1MkV nucle power generation set under constructi in the country.

The integrated power grid functions accordance with the principles of f independence of national systems a efficient coordination of joint efforts. case of a breakdown at a power stati in one of the countries, current will supplied through the transmission lin from the neighbour states.

The first power transmission line this class was put into operation in 197 it was a 750 kV power transmission brid linking the Soviet city of Vinnitsa and t Hungarian city of Albertirsa made possible to increase electricity suppli from the USSR to the European CME member countries. The second 400 k long 750 kv power transmission line we into operation recently. It was design to increase the flow of electricity from t USSR to Poland, and Poland will, in i turn, ensure transit electricity supplies Hungary, the GDR and Czechoslovaki There will be five transmission lines i operation by the end of the century.
Source: Novosti press agency

Extensive oil/gas pipe network

Freak weather will no longer interfe with the work of the off-shore oil fiel Neftyanye Kamni in the Caspian. In th past, storms often prevented tanke

*The equipment was provided by Nucle Enterprises m mooring alongside brimming fuel rage tanks. Now a high-capacity eline has replaced ships which used to ng oil to the mainland. For the first e in the USSR the underwater pipeline s made out of 600 mm pipes.

The main work was done on board a cialized pipe laying ship. The pipes re welded together on the ship and cked for their durability with x-rays. ey were then insulated before being vered to the seabed.

The pipeline crosses a rugged seabed d strong underwater currents and rms put an additional strain on the nstruction workers.

Altogether, they have succeeded in ilding 5000 km of underwater pipeline ich have been laid. The network is the gest and most complex in the country. will carry oil and gas from 14 offshore lds in the Caspian.

urce: Novosti press agency

attelle
ew coal research rogramme

n international programme to identify cent and near-future developments in hnologies involving the use of coal is ing offered by Battelle.

The programme, to be sponsored by a oup of companies, has been conducted a year-by-year basis since 1981. pporting the research have been coal oducers, equipment manufacturers, ocess developers, materials producers; d users of coal conversion products, -products, and co-products from ound the world.

Researchers will gather data on ernational coal utilization technologies at may be significant during the next cade, particularly in coal handling, mbustion, and cleaning; coal nversion; coal-water mixtures; and her advanced concepts. Of special terest will be recent efforts on integrated sification and combined cycle eration.

According to Dr Joseph H Oxley, who ill head the study team, 'In the recent st, fluctuations in the price and ailability of oil and natural gas have turned many companies' attention away from monitoring the relative status, or even the existence, of new technology developments based on the use of coal. But it is critical for all organizations whose operations are affected by shifts in fuel use and price structure to follow available commercial opportunities for coal.'

During previous studies, new uses for finely divided coal represent one of the most important areas for future business opportunity by organizations interested in the energy field.

In the new study specific technical areas to be examined are: direct combustion, coal handling, chemical manufacturing, coal gasification, coal liquefaction, and coal coking technologies; physical coal, chemical coal, and fuel gas cleaning; coal fluid mixtures; fluidized-bed combustion; coal and shale pyrolysis; particulate gas separation; and other advanced concepts.

Source: Battelle

China
Gas plant from Czechs

Technical and commercial dealings were successfully concluded in Peking on the delivery of a Czechoslovak generator for pressure gasification of coal. Representatives of the Czechoslovak Foreign Trade Corporation, Technoexport of Prague and the Chinese Foreign Trade Enterprise, China National Machinery Import and Export Corporation signed a contract according to which equipment is to be delivered for the Shen-Yang Gas Plant early next year. In line with the contract, Technoexport will also render technical assistance during erection of the generator and its placement into operation.

Source: press release

Diesel power from Japan

Two Japanese companies*, under a co-operative agreement, have received the first order for a diesel power plant from China. One company will be responsible for manufacturing the diesel engines and the other will supply the power generators. On-site installation is scheduled to be completed by the end of this year.

The contract, valued at around one billion yen (US $4 M), for China's first diesel power plant was signed, as with the Czech agreement, through the China National Machinery Import and Export Corporation in Guangdong. The 16 000 kW diesel power plant will be built in Guangdong to supply power to the largest polyester plant in China.

This plant will enable the electricity supply bureau of the area to ensure an independent power supply source.

China is currently planning construction of additional major power supply facilities including a one million kW class nuclear power plant and a coal thermal power plant.

Source: press release

Oil research
£20 M centre opened

The £20M Schlumberger Cambridge Research centre was opened by Peter Walker, the Secretary of State for Energy, in November.

The building has been custom designed to contain a wide range of scientific and experimental facilities. Its primary aim is research into improvement of drilling, well-testing and completion for the world's oil industry.

The centre houses laboratories for the study of rock physics and mechanics, fluid mechanics and chemistry and computer modelling. These are supported by a unique test station which accurately simulates various drilling and production techniques.

The centre's general manager, Bernard Vivet, comments 'As the search for oil moves to deeper water, more hostile environments and smaller reservoirs, only constant technical improvements in the exploration and production process will allow operators to remain cost-effective.'

Source: Schlumberger Cambridge Research

*Nippon Kokan (NKK) and Fuji Electric

Are *you* missing out on the Journal?

The *Journal* of the Institute of Energy is published quarterly and is optionally available to members of the Institute of Energy wishing to receive it. (To those outside of membership it is available on subscription jointly with *Energy World:* price £97.00).

Authors and titles of papers published in the JInstE, September and December issues respectively

September issue

PROF A K GUPTA and PROF T W JACKSON: *Fouling and particulate deposition in practical systems*

A S ABBAS and DR F C LOCKWOOD: *Note: Prediction of soot concentrations in turbulent diffusion flames*

DR G F ROBINSON: *A three-dimensional analytical model of a large tangentially-fired furnace*

DR M A RABAH and DR S M ELDIGHIDY: *Mechanism of α-iron ore deposition on a heat transfer surface in boiling water*

December issue

DR E HAMPARTSOUMIAN and PROF A WILLIAMS: *Principles and applications of fibre optic sensors for process instrumentation and control*

I W CUMMING, W I JOYCE and J H KYLE: *Advanced techniques for the assessment of slagging and fouling propensity in pulverized coal fired boiler plant*

O TA'EED and DR B M GIBBS: *A non-linear analysis of exergy-lethergy: application to the miners' strike and FBC utilization*

J H BROMLY, F J BARNES, R C R JOHNSTON and DR L H LITTLE: *The effect of vitiation on trace pollutants from domestic gas appliances*

G K LEE and I T LAU: *Current coal-fired boiler technology in China*

B C DUTTON and R J SOUCHARD: *Gas interchangeability: prediction of incomplete combustion*

PROF S RAHMAN: *Hierarchical electric energy system planning using micro/mini computers*

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Conference proceedings

☐ **Fluidised combustion: is it achieving its promise?**
(London, October 1984)
Price: £50.00

☐ **ICLASS-85**
(London, July 1985)

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Conference notices

☐ Merseyside branch
Fuel trends: economics and utilization
18/19 March 1986 at
Liverpool Polytechnic
(Enquiries: E Curd)

☐ Institute of Energy
Yorkshire branch
jointly with
Institution of Chemical Engineers
Combined heat and power:
9 April 1986

Programme and registration form in January issue of *Energy World*

tomatic coal-fired boilers

aldwin & Sons are now producing ew range of automatic coal-fired ers which, it is claimed, operate ip to 45% less fuel costs than ivalent oil-fired units. The boilers uire minimum maintenance and rator attention time averaging ut ten minutes a day.

lew developments include a ented burner, which utilizes lraulic drive and electronic trols to operate a reciprocating te and special drag link conveyor em for automatic ash removal. s ensures completely automatic ration in the feeding of fuel from age bunkers or hoppers and the ioval of ash without the need for nual attendance.

ader enquiry no 1/1

mbination boiler

nini, the new combination boiler, nched by **Thorn EMI Heating**, can installed in situations where a ventional gas central heating eme may not be possible — ie ere conventional cold water rage, and feed and vent tanks not be fitted. It is therefore able for single-storey dwellings, conversion living areas and for ises being converted into flats.

The boiler offers the choice of nplete- or part-mains pressure tallation. Where an open-vented eme is preferred, domestic hot ter is connected direct to the mains obviating the need for a 30-gal rage tank and copper cylinder — h central heating being connected he conventional open vent system. iere total-mains pressure tallation is required, Thorn will vide the optional sealed system ssure components.

ader enquiry no 1/2

nproving burner efficiency

ı-way, a manufacturer of oil and s burners, has completed an portant product enhancement ogramme which will mean nificant cost savings for customers the heating and process industries. The main features are a new burner ad giving higher combustion rformance together with provements in the fuel control stem. The changes were primarily signed for the company's natural s burners but they have also led to in-off' benefits in the dual-fuel odels. Other features include new essure switches and a slow rvomotor providing improved itput control on the burner.

Nu-way markets a wide range of s, oil and dual fuel combustion uipment with rated outputs from -11 000 kW. There is a mprehensive spares service.

eader enquiry no 1/3

arge export order for clean ombustion burners

contract has been awarded to **NEI ternational Combustion** by Florida ower and Light Company to supply combined oil/gas burners for two the largest oil-fired boilers in the SA.

These boilers, each rated at 800 W, will be converted from oil firing combined oil and natural gas firing early 1986, using special burners developed on the company's full-scale test rig in Derby. These NEI International Combustion CMH (controlled mixing history) burners are designed to produce the lowest possible concentrations of nitrogen oxides and to operate, overall, with the cleanest possible combustion.

The prototype full-scale burner, having a maximum output of 13 000 lb/h of heavy fuel oil, will be tested and approved on the NEI Derby-based test rig to achieve the guaranteed particulate and NO_x emission levels. The burner test rig has the capability to fire oil and pulverized coal, separately or in combination, at rates of up to 88 MW.

Reader enquiry no 1/4

Boiler water level controls

Recently introduced to the UK market, the **Gestra** system represents a new concept in the monitoring and control of boiler water level, and has been designed to increase safety and reduce operating costs in steam boiler plant. The system continuously checks itself for correct operation, and if a malfunction is detected, the boiler is immediately shut down.

The equipment includes a new type of high-reliability probe, with the electrodes fitted directly in the boiler shell. This arrangement eliminates the need for external control chambers, which can be a source of trouble if connections to the boiler become blocked with sludge or scale. Because this potential problem represents a danger, current regulations call for a daily purge of the control and alarm chambers. AOTC, the insurance companies' technical committee, have agreed that this daily test is not necessary with the Gestra equipment when it is directly mounted in the boiler, although the weekly check by reducing boiler water level is still required. In making this decision, AOTC comment that the Gestra controls 'represent an equally safe more modern approach to the safe protection of a boiler'.

The Gestra equipment type EF86/NRS1-4 is mainly designed for shell boilers and is suitable for boiler pressures up to 32 bar (465 psi). Other level controls are available for the highest pressures and temperatures.

Reader enquiry no 1/5

Condensing airheater

Covrad Dravo have launched a new range of high-efficiency industrial airheaters, the UK's first condensing airheaters.

These 'Condensaire' heaters offer efficiencies of at least 95%. They achieve this high efficiency by passing the (normally wasted) flue gas through a specially designed stainless steel heat exchanger to squeeze out even more heat. Instead of venting the flue gas up the chimney while it is still hot (typically 300°C), it is cooled in the heat exchanger to such an extent that a proportion of it condenses and gives up its latent heat. The resultant flue temperature is in the order of 45°C enabling an ordinary plastic drain pipe to be used for the disposal of the products.

Two sizes of airheater will be manufactured initially: one with an output of 90 kW and one of 150 kW. They are suitable for natural gas and LPG firing. These condensing airheaters are inevitably more expensive than conventional heaters because of their more advanced design, but it is claimed that the payback time on extra capital cost is estimated to be only around two years.

Reader enquiry no 1/6

Carbon dioxide recovery in breweries

WS Atkins have developed a system for recovering carbon dioxide in breweries that could save a large brewery up to £½ million per year with a return on investment in less than two years.

Investigation had shown that breweries were spending large sums of money (up to £½ million per year) on carbon dioxide. It was also apparent that there is enough of the gas being liberated in the fermenters for most sites to be fully self-sufficient. Analysis showed that the conventional carbon dioxide recovery plant in a brewery was recovering only 35% of the available gas. This was due partly to mis-operation and partly due to an inherent limitation of conventional plant.

Atkins's energy consultants devised a brand new system which could liquefy 70% of the gas available. The plant requires a minimum of operator involvement and uses a source of free refrigeration hitherto untapped. The first unit has now been installed and is working satisfactorily. The plant, it is claimed, substantially improves the recovery of this valuable material and does so without using any energy.

Reader enquiry no 1/7

Four-frequency tube inspection system

Hocking NDT have introduced Phasec D8, a new four-channel multi-frequency non-destructive test system for the internal inspection of heat exchanger tubing in power stations, air conditioners and industrial processes.

Using the latest eddy-current technology, the Phasec D8 detects and identifies corrosion pitting, erosion, support plate wear, tube clashing, and stress corrosion cracking — which can result in tube wall failure if allowed to continue and propagate.

The system's four independent channels, each with a frequency range of 1 kHz to 1MHz, have variable gain, filtering and phase rotation to eliminate unwanted signals generated by tube supports, fins, studs, dents and probe wobble. Simpler, faster inspections result, with the high integrity demanded by the nuclear and conventional power generating industries.

All signals can be viewed on an integral memory-backed oscilloscope, with selected display grouping and matrix option. Up to eight outputs are available for data recording and remixing.

Reader enquiry no 1/8

Room thermostat

Smiths Industries Environmental Controls Company have launched a new battery-powered electronic room thermostat. The thermostat can provide different temperatures at different times of the day — and separate 'weekday' and 'weekend' programming — giving homeowners the opportunity either to reduce their fuel bills substantially or to increase comfort levels economically.

An advantage is that it is easily programmable, with electronic precision both in time-keeping and temperature measurement, and can quickly be fitted in place of a conventional mechanical thermostat for vastly enhanced control.

Reader enquiry no 1/9

Trade publication

Cavity wall insulation. Three product data sheets, each describing one of the different cavity wall insulation processes on the UK market — using uf foam, blown mineral wool (rock and glass), and expanded polystyrene beads and granules — enable the specifier to compare for the first time the individual properties of the recognized materials and methods used. The A4 sheets are an integral part of a set of fully illustrated informative literature, entitled *Injected cavity wall insulation* and produced by the **National Cavity Insulation Association**, the trade body for the entire industry.

Reader enquiry no 1/10

☐

ENERGY WORLD — COMMERCIAL
(Photocopy acceptable)

Please send me further information against the reader enquiry no(s) listed below (please tick)

1/1 1/2 1/3 1/4 1/5 1/6 1/7 1/8 1/9 1/10

Name ....

Address ....

....

Organization ....

Engineering Council

The Institute of Energy is included in the second list of nominated bodies published by the Engineering Council on 22 November 1985.

In common with other major chartered engineering institutions, the Institute of Energy has been nominated for a five year period; the maximum allowed. The Institute of Energy has also been authorized by the Engineering Council to accredit academic courses.

As a nominated body of the Engineering Council, the Institute is formally recognized by the Engineering Council as fit to determine whether individuals should be registered with the Engineering Council as Chartered Engineers or Technician Engineers as appropriate. As an authorized body, the Institute is deemed by the Engineering Council fit to accredit academic courses which satisfy the standards laid down for individuals subsequently seeking to register as Chartered or Technician Engineers as appropriate.

New members

Fellow

William Eric Francis, British Gas Corp, Solihull, W Midlands *(transfer)*
David Lloyd Williams, Energy Engineering, Preston *(transfer)*

Member

James Gillespie Alexander Borland, Scottish Gas, Paisley *(transfer)*
Thomas Ramsay Brown, Babcock Power, Nuclear Engineering Dept, London
Kai Wah Chan, Air Pollution Control Division, Hong Kong *(transfer)*
Brendan Paul Cooper, Emstar, Staines, Middx
Anthony Derrick, I T Power, Mortimer, Reading
David Flaxington, W S Atkins & Partners, Epsom
Geoffrey Colin Harwood, Michael Aukett Associates, London
Maureen Jennings, Shell Expro, Aberdeen *(transfer)*
Hoi Fai Lau, Hong Kong Telephone Company, Hong Kong
Sau Weng Lum, Vickers Hoskins, Malaysia
Hector Wilkie Munro, Paisley College, Scotland
Wing Hung Poon, Hong Kong Productivity Centre, Hong Kong
Robert Rishworth, NIFES, Yeardon, Nr Paisley
Peter Hamish Athey Roebuck, Kanthal, Perth, Scotland
Raymond Tomkins, Imperial College, London
Charles Yves Wereko-Brobby, Commonwealth Science Council, London
Ronald Clark Willis, Babcock Power, London
Yuet Ming John Wong, Shui On Engineering Services, Hong Kong *(transfer)*

Graduate

Brian Christopher Baker, NCB, Ind Sales & Technical Services, Doncaster
Michael Holmes, Sheffield Forgemasters, Sheffield
Trevor Anthony James, Guyana Sugar Corp, Guyana
Nicholas Paul Mann, Associated Octel
Kuda Ronald Mutama, Ziscosteel Coke Ovens Plant, Zimbabwe
Hugh Vaughan Norris, BOC, Sales Dev Dept, London
Christopher Charles Ottaway, Islington Health Auth, London
James Paul Ross, Metal Box, Worcs

Personal

John Bolton CB (Fellow), chief works officer and director general of works of DHSS — and formerly chief engineer to the Department — retired from the Civil Service in December. He is setting up in practice as a consulting engineer and arbitrator operating from Little Shelford in Cambridgeshire.

Dr W B Gillett (Member) was promoted to head of mechanical engineering with Sir William Halcrow, consulting engineers, on 1 January 1986. As the Engineering Services Division of Halcrow has recently been re-structured and now includes the Energy Studies Unit, Dr Gillett has assumed responsibility for both mechanical and energy engineering in the firm.

Obituary

Dr I G C Dryden (Senior Fellow) died on 14 September 1984, after a protracted illness. He was well known internationally, not only for his research on coal and its derivatives, but also for his editorial work both for the British Coal Utilisation Research Association and for the journal, *Fuel.*

He studied at the City of London School, Chelsea Polytechnic and Birkbeck College, London graduating in 1930 with a degree in physics and, later, in 1935, took a BSc in chemistry with first-class honours. Following his work in coal research he was awarded the degree of PhD in 1950, and DSc in 1953. His interests and expertise covered a wide field, as indicated by his Fellowship of the Royal Society of Chemistry, Institution of Chemical Engineers and Institute of Energy.

His distinguished career was devo largely to fuel and energy, beginnin 1928 when he joined the Fulham resea laboratories of the Gas Light and C Company. Here he worked on treatment of the by-products of c carbonization, on alternative methods removing H_2S from coal gas and ste stripping systems for benzole recov involving heat and mass transfer stu on laboratory and pilot-plant scale.

In 1943 he joined the British C Utilisation Research Association, wh he was to spend the major part of research career and make his outstand contribution to knowledge in the fielc coal research. Initially he worked on recovery of tar from coal bef combustion in the down-jet furnace a later turned his attention to solv extraction of coals, particularly w amine solvents. In 1946 he took charge the Physical Chemistry Section BCURA, and in 1949 was appoin superintendent of the newly form Chemistry Department. Additionally, was appointed deputy director of Ba Research in 1955 and in 1963 beca director of Intelligence and Publicatio In 1951 the work at BCURA on tars w relinquished to the Coal Tar Resea Association and he initiated a long-te study of the chemical nature a utilization of coals. This includ fundamental studies of carbonizati reactions, including the primary pyroli products responsible for coki behaviour and the mechanism formation of active carbons; extension solvent extraction of coals fractionation using a wide variety solvents and study of the properties of t fractions; chemical degradation stud and investigation of the physic properties of coals using non-destructi measurements which, along with t work of Prof van Krevelen's schoo established statistical constitution analysis as a method of major importan in elucidating the chemical constitution coal.

He was the author of more than publications, including some extensi works such as the chapter on 'Chemic constitution and reactions of coal' in t

IMPERIAL COLLEGE

Combustion research colloquia (1545 h, tea from 1530 h)

11 Feb (Tu). Prof Alun Thomas (Shell Research, Thornton and University of Liverpool). *A new simplified theory of turbulent premixed flames.*

25 Feb (Tu). Dr Ken Nicholson (Imperial College). *The dry deposition of sulphur compunds from the atmosphere.*

Enquiries to Prof Felix Weinberg (tel 01-589 5111 ext 4360).

plementary volume of H H Lowry's *emistry of coal utilization* and the ion on coal in the Kirk-Othmer *cyclopaedia of chemical technology*. He acknowledged as a world authority coal constitution and utilization, and and energy matters generally. He was author of the United Nations plication *Carbonization and rogenation of coal*. When the Ministry Power in 1972 decided to up date their t seller *The efficient use of fuel* duced during World War II they ed the Institute of Fuel (now Energy) handle the changes. The Institute ided to adopt an entirely new roach to the subject, and selected cialist authors for each chapter with Dryden as overall editor. The task was ajor one and produced an impressive ok with an authoritative text. Its cess is evident in that *The efficient use energy*, produced by Butterworth is w in its second edition.

He had a great respect for, and facility h, the English language, and an ability explain difficult concepts in a simple id way. He was also very willing to opt new techniques, methods and tems that were advantageous; his oklet *SI and related units* has provided lcome clarification for countless entists and engineers. The scientific and neral excellence of the BCURA blications reflected his literary ability ich also proved of the greatest value *Fuel*. He retired from BCURA in 1969 concentrate on his activities as nsultant and editor.

His work for *Fuel* was clearly an portant part of his life. He joined the itorial Board of *Fuel* in 1957, finally iring as editor-in-chief in 1979, being longest-serving editor in the history of at journal which began in 1922 as *Fuel science and practice* with the object of blishing pages on coal, which were not sily accepted by existing scientific urnals. It was initiated by the Coal search Club, an association of world-nowned experts on fuel matters which ryden was himself invited to join in 51. To begin with it appeared as a pplement to the *Colliery Guardian*, but came independent in 1923; an unusual uation since at that time most scientific urnals were associated with, and blished the proceedings of, learned cieties. In 1947-48 the journal was blished by Butterworth under the new le *Fuel*. Dr Dryden took over in 1959 d built it up into a substantial monthly blication, larger than at any time in its story. In 1982 he compiled the 60-year dex to *Fuel*.

Ian had a very high reputation as a fuel ientist and engineer; he travelled widely, cturing particularly on the Continent d in North America, and was a member the organizing committee for the ternational Conferences on Coal ience. He is much missed by his many iends.

R R JACKSON
(Senior Fellow)

Branch report — North Western

Electricity supply and demand in the North West

At a recent joint meeting of the North Western branch of the Institute of Energy and the South Manchester Energy Managers Group, Dr Paul Haigh presented a lecture on electricity supply and demand in the North West with particular reference to the unusual operating situation that the CEGB encountered during the winter of 1984/85.

The lecture started with an overview of the 'normal' UK energy scene which showed the contribution of each of our available fuel sources to the nations energy needs. Of the 340 Mt of coal equivalent (Mtce) currently consumed per annum approximately 90 Mtce are used for electricity production. Although the total amount of fuel used by the CEGB in 1984/85 was not significantly different from recent years it was obvious that the amount of coal used had reduced by almost 50%. The CEGB's strategy in operating available oil fired power stations was explained as was the reversal in normal direction of power flow from the Midlands to the South. An increase in electricity imported from Scotland was also noted. The importance and flexibility of the pumped storage power station at Dinorwig was illustrated and it was noted that during the winter the CEGB had met its highest ever demand for electricity. A glimpse at the future revealed progress in the construction of the second AGR at Heysham and early investigations into the possible siting of a further nuclear power station in North Wales.

During a rigorous question and answer session Dr Haigh discussed aspects of nuclear power safety, renewable energy resources and conservation, acid rain and radioactive waste management in addition to the main subject matter of the lecture.

DR C P HAIGH
(CEGB, Scientific services division)

Around the branches

Yorkshire annual dinner

The annual dinner of the Yorkshire branch was held at Ardsley House Hotel, Barnsley on 1 November 1985. In the top picture Sir Denis Rooke, chairman of the British Gas Corporation, proposes the toast 'The Institute of Energy'. Our second picture shows the president of the Institute of Energy, P C Warner, replying to this toast

London and Home Counties

Dr James Pfafflin from New Jersey, USA visited the UK in November with his wife, Dr Sheila Pfafflin, and attended the meeting of the London and Home Counties branch on Thursday 28 November 1985 at the Royal Institution. J D Rankin, who is group manager, Process Technology Group, ICI, spoke on *Energy, materials and processing*.

Dr Pfafflin has written to us since saying how much he and his wife enjoyed the meeting and the buffet supper that followed. He commended the speaker for his excellent lecture and wrote that 'everyone was so pleasant and made us feel so welcome'. As Dr Pfafflin and his wife are frequent visitors to the UK, he hopes that it may be possible for him to become a member of the London and Home Counties branch. He is already a Member of the Institute of Energy.

SPECIAL ANNOUNCEMENTS

52nd Melchett Lecture: Royal Institution, 6 March 1986

As previously reported (this page, December issue), *Prof N L Franklin CBE FRS FEng* (Imperial College) will give the fifty-second Melchett Lecture of the Institute of Energy at the Royal Institution, Albemarle Street, London W1 on Thursday 6 March 1986 at 1800 h (tea at 1730 h). The title of Prof Franklin's Melchett Lecture is: *Swords and ploughshares — nuclear fuel.*

Engineering Council

Please see Engineering Council, p 24, this issue, for an important notice on the inclusion of the Institute of Energy in the second list of nominated bodies published by the Engineering Council

The Institute's correct address, departmental telephone numbers and telex addition

Members and others writing to the Institute in Devonshire Street are especially asked *not* to include Portland Place in the address, which should simply be: The Institute of Energy, 18 Devonshire Street, London W1N 2AU.

As publicized on this page in November, there are now direct departmental telephone lines for speedier access. Members and others may care to note, and record, these as under:

Direct line to *Publications,* Conferences and Information 01-580 0008

Direct line to *Membership* enquiries and journal subscriptions 01-580 0077

Calls to Administration, Education and Accounts should continue to be made on 01-580 7124.

It will be helpful if it is also noted that the telex number 265871 MON REF G should additionally carry, on separate line, the mail box number: MNU142.

London and Home Counties: March meeting

Prof Bodo Linhoff of the Department of Chemical Engineering, UMIST will talk on *Energy saving through pinch technology* at the March meeting of the London and Home Counties branch. This will be held, as usual, in the Bernard Sunley Theatre at the Royal Institution, Albemarle Street, London W1 on Thursday 13 March 1986. Please note, however, that this lecture will start at **1800 h** (tea at 1710 h). The meeting will be followed by a buffet supper (by application only).

ASME/IEEE joint power generation conference 1986: Call for papers

The Steam Generators and Related Auxiliaries Committee of ASME will be sponsoring five sessions at the *Joint power generation* conference between 19-23 Oct 1986 to be held at the Portland Hilton Hotel, Portland, Oregon, USA.

Prospective authors are invited to send a short abstract to Colin R Coleman CEng, 7 Rowlls Road, Kingston-U[illegible] Thames, Surrey, KT1 3ET, who is co-ordinating the wo[illegible] the committee in the United Kingdom.

The subject of sessions will be:

a. Fluidized bed combustion.
b. Life extension.
c. Boiler auxiliaries.
d. Municipal solid waste — stoker firing.
e. Regulatory issues/capacity shortfall.

ECRO: Surrey branch AGM

The annual general meeting of the Surrey branch, ECRC[illegible] be held at the Assembly Hall, Royal Aircraft Establishm[illegible] Farnborough, Hants on Wednesday 12 February at 193[illegible] 2000 h.

Fellowship of Engineering: Engineering in agriculture

On Thursday 27 February 1986, the Fellowship of Enginee[illegible] will be holding a meeting to highlight some of the contribut[illegible] that engineering makes to agriculture. Prof Brian May, [illegible] of Silsoe College will speak on a selection of topics.

The meeting will be held at the Institution of Mechan[illegible] Engineers, Birdcage Walk, Westminster, London SW1 at [illegible] h (tea from 1700 h). Anyone interested in attending is a[illegible] to contact Mrs J Lindley, Fellowship of Engineering, 2 L[illegible] Smith Street, Westminster, London SW1P 3DL (tel 01-[illegible] 2688).

National Energy Management Awa[illegible] 1986

1986 is the eighth year of the Powrmatic/NIFES *Nati[illegible] Energy Management Award* — a competition in which suc[illegible] has become a prestigious honour keenly sought by the grow[illegible] number of aspirants who enter each year.

The competition, which receives the co-operation [illegible] support of the Department of Energy, is designed to find [illegible] most effective energy programme and to reward its mana[illegible] It reflects a new impetus in the drive for more efficient us[illegible] energy by industry, commerce and local government.

A top prize of £1000 will be awarded to the national win[illegible] who will be selected, by a panel of independent judges, fr[illegible] regional winners who will each receive £50 and an engra[illegible] gold pen. A certificate of commendation will be presente[illegible] the winning companies. The national winner's organizat[illegible] will hold the Energy Management Trophy for one year.

The competition is open to everyone responsible for [illegible] efficient use of energy — ranging from large ene[illegible] management schemes to original individual measu[illegible] implemented before the end of 1985. The judges will t[illegible] particular note of the application of sound ene[illegible] management principles and of the comparative size [illegible] resources of each entrant's organization. Entrants in large [illegible] small organizations have an equal chance of winning.

The following points should be taken into considerat[illegible] when submitting your entry:

- ☐ Effective energy management with clear accountability [illegible] energy costs.

(continued on p

REGISTER OF ENERGY COURSES

mbers are invited to make use of the titute of Energy's national register of rgy courses, through which we can ply salient details of forthcoming irses of all types. As well as the mber's name and address, we need to ow (a) the specific subject in which he interested; (b) his present level of nical qualification; and (c) the ferred geographical location. Only ails of suitable courses will be sent in ly.

Ve take this opportunity of listing a ction of courses due to start in the ir future, and details of each can be ained by quoting the reference number wn against the entry. Please enclose a mped addressed envelope.

ourse No 00-340

le: Space heating controls.
ration: 2½ days.
cation: British Gas School of Fuel Management, Solihull.
irting: 4 March 1986.
ntent: Control aspects of different heating systems, meeting various legal requirements and factors that can be controlled. Temperature controls and the theory of closed loop controllers and compensators, both in their simple and more sophisticated form. Simple time controls, the theory of

Course No 00-340 (continued)

Content: optimum start control and the various kinds of optimizers available. The theory, application and planning of computer-based energy management and building automation systems.

Course No 00-344

Title: Electric circuitry and controls (stage 1).
Duration: 4½ days.
Location: British Gas School of Fuel Management, Solihull.
Starting: 10 March 1986.
Content: Electric current, voltage and power, AC and DC circuits, single-and three-phase supplies. An examination of simple electrical control circuits found on a wide cross-section of high- and low-temperature non-automatic plant. An introduction to the operation of semi-automatic control systems and flame detection devices. An introduction to the requirements and applications of on/off fully automatic control units. Wiring up exercises on switches, relays and timers.

Course No 00-344 (continued)

Content: Wiring up exercises on high- and low-temperature control systems. Fault finding on simple gas-fired plant.

Course No 00-341

Title: Combustion and its control.
Duration: 3½ days.
Location: British Gas School of Fuel Management, Solihull.
Starting: 11 March 1986.
Content: Basic combustion chemistry, flame temperature, emissivity, fuel quality and flame shape, air/gas ratios. Flue gases and flue gas testing, corrosion and acid dewpoint etc. The practicalities of combusting oil, gas and coal are examined separately. Differences in burner and plant design, heat transfer characteristics, storage and handling, pollution etc. Features of different control systems and the implication for fuel economy. Case study work—heat balances. Practical boiler and furnace testing. □

cial announcements (continued)

Appropriate monitoring procedures.
Effective use of energy data and active energy control procedures.
Use of target energy reductions and other motivational methods.
The use of a total approach to energy efficiency including management techniques, training, and cost effective technology, etc.
Achievement.

ry forms from: GKPR, Powrmatic & NIFES National rgy Management Award, 60/63 Victoria Road, Surbiton, rey KT6 4NW.

ntries will not be accepted after the closing date of *1600 12 June 1986.* All entries will be acknowledged on receipt. organizers accept no responsibility for entries that are lost rrive late. The judges reserve the right to reject any non lible entries.

ew award to boost engineering design

important award to promote engineering design has been ched by the Council for National Academic Awards, the ly which grants and confers degrees in the non-university or. The *Sir Denis Rooke award* will be offered annually an engineering product which has been designed by a lent, or group of students, on an approved CNAA degree, ch most aptly matches design with practical engineering cepts.

Sir Denis Rooke, chairman of British Gas, is an ex-chairman of CNAA. He is backing the award strongly: "There is no doubt that the more effective creation of wealth is of paramount importance to our country and that the contribution of engineers is vital, both to industrial regeneration and to international competitiveness. The success of that engineering contribution rests primarily on the quality of the education and training... which our engineering students undergo."

The closing date for entries will be *30 September 1986* and the prize will be £500. Entries will be appróved by a panel of academics and industrailists.

For criteria and regulations please contact David Sheppard, Sally Keith or Dr Alan Hibbert (CNAA) (tel Tyneside (091) 281 7094/5, 01-278 4411 (CNAA); *after hours,* Longframlington (066570) 464, D Sheppard; Seaton Delaval (091) 237 6021, S Keith).

Stop Press....

As we were going to press we heard, with regret, of the death of Dr H E Crossley OBE, a past president and former honorary secretary of the Institute of Fuel (now Energy) and a Melchett Medallist. He was at the time of his retirement in July 1971 chief fuel technologist of the Central Electricity Generating Board. A full obituary will appear in a later issue of *Energy World.*

CONFERENCES

The following conferences, courses and meetings are organized by bodies other than the Institute of Ener
For Institute conferences please see page 1

February 1986

Coal testing

Fifth international conference, Lexington (KY, USA), 11-13 February 1986.
Details from K Gallagher, 1001 Overlook Way, South Charleston, WV 25309, USA (tel (304) 768-0556; tlx 907040).

Technology for environmental protection

Fifth international congress and trade fair, Düsseldorf (FRG), 17-21 February 1986.
Details from NOWEA, Postfach 32 02 03, D-4000 Düsseldorf 30, FRG (tel (0211) 456001; tlx 8584853 mes d).

Effectiveness and economics of various back-up systems in power stations and grids

Technical meeting, München (FRG), 19 and 20 February 1986.
Details from VDI, Postfach 1139, 4000, Düsseldorf 1, FRG (tel (0211) 6214-228).

Transfer and utilization of particulate control technology

Sixth symposium, New Orleans (USA), 25-28 February 1986.
Details from Dale L Harmon, Air and Energy Engineering Research Laboratory, MD-61, Environmental Protection Agency, Research Triangle Park, NC 27711, USA.

February/March 1986

Energy law

Seminar, München (FRG), 23 February - 1 March 1986.
Details from seminar administrator, International Bar Association, 2 Harewood Place, London W1R 9HB (tel 01-629 1206).

March 1986

Air conditioning: impact on the built environment

Conference, University of Nottingham, 20 and 21 March 1986. *The Institute of Energy is a sponsor.*
Details from conference secretary (AC), CICC, PO Box 2, West PDO, Nottingham NG8 2TZ (tel 0602 282257).

April 1986

Advances in reliability technology

Seminar, University of Bradford, 2-4 April 1986.
Details from Mrs Ruth Campbell, Technology Transfer Unit, National Centre of Systems Reliability, Wigshaw Grange, Culcheth, Warrington WA3 4NE (tel 0925 31244 ext 7243/7318; tlx 629301 ATOMRY G).

April 1986 (continued)

Amer Inst of Chem Eng spring national meeting

New Orleans, USA, 6-10 April 1986.
Details from Dr J R Hopper, Lamar Univ, Beaumont, TX 77710, USA (tel (409) 838-8784).

Energy

International exhibition, Budapest (Hungary), 14-17 April 1986.
Details from Aideen Barrett, Industrial and Trade Fairs International, Radcliffe House, Blenheim Court, Solihull, West Midlands B91 2BG (tel (021) 705-6707; tlx 337073).

Ifsec 86

International fire and security exhibition and conference, London, 14-18 April 1986.
Details from Ifsec 86, Communication House, 879 High Road, North Finchley, London N12 8QA (tel 01-446 8211; tlx 8811108 IFSSEC G).

Air pollution

Eighteenth annual workshop, Chicago (USA), 15-17 April 1986.
Details from Lorene L Sigal, Environmental Science Division, Oak Ridge Laboratory, PO Box X, Oak Ridge, Tennessee 37831, USA (tel (615) 574-7266).

Enhanced oil and gas recovery

Seminar, London, 16-17 April 1986.
Details from Miss Mallory Barker, Oyez Scientific & Technical Services, Bath House (3rd floor), 56 Holborn Viaduct, London EC1A 2EX (tel 01-236 4080).

Australian coal

Fifth conference, Surfers Paradise (Queensland, Australia), 21-24 April 1986.
Details from Dr J B Ritchie, Austn Coal Assn, POB Q 339, Sydney, New South Wales 2000, Australia (tel (02) 297202; tlx AA2740).

Measurement of toxic air pollutants

National symposium, Raleigh (NC, USA), 27-30 April 1986.
Details from Dr R K M Jayanty, Research Triangle Institute, Research Triangle Park, NC 27709, USA (tel (919) 541-6483).

April/May 1986

Coal science

International symposium, Rolduc (Netherlands), 28 April-1 May 1986.

April/May 1986 (continued)

Details from F Kapteijn, Inst f Chemical Technology, Univ Amsterdam, Nieuwe Achtergracht 1(NL-1018 WV Amsterdam, Netherlan (tel (020) 522-3490; tlx FACWN 1646

May 1986

Effective utilization of raw materials, semis & consumables iron & steel industry

Conference, Kuala Lumpur (Malaysia 21-25 May 1986.
Details from 5th floor, Ortigas Bld Ortigas Ave, Pasig, Metro Manil Philippines (tel 6732161 or 6732069).

Programmable electronic systen safety

Seminar, Guernsey, 28-30 May 1986.
Details from Mrs Ruth Campbe Technology Transfer Unit, Nation Centre of Systems Reliability (see addre above).

June 1986

Commercialization and indus rialization of outer space

International conference and exhibitio Montreux (Switzerland), 16-20 Ju 1986.
Details from Space Commerce 8 secretariat, PO Box 122, CH-182 Montreux, Switzerland (tel (41 21) 63 4 48; tlx 453 254 mtx ch).

Project management training – future needs, scope and results

One-day conference, London (Cit Conference Centre), 19 June 1986.
Details from Lionel Plumb, Proje Management Forum, c/o Institution c Mechanical Engineers, 1 Birdcage Walk London SW1H 9JJ (tel 01-222 7899 e 296).

Rov 86

Fourth remotely operated vehicl conference and exhibition, Aberdeen 24-26 June 1986.
Details from Society for Underwate Technology, 1 Birdcage Walk, Londo SW1H 9JJ (tel 01-222 8658; tlx 917944)

September 1986

Aquatech 86

Eleventh international water technolog exhibition and congress, Amsterdam (Netherlands), 15-19 September 1986).
Details from Industrial Presentation ((Europe) BV, 's-Gravelandsewe 284-296, 3125 BK Schiedam, Th Netherlands (tel (010) 158244; tlx 2142 EUREX NL).