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A clarion call to companies and organisations

Training accreditation

The Engineering Council during the past year has published a number of reports all with the ultimate aim of raising the standards of education and training of professional engineers in this country.

One of these papers *Standards and Routes to Registration — Codes of Practice (SARTOR)* deals with the Engineering Council's requirements for chartered status both for academic courses and industrial training. It emphasises particularly the need for industrial training programmes to be accredited.

The Education and Training Committee of this Institute is aware of its increasingly important role in advising the Council (of the Institute) of the training requirements acceptable for membership. Accordingly last year it set up a Training Accreditation Panel with the following remit:

To:

a) monitor and consider all matters concerned with training in the field of energy and related subject areas and continually review the Institute's training requirements for membership and recommend any changes considered appropriate.
b) advise on suitability of courses of training as satisfying the requirements of the Institute.
c) advise organisations and individuals of the Institute's training requirements.
d) liaise with Membership Committee, organisations, companies and other institutions on all matters to do with training in the field of energy.

The panel sees as one of its first tasks the definition of training programmes acceptable to the Institute.

It is aware that many companies and organisations have excellent programmes for their young staff both at graduate and technician level. It would be glad to hear from them so that their experience can be applied for the benefit of this Institute and future applicants.

The committee has already approved a first-class training scheme submitted by a major company.

If you feel your organisation can help in this task, please contact me with a view to arranging a meeting or sending particulars of your training programme to me at the Institute.

I look forward to hearing from you.

J R Willetts *(Fellow)*
Chairman, Training Accreditation Panel

Second in a series of three papers given to the World Energy Conference last year: this paper formed part of the session on rational energy use

The potential for energy conservation in developed and developing countries

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Energy conservation is of major importance to all the countries in the world for reasons which vary from country to country. Up to 1972 the world energy demand was rising at over 4% pa and had done so since 1960. The sharp increase in crude oil price demanded by OPEC (Organisation of Petroleum Exporting Countries) in 1973 and again in 1979 caused difficulties in the energy supply system and plunged the world into economic recession.

The proposed solutions to this problem were energy conservation, fuel substitution, alternative energy sources and nuclear power. The remarkable features of the last decade have been the slow growth in nuclear power and more particularly the failure of alternative energy sources to materialise. Whilst great advances have been made in basic research, little has resulted in practical terms. Thus renewable energy sources (from solar to tidal), and liquid fuels derived from biofuels (and from coal) have all been disappointing and not economically viable in the face of the success of developing technology to extract greater quantities of traditional fossil fuels. Thus it seems that for many decades there will be a continued dependence on fossil fuels, both as primary and secondary energy sources, and it is important that all these fuels should be utilised as effectively as possible. This partly arises from economic considerations and partly because of a greater understanding of the finite nature of fossil fuels.

In addition, because of the slow development of nuclear power, it is likely that by the year 2000, only about 10% of the world energy supply will be in the form of nuclear-generated electricity. Nuclear-generated electricity is also constrained by technical and economic reasons to maintain a high load factor and this can raise problems in many applications. As a result, considerable effort has been devoted to energy conservation and energy management so that the use of available energy resources can be maximised.

Further efforts are being made to develop new sources of both renewable and alternative energy. In doing so there is a need to compare the merits of a number of energy options, and in particular, it is necessary to have the right balance between energy production and energy conservation. This comparison cannot always be usefully undertaken in economic terms because of the rapidly changing prices of fuels and equipment. Analyses in energy terms can be a more helpful and useful way of achieving comparisons.

We must also distinguish between the interest of the nation concerned, and that of the individual or compa In the case of the nation, the primary interest in selec an energy strategy is the national balance of payme whereas the individual consumer or company compare the overall cost of energy conservation measu with the cost of the fuel which would be saved. Th investment in an energy option which does not give a h enough rate of return to be attractive to a company wo be rejected, whereas the same option, duplicated ma times, could represent considerable savings to the natio balance of payments.

Energy provision: current policies and technolog

Improved efficiency of energy usage has a major rol play in the economic growth of both developed a developing countries. Major energy conservat programmes have been instituted in industriali countries and generally these have many similar featu They were largely initiated by the 1973 oil crisis and ma countries instituted 'crash' programmes over subsequent three or four years. Whilst initially supply a problem, the major longer term effect was price and avoid the economic consequences action was taken various countries. However progress has been uneve Thus, as shown in Table 1, Japan has achie considerable success, a growth in GDP between 1978 a 1982 of 39% with negligible change in energy usage, a a reduction of a third in the energy component industrial activity. In contrast the UK has reduced energy content of the GDP by 20%, although thi partially due to the increase in GDP resulting from No Sea Oil production and in general the UK is a hig energy intensive country. The USA has been even successful having reduced its GDP-energy ratio by o 14%.

Table 1 *Effects of energy conservation programm in industrialised countries*[1]

	Energy-GDP ratio				*Energy consumption % change*	*GDP growth*	*Indust produc*
	1973	*1982*	*Change (%)*		*1973-82*		
UK	0.98	0.78	−20	(−21[a])	−15	+7	−18[a]
USA	1.12	0.96	−14	(−23)	+5	+17	+7
Japan	0.69	0.50	−18	(−34)	+1	+39	+24
FR Germany	0.64	0.52	−19	(−30)	−6	+16	+3
Europe[b]	0.71	0.60	−16	(−30)	−2	+16	n.a.

[a]Manufacturing only. [b]Excluding France.
Note: Figures in brackets are changes in industrial energy use — indu production ratio.

In the developing countries the response was a uneven. In the early 1970's, the energy consumption the developing countries was only 10% of the world to

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they supported two-thirds of the world's population. as been estimated that at the time of the 1973 oil price that the industrial developed countries utilised energy h a 50% conversion efficiency whilst the developing ntries only had a 35% conversion efficiency or less. What happened subsequently in the 1970's is of siderable interest. There was great scope for the eloping world to improve its standards of fuel version efficiency. This scope is even greater now that developing countries have doubled their share of mmercial fuel energy (20% now compared with 10% 1955).

n addition there has been a considerable growth of ups or individual energy consultants offering energy- ing advice and services, from simple energy savings to plete factory retro-fitting. They have varied in petence, with some advice being financially unsound, ause they were over-optimistic, or based on continually easing energy prices which did not materialise. fessional Institutions also took an active and minent role, but their contributions varied widely from itution to institution and from country to country. Since 1973 energy conservation strategies have ranged ween two extremes, one in which governments have en an active directing central role, and others in which liance on market forces is a major ingredient.[1,2]

rgy resources and policy

perceived availability of energy resources, possible straints and likely price changes influence energy cies, such as they are. The inability in the past to lict likely increases, or decreases in energy demand — present depressed state of world oil demand is a case oint — or sudden price rises, for whatever reasons, caused some analysts to despair. Nevertheless, we eve some sort of planning framework, however ible, is better than no plan at all. Planning for ertainty has become the norm: unfortunately, the nagerially unhelpful technique of 'multiple scenario ning' in which a wide range of possibilities is presented also become fashionable.

here are, however, some foundations in the constantly ting sands. The World Energy Conference (1980) has prehensively assessed the world energy resources. The ld resources of all fossil fuels amount to 347×10^{21} which only 31×10^{21} J are recoverable under current nical and economic conditions. At the present time ld consumption of fossil fuels is running at 400×10^{18} hich, using simple arithmetic gives only 80 years or f supplies left. Uranium used in current thermal tors does not make much difference to this ppointingly short time to fuel famine. If, however, der technology is adopted, and the uranium is ned' some 60 times more efficiently than in thermal ons, uranium-proved reserves will provide 114×10^{21} mounting to six time the recoverable coal reserves, h is a striking improvement.

steady increase in supply is anticipated for all energy ces except nuclear power, where growth is expected extremely rapid, and oil and gas, on the other hand, h are expected to peak in 1995 and 2010 respectively. four-fold growth in renewable resources over the d will only be achieved with extreme difficulty and major component at the present time, fuelwood, is expected to increase at all in absolute terms. A possible ly maximum of 690 exajoules (1 EJ = 10^{18} J) is ected for 2000, rising to 1000 exajoules by 2020. The lem is to anticipate demand in sufficient time to plan execute a strategy that will ensure an adequate, safe, ly of energy. There has been a tendency recently ngst policy makers to despair of ever getting demand projection right and *ad hoc* solutions have become the order of the day. This could well prove a recipe for disaster so that some new initiative could be welcome.

One approach is to examine critically the different methods adopted for solving the 'energy equation', namely[3]

$$\text{Supply} \leqslant \text{Demand}$$

This supply-demand equation can be formulated simply in terms of a series of, not always independent, parameters, thus

DEMAND can be expressed as:

Ψ[(economic growth), (energy coefficient), (price changes)]

The long term also includes Ψ[(inflation), (accumulated debt)] , and therefore

Demand $\propto \Psi$ [EG, EC, PC, IF, AD]

Demand is a function of economic growth and the price mechanisms. The energy coefficient is defined as (% growth in energy consumption)/(% growth in output) and is a measure of the effectiveness of energy conservation strategies. An important exponential effect is that of population growth which, worldwide, averages at 2% pa; but in some countries, noticeably India with a population of 800 M, it is double this figure. Over the next 20 years population growth could account for some 60% of increased energy demand.

SUPPLY can be expressed as:

Φ[(fossil fuel production), (nuclear power), (renewables)]

Multiply by an efficiency factor

The long term also includes Φ[(discovery), (investment)] , and therefore

Supply $\alpha\varepsilon \times \Phi$ [FF, N, RE, D, I] x risk factor

On the supply side the efficiency factor, incorporating both recovery and use, has a dominating multiplying effect. A risk factor is also included to take account of unexpected happenings, such as the Iranian coup, or the accident at Three Mile Island, which affect supply.

The supply and demand equation can be complex or simplified. In the short term, discovery, investment and renewables can be neglected on the supply side. On the demand side inflation and accumulated debt can be omitted. Taking also a very simple series of assumptions about Efficiency = 0.5 (but could be much less, say, 0.3), Risk Factor = 0.8 and Energy Coefficient = 0.7 (for the industrialised West) a much reduced form of the equation emerges as follows:

$\varepsilon \times \Phi$[FF, N, RE, D, I]. RF $\leqslant \Psi$[EG, EC, PC, IF, AD]

In the short term this reduces to $\varepsilon \times \Phi$[FF, N] , RF $\leqslant \Psi$[EG, EC, PC]

Very simply it can be expressed as $0.5 \times \Phi$[FF, N] $\times 0.8 < 0.7 \times \Psi$[EG, PC]

In trying to achieve an analytical solution to the equation the appropriate boundary conditions must be included. The finite nature of fossil fuel or uranium resources represent ultimate limits on fuel availability. Exponential growth in consumption quickly leads to exhaustion. The equations are much simplified if, as in France, a largely single-fuel solution such as nuclear is introduced. Another simplifying technique has been adopted in some centrally planned economies where growth and choice and prices are closely controlled.

If a numerical solution is attempted it involves the amassing of large quantities of data on historical fuel usage and the generation of future projections using a series of possible economics-based mechanisms. It is usually an inelegant 'number-crunching' exercise leading to a preferred solution, such as the UK 1974 plan for coal, which can be slavishly followed, despite early indications of it being 'off target'.

The iterative method has rather more to commend it. Here a solution is guessed at, the Coal-Conservation-

Nuclear solution is a good example, and it is introduced in an experimental way to see how it works. Flexibility is introduced at an early stage so that the plan can be modified to accommodate unexpected changes. This way one steadily approaches a solution to the problem. It is important not to react too quickly to change, as 'hunting' can be introduced into the demand curves. Short-term fluctuations must be damped down, otherwise they introduce too strong a perturbation. This can be achieved by building across national boundaries, and so on.

Guessing a solution is an extremely unsatisfactory way of proceeding. Despair at the failure of previous predictions and plans can lead to the belief that R & D will surely turn up with something, but this is no kind of solution. There is another danger and that is attempting to solve the wrong equation, or a different equation. For example, if as a result of perfectly understandable concern, one maintains an uneconomic, oversized coal industry in order to preserve jobs, one is trying to solve an equation involving social engineering by imposing an unacceptable condition on the energy equation. Unemployment problems cannot be solved this way. The intrusion of other constraints, such as fear of a nuclear accident or an indefinable affinity with, and desire for, renewable and benign energy supplies also leads to an 'irrational solution' of what is really a different equation with added parameters, such as emotion.

Patterns in energy conservation

The patterns in energy consumption for the world are shown[4] in Fig 1, together with predictions made by the Institute of Energy in 1972.[5] Those predictions predated the OPEC influence on petroleum demand and the consequences in total energy are clear in Figs 1 and 2. This is the result of a lower dependence on oil than in 1975,

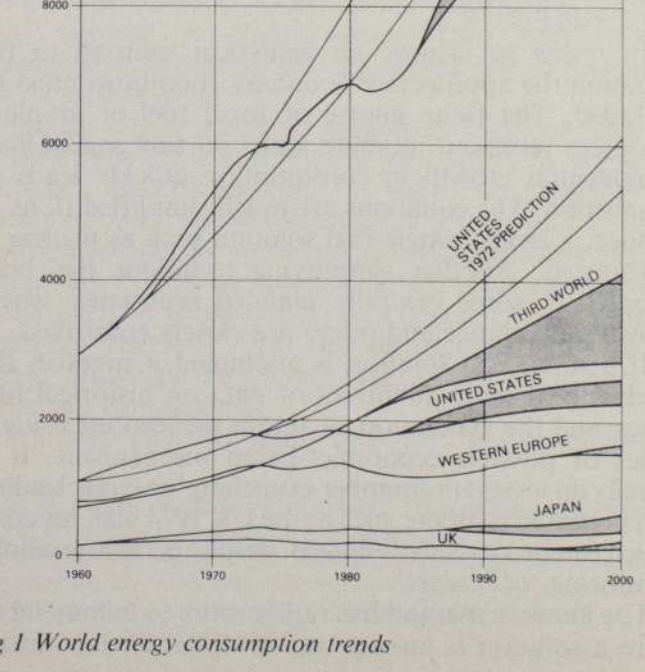

Fig 1 World energy consumption trends

and oil now accounts for 40% of the world's ene usage, whereas it was 45% in 1975.

The energy consumption patterns in Western Euro UK, Japan and USA are shown[4,5] in Fig. 2. The detai are as follows:

Table 2 *Energy ratio and primary energy consumption for the UK*[12]

Year	*Energy ratio (tonnes of coal equivalent/£1000 GDP)*	*Total inland consumpti of primary energy (temperature correcte Mt coal equivalent*
1950	2.3	227.7
1960	2.1	270.9
1970	2.0	336.3
1973	1.9	354.2
1975	1.8	326.9
1980	1.7	327.2
1982	1.6	311.7
1984	1.5	312.1

Energy ratio = $\frac{\text{total inland consumption of primary energy}}{\text{gross domestic product at 1980 factor cost}}$

(i) Western Europe

Energy consumption fell in the Western Europ countries from 1979 to 1984 but now appears to increasing at an average rate of 1.8% to the year 20 Reductions in oil consumption, however, are proceed rapidly and this region cut its oil dependence from 6 in 1973 to 48% in 1984, and a predicted 38% in 20 Many countries are, however, still more than 50% dependent: Denmark, Finland, Greece, Italy, Portug Spain and Sweden are among them.

Studies by the EEC commission show an impres drop of 19% in the energy demand/GDP ratio betw 1973 and 1982, but this is now levelling off. Not all this can be accounted for by changes in the regio industrial structure, and the EEC had found 'cl improvements in the efficiency of energy use' in member countries. Given an average GDP growth 2.4% a year in 1985-2000, this represents an 'ene coefficient' (energy use against GDP) of about 0.8 1985-1990 compared with 0.94 in 1982 and 0.98 in 19 However, these global figures disguise widely differ situations among the countries in Western Europe.

(ii) UK

Energy consumption in the UK peaked in 1973 and gradually decreased over the last ten years as showr Fig 2 and Table 2. The contributions from individual f have also changed markedly, as shown in Fig 2. The is discussed in further detail in section 4.

(iii) Japan

Primary energy consumption in Japan increased by in 1984 after having levelled off in 1982-83. consumption has been reduced even more effectiv falling by 22.3% between 1979 and 1983 (although drop in 1982-83 was only 1% and there was a slight in 1984) but Japan remains over 60% dependent on however this is expected to fall to 47% by 2000. Japa proposed coal growth has so far failed to material demand actually fell in 1981-82 but it will increase at 1. from 1984-2000. The expansion of nuclear power has slowed, but the recent improvement in Japanese reac performance and the coming on line of new capac should raise nuclear's share over the next few years fr supplying 8% in 1984 to 17.5% in the year 2000.

MITI has cut back its forecasts of 1990 energy dema in all quarters and total demand in 1990 is now forec to be cut 20% on estimates made four years previou The most radical cuts were in the forecasts for coal a

demand. Coal use in 1990 is now put at 107-113 Mt
ıpared with a former forecast of 153 Mt; gas
ıjections have been cut from 68 mkoe to 56-60 mkoe.
se statistics provide clear evidence that the country has
le genuine progress in reducing its energy intensity.

USA

nary energy consumption has fallen steadily in the
A and Canada since 1979; by 10% in the USA and by
in Canada. In the USA, this has in the past year
n mainly at the expense of coal and gas. Oil
sumption, after dropping rapidly in 1979-1982, fell by
0.7% in 1982-83. Gas consumption, however, was
n nearly 6% in 1982-83 while coal consumption,
ite rising 1.4% to 400 mtoe, failed to regain its 1981
l of 406 mtoe. The rapid growth in nuclear power
erienced in the early 1970's has tailed off, with
sumption rising on 3% last year. Hydropower use,
vever, is still developing. Canada, by contrast, cut oil
sumption by 8.8% in 1982-83, whilst nuclear
sumption was up 26.7% and coal consumption up
%.

A number of forecasts suggest that US energy demand,
r four years of decline, will begin to pick up again and
eed it was increased by 3% in 1984 and *ca* 2% in 1985.
expected to rise steadily at about 1% a year through
rest of the century. The demand increase caused by
proving economic performance will be offset by
eased efficiency of energy use, saturation in many end-use markets, and a general population shift away from the cold north-east to the warm south-west.

A substantial improvement is expected in the ratio of energy use to industrial production. In 1984 the energy coefficient was 0.87 (compared with 1972) and this is expected to decrease to 0.60 by the year 2000.

The influence of energy conservation on energy consumption patterns in the UK

The UK has traditionally been strong in fuel or energy efficiency and there have been gradual improvements in efficient utilisation of fuels. it is estimated that in 1913 only 15% of the potential energy of coal was usefully used, in 1947 it is estimated that this had risen to 30%, and in 1980 it was 50%. The need for the efficient utilisation of energy has been given several major reminders during this century. For example, during the Second World War and for a period afterwards, very considerable efforts were devoted to fuel efficiency. The Ministry of Fuel and Power had a 'Fuel Efficiency Committee' which published *Fuel Efficiency News.* In the June 1946 issue, the then Minister of Fuel and Power, the Rt Hon Emanuel Shinwell, MP, wrote "let no one be content until he is satisfied that every ton of coal is doing the maximum work that can be got out of it. Remember that the little you can do is part of the greater whole of many." Conferences were held on the efficient use of energy, excellent reference books were produced and the Ministry, together with the Institute of Energy established

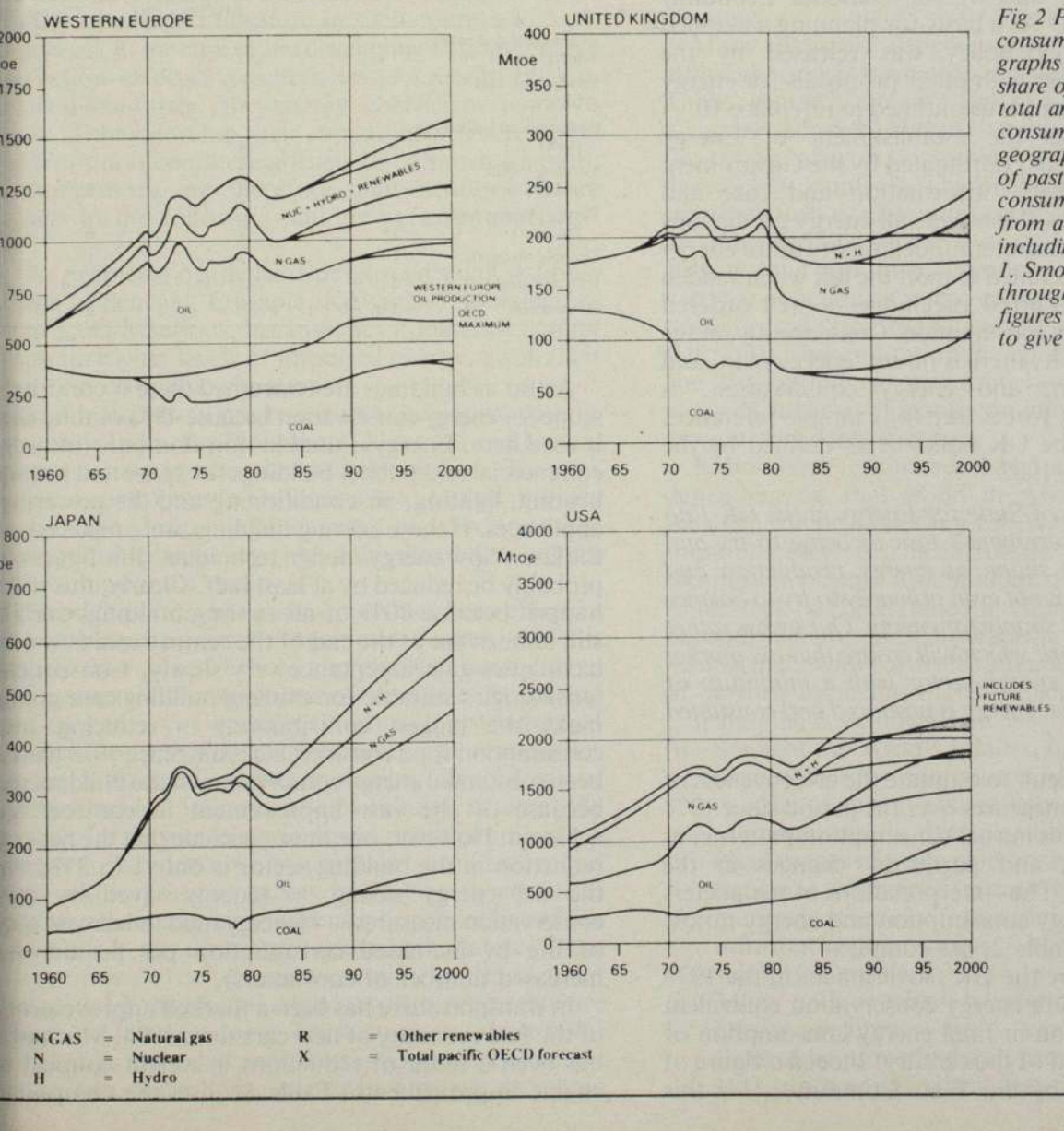

Fig 2 Patterns of energy consumption: these graphs illustrate the relative share of each fuel in the total annual energy consumption of various geographical areas. Statistics of past and predicted consumption were obtained from a variety of sources including those listed in Fig 1. Smooth lines were drawn through the historical figures and forecast figures to give the curves shown

a programme of higher education in fuel technology.

The advent of cheap oil, North Sea gas and the promise of nuclear power led to a decrease in interest in energy conservation. Thus the *Fuel Policy* document[7] presented to Parliament in 1967 was concerned only with sources of energy, and no reference was made to energy conservation.

The 'energy crisis' generated by the oil shortage and the associated price increase caused acute public concern. In 1974 the Government produced an energy saving package which covered

(i) a loan scheme for energy-saving investment in industry
(ii) energy saving schemes for buildings, including a 20°C compulsory limit on room temperature
(iii) a reduction in maximum speeds for vehicles
(iv) a publicity scheme (SAVE IT) launched by the Department of Energy.

In addition, since oil product prices increased this was the main method used to reduce oil consumption. However, between 1974 and 1979 the price mechanism was not the major method used by the Government to reduce energy consumption. Indeed, in the 1970's energy prices did not reflect true costs and it was some time before natural gas prices equilibrated with other energy prices.

Various coordinating or advisory committees in energy conservation were formed, such as the Advisory Council on Energy Conservation, and indeed a National Energy Conference was held in 1976 as a means of opening up and extending public debate on the energy issues and options facing the UK. Many excellent reports were issued, for example that by the National Economic Development Office.[8] As a basis for planning a detailed document on energy policy was released by the Government,[9] together with other proposals for energy conservation, for example as outlined in reference 10. A major outcome was the establishment of Energy Managers' Associations coordinated by the Government together with publicity, information and case and demonstration studies. However, all energy predictions including complex computer modelling of future energy consumption patterns failed to meet the test when sudden economic change occurred precluding a well ordered development in energy consumption. Consequently, at the present time in the UK, there is no set 'energy plan' and energy consumption, and energy conservation, is controlled by market forces (see for example references 2 and 11). Indeed the UK policy is as defined by the Secretary of State in 1982:

> *'As Secretary of State for Energy in the UK I do not see the Government's task as being to try and plan the future shape of energy production and consumption. It is not even primarily to try to balance UK demand and supply for energy. Our task is rather to set a framework which will ensure that the market operates in the energy sector with a minimum of distortion and that energy is produced and consumed efficiently.'*

It is extremely difficult to estimate the effectiveness of energy conservation measures over the period since 1974 because of the changes in fuel consumption patterns, as indicated in Fig 2, and partly by changes in the structure of industry. Thus interpretations of parameters such as primary energy consumption and energy ratios, which are given in Table 2, are complex.

Calls were made by the UK Government in the 1978 Green Paper for future energy conservation equivalent to an overall reduction in final energy consumption of about 20% by the end of the century. Indeed a figure of 30% was proposed by the Watt Committee,[13,14] this being based on

(i) 10% by good housekeeping or behaviou conservation, and
(ii) 20% by technological conservation, this consisting 10% by applying existing technology and 10% developing new technology.

In fact other analyses, for example, reference postulated even greater conservation measures. Howe it is apparent that this has not yet been achieved, considerable progress has been made and this is analy below.

Within the UK, energy is consumed via the follow sectors thus:

Industrial processes	*32%*	
Domestic building	*29%*	*48%*
Non domestic building	*19%*	
Transport	*18%*	
Others	*2%*	

As far as industrial processes are concerned the ene conservation that has been achieved is w documented.[16,17] The changes in energy consumpt that take place result from an aggregate of long-te structural changes in industry and the economy. improvements in energy efficiency achieved are show Table 3.[17]

Table 3 *Energy efficiency and structural change in industry, 1967-1980*[18]

	Overall change in Energy-Output Ratio (%)	Change in Energy-Output Ratio due to Energy Efficiency (%)	Change in Ene Output Ratio to Structura Change (%
Engineering and other metal trades	−3	−3	—
Food, drink and tobacco	−7	−9	+2
Chemicals and allied trades	−4	−4	—
Textiles, leather and clothing	−11	−9	−2
Paper, printing and stationery	−15	−9	−6
Ceramic materials	−1	−2	+1
Iron and steel	+2 (−9)	+2 (−9)	— (−)
Other trades	−1 to −2	+1	−2 to −3

As far as buildings are concerned there is considera scope for energy conservation because 48% of total ene is used here. Energy is used in non-domestic (industr commercial and public) buildings for space and hot wa heating, lighting, air-conditioning and the powering appliances. If these existing buildings were replaced us the latest 'low energy' design techniques, this figure co probably be reduced by at least half. Clearly, this will happen because 80% of all existing buildings are lik still to be in use at the end of the century and new des techniques gain acceptance very slowly. Consequen technologies suitable for existing buildings are going make the biggest contributions in reducing ene consumption for a considerable time. Since 1973 there been substantial energy conservation in the building sec because of the vast improvement in comfort le achieved. However, one must conclude that the net ene reduction in the building sector is only 1 to 3%, wh the net energy saving = (energy saved by ene conservation measures) — (energy used to increase qua of life by increased consumption per person or increased number of consumers).

In transport there has been a marked improvement of the fuel economy of new cars since 1974. Much of has been a result of reductions in weight coupled v engine improvements. Table 4[20] lists the compoun

rovements possible for various options and shows that matic improvements are still possible. Nevertheless in period 1974 to 1984 energy consumption in the sport sector has increased. In the case of motor cars fuel consumption/vehicle has increased by 2%, whilst consumption/head of population increased by 20% that period.

Consequently in the UK improvements in energy iciency, in both transport and heating buildings, have n offset by improvements in the quality of life so that net energy savings are small. Taken in conjunction n the significant savings in the industrial sector then overall net energy reduction in the UK due to energy servation is only about 3% over the last ten years. One conclude that there is considerable scope for further rgy conservation in the UK, and that the current call a '20% savings', by the Secretary of State, is a realistic .

Similar analyses apply to almost all the developed ntries indicating the very considerable scope for energy servation.

ergy conservation techniques for developing ntries

ergy consumption trends in a number of developing ntries have been analysed[21] because they provide a ful indicator of current and future energy problems hese countries. Whilst such trends have to be treated h some caution becuase they reflect changes in nomic performance and of the pattern of energy usage, y can nevertheless give some useful information on the ciency of energy utilisation in such countries.

n general, in the case of the developing nations, energy servation efforts have been less successful than in eloped countries, the energy coefficient tends to rease as they develop their capital infrastructure and ve from non-commercial fuels to commercial fuels. e implications are therefore quite serious. Future spects in the following nations were summarised[21] s:

The problems of the least-developed small nations, such as Senegal, Ethiopia, Kenya and Somalia, are particularly serious, because they apparently cannot sustain higher levels of imported energy, given their current economic situations.

Despite higher oil prices some of the poorer nations (such as India, the Philippines, Morocco and Kenya) seem to have increased total consumption. This was due in some cases to easier access to capital markets and the large momentum of development programmes that were inevitably geared to greater consumption of energy.

) The oil exporters have apparently not been effective in curbing the growth in their own demand and it is likely that some of them may become large energy consumers with net imports of energy before the end of the century. Generally the changing structure of the economics of the energy exporting countries has been influenced by the increasing size of oil or petrochemical industries or by mining, often at the cost of a decline in agricultural production.

Trends in indigenous consumption, production and ports and imports of energy in developing countries ggest that there is a fairly large number of nations which l continue to rely on energy imports in the future. There a number of oil-exporting countries (Indonesia, inidad and Tobago, and Algeria) with reserves that are t likely to last very long. These countries must build basis for sustained economic development before oil venues start declining permanently. Furthermore some

Table 4 *Some technical options and fuel economy improvement prospects for European sized cars*[20]

Propulsion and vehicle system *Cars*	*Possible increase in mpg relative to a 1974 base* *Range of Predictions*
Conventional Otto, short term gear modifications	0-6
Conventional Otto, existing gears, reduced weight and drag	15-20
Conventional Otto, short term gear modifications, reduced weight and drag	15-27
IDI diesel with 4-speed gear box	20-30
Improved Otto, short term gear modifications, reduced weight and drag	24-42
DI diesel with 4-speed gear box	32-43
Conventional Otto, CVT, reduced weight and drag	36-49
IDI diesel, 4-speed gear box, reduced weight and drag	38-56
Advanced Brayton, appropriate transmission, reduced weight and drag	21-80
Improved Otto, CVT, reduced weight and drag	43-61
DI diesel, 4-speed gear box, reduced weight and drag	52-72
Composite, 4-speed gear box, reduced weight and drag	52-80
IDI diesel, CVT, reduced weight and drag	52-79
Advanced Stirling, 4-speed gear box, reduced weight and drag	50-100
DI diesel, CVT, reduced weight and drag	67-97
Advanced Stirling, CVT, reduced weight and drag	61-102
Composite, CVT, reduced weight and drag	67-107

inter-fuel substitution from oil to coal or electricity together with some energy conservation has occurred. Thus during 1975-81 oil consumption was reduced in Madagascar, Ghana, El Salvador, Nicaragua, Jamaica, Ivory Coast, Dominican Republic, South Africa and Uruguay.

Many areas are dependent on wood as a fuel but, although some information is given in the UN Statistical Tables, generally there is a lack of accurate data. However it can be deduced[21,22] that there are serious problems in the supply of wood or other bio-fuels in many of the developing countries. The problems are as follows: (i) substitute fuels or alternative energy sources (such as solar) are not available or are too costly. In such situations animal dung and other organic wastes which should be used for agricultural purposes are used as a fuel, and (ii) wood is used faster than it can be grown. In such a non-self-replenishing situation the collection, transportation and distribution uses increasing human resources, and in areas of adverse climatic conditions this leads to soil erosion and desertification.

It has been estimated that the number of people depending on fuel wood in Africa, Asia and Latin America will be more than 150 M. It is clear that in such situations there is a need for the application of good combustion practice for utilisation of the wood, and whilst some work has been done this could be much improved. Secondly there is considerable scope in forestry management with particular attention to the conservation of biofuels by means of self-replenishing schemes.

It may be concluded that:

(i) Some of the world's smaller, poorer nations possess meagre energy resources and need external assistance in order to improve the efficiency of their production of energy and its effective utilisation. All aspects of good energy management are required, and an infra-structure of trained energy engineers and energy managers is required. In addition, access to technical information to training schemes and to technical support is required.[37]

(ii) Many nations which have considerable indigenous energy resources need capital investment for them to be properly developed. In the case of energy saving schemes, which may have short pay-back

times, the initial capital investment is lacking.

(iii) The oil exporting, developing countries are often doing little in relation to good energy management. Thus their own high levels of domestic energy consumption will reduce export revenues and will in turn constrain economic development. Again an infrastructure of energy engineers and energy managers is required, together with training schemes and technical support.

Energy conservation technologies for developed countries

Major energy savings can be achieved by the following techniques:

Electronic energy management

Automatic controls have for many years been incorporated in building service systems as well as in combustion chamber control systems. However, the development of microprocessors has increased the possibility of very effective electronic energy management (em) systems, which could be one of the most important energy conservation technologies in the next decade. Thus by raising the efficiency of energy utilisation through improved monitoring and control techniques, it is possible to reduce the consumption of a building by 10-30%,[23] if properly implemented. As an example of what may be achieved, a projected target penetration of 20% of the total market by the year 2000 would give an overall UK national energy saving of at least 3 Mtce/year (*ca* 1% total energy consumption). The present uptake of em in the UK is however less than 1% of the total market.

Energy management systems can be used in buildings for the automatic monitoring and control of services such as lighting, heating, air conditioning, boilers, etc. For example:

(i) Automatic switching of plant on and off (eg on the basis of time, or environmental conditions), for instance the control of lighting to avoid unnecessary consumption outside normal working hours or when ambient daylight levels are adequate.

(ii) Optimisation of plant operation and services, for instance the optimum start/stop routine for space heating where the start and stop times can be automatically adjusted by the system to compensate for external temperature changes and the thermal inertia of the building. The latest techniques use 'adaptive' control or 'expert' systems.[24] Fuel/air mixture ratios on boilers is another area where em optimisation techniques can be applied successfully. Since the cost of em systems is reducing rapidly, the size of boiler to which it can be applied with cost benefit is also reducing, and this is a potentially important application.

(iii) Monitoring of plant status and environmental conditions and provision of energy management information. Data on energy flows, consumption, trends and overall building performance are easily accessible. These data can be used for assessments of energy efficiency measures and for forward planning and targeting.

The use of computer-based energy management systems for buildings and its extensive application to industrial plant, where there is considerable scope, offers great potential for the future. The coverage of optimisation techniques and computer selection criteria for energy management requirements is also significant.

Improved combustion technology and heat recovery

In terms of heating efficiency most recent developments have been concerned with gas,[25,26] and electroheating. Whilst considerable advances have been made in relat to the combustion of oil and coal, most work is direc to environmental pollution control rather than increa efficiency.

(i) *Gas*

In many industrial heating processes, gas can o considerable advantages over other fuels. However, m of these processes are still carried out in traditio furnaces, principally designed for oil firing, which do make full use of the particular qualities of gas. Natu gas (and LPG) has the following advantages as a f capability of high-speed efficient heating, ease of cont can be supplied precisely where heat is requir cleanliness, and consistent fuel quality.

The performance of a number of traditional gas-fi furnaces has been compared[25] with the actual consumption with the theoretical heating requirements typical applications, for example, in steel reheating, specific fuel consumption is 4.22 GJ/t, whilst theoretical heat requirement is 0.88 GJ/t. There is a la difference between the theoretical heat requirement of process and the actual usage. This is because in most c the work to be heated is packed into large-volume furn which, as a consequence, are difficult to control and he inefficient in the use of fuel. Also because of their la capacity they control production rate and product qua These limitations are widely recognised and attempts h been made to improve the performance of traditio furnaces fired by gas.

Traditional furnaces may be improved in the follow ways, applied either individually or in combination: improvements in operating practice and g housekeeping and maintenance and minimising flue lo by reducing air in-leakage and improving control fuel/air ratio and process temperature, (b) impro insulation by minimising structural losses and reduc themal inertia through the use of ceramic fibre materi and (c) waste heat recovery by load preheating combustion air preheating. The use of recupera burners and regenerative burners presents the m advanced state of the art with savings up to 30% be achieved, and (d) rapid heating by jet impingement. Th techniques have been reviewed by Fricker *et al*[26] Coles.[25] The UK Department of Energy has supported a number of projects under its Ene Conservation Demonstration Projects Scheme to pron improved methods of fuel utilisation in exist furnaces.[27] The British Gas Corporation has supported many energy conservation demonstrat schemes.

The technical merits of, and financial incentives using gas-fired rapid heating or recuperative burners fi to traditional furnaces have been compared with e other and with those of competing electrical furnace It was shown that the gas-fired furnaces achieved hig overall primary fuel efficiencies than their electr counterparts and that they offered significantly grea scope for further increases in efficiency. Whilst sm convective rapid heating machines have proved succes it is evident that there remains a need for larger convec rapid heating furnaces for large throughputs of metal there are also very important requirements for ra heating radiant furnaces and kilns in the ceram industry.

In domestic applications the advent of condensing boilers has been the major recent innovation. It mus expected that their applications will be greatly expan to larger capacity units. The success of condensing boi depends largely on manipulating the cold water to ma the boiler operation. It is considered that em could

lied much more extensively to optimise this aspect of em behaviour.

Oil and coal

ile oil and coal are burnt under extremely controlled gy-efficient conditions by power stations this is not case in smaller installations. The advent of cheap roprocessor-based flue gas analysis units and ciated control systems is of increasing importance and which can lead to substantial savings.

Electroheat and electrical processing

wide variety of applications involving electroheat niques are available,[28] and considerable R & D work been undertaken by such bodies as the Electricity ncil, etc. These techniques are particularly valuable n electrical techniques can undertake a process not ievable by other ways, eg microwave heating or certain a-red drying operations. Savings involving electrical rgy are particularly important when electricity is erated by non-renewable (hydro, wind, etc) methods ause of the huge ratio of primary energy input to trical energy output.

Heat recovery

at recovery by increasing use of improved techniques at pipes, ceramic regenerative burners, heat pumps, etc) play a major role in future energy conservation tegies. Detailed analyses of industries, eg by the UK rgy Audit Series[29] and waste heat management erally as detailed for example in reference 30, are portant.

mbined heat and power

najor attraction of combined heat and power (CHP) ults from the fact that the overall efficiency of energy is increased from 35% to 39% for electricity duction alone to a theoretical limit of 60% to 70% for HP unit. Combined heat and power is increasingly ng used for residential, commercial and industrial plications.[31,32] However, whilst CHP is used in many ntries it is not, for various social and economic sons, widely adopted and has not been widely used in UK so far, because of very effective competition with ed gas to domestic consumers. Since considerable ings can be obtained in principle by means of CHP countries where considerable amounts of energy are d for heating buildings, such as the UK and other EEC ntries, it must be expected that such systems will reasingly come into use. However great care must be en in the choice of application which requires high sity heat loads. In the UK this reduces the potential only 2.5% of the UK energy consumption at the most, l perhaps significantly less than this.

The application of CHP to integrated industrial plants, h as chemical processing or petrochemicals is also reasingly coming into use and giving considerable rgy economies, with the pay-back time for such plant quently being one year or so.[33] In the industrial plant ntext the use of optimised plant design with full use of t recovery has very considerable potential.

proved building design for energy conservation

e four key factors[34,35] which have to be taken into ount involve (a) the source of energy, (b) systems and trols, (c) the building design and (d) most important all the occupant's behaviour and requirements.

Whilst the House of Commons Select Committee on ergy[36] indicated that in the UK 'that cost-effective asures, many with pay-back periods of five years or , could produce savings of the order of 30% of present delivered energy consumption in both domestic and non-domestic buildings, using existing technology', in fact achieving this in practice is extremely difficult. This is partly because there have been essentially separate approaches by architects, builders, heating engineers, fuel industries and appliance controls and component manufacturers.[34] Unless these are coordinated the resulting energy savings will always be less than expected. At the same time, the importance of the end-users, the people who live in the house, cannot be ignored. To the householder, conservation is only one of many issues and may frequently be either one of only marginal importance or one not fully appreciated.

It is thus possible to reduce energy consumption by choosing the appropriate energy source, level of insulation, optimising solar input and integrating the system with some form of electronic energy management. Such systems could give a 30% saving but only in time, and is unlikely to be achievable economically in a five year span. The replacement rate of heating systems to ones of higher efficiency is slow and this also applies to other forms of energy saving such as controls. Many forms of energy saving are only economic (such as double glazing) when applied to new houses, limiting their application. In hot climates air conditioning is a major user.

One must conclude that housing offers considerable savings in energy consumption but the improvement can only be slow.

Improved motor vehicle design

Within the UK there is considerable scope for technical improvements to reduce fuel consumption in engines, and it has been suggested that up to 40% might be saved,[20] this arising from changes in engine design, body weight, drag coefficient and frontal area. In particular conversion to diesels, which so far has been resisted for a number of reasons, would do much to reduce fuel consumption.

In addition the optimisation of traffic flow, control of speeds and the appropriate use of means of transport for particular applications could add to that. However as indicated previously, as far as the UK is concerned, no saving has resulted in the last decade and it is likely that any overall energy saving in the next decade will only be small.

Conclusions

(i) Considerable advances have been made in energy conservation in developed countries, the success depending upon the structure of decision making at government level. Concentrated efforts, such as a task force approach, are difficult to achieve because of conflicting interests of energy users and energy suppliers, but where they are applied they are very successful.

The rate of implementation of energy conservation strategies is more rapid in the case of industry where the lifetimes and pay-back periods of equipment is around five years. The 'time constants' for the implementation is greater in the case of motor vehicles, and very much greater in the case of buildings. As a result, whilst a future reduction in energy consumption of 20% could be achieved by the year 2000, it seems likely that the actual overall reductions will be *ca* 5%.

(ii) Energy conservation strategies based on pricing mechanisms will have an uneven effect. Thus in industry it may be effective because the response time is rapid, but in domestic situations the major effects will mainly be concentrated on new properties, and the owners of existing properties which cannot be upgraded will be disadvantaged.

(iii) Considerable improvement in energy efficiency can be achieved by the more rapid introduction of electronic

energy managment systems to both buildings and plant. There remains considerable scope for improvement and extension to small boilers, furnaces and engines.
(iv) Energy conservation in developing countries has been disappointing so far. The major advance could be simply by applying good energy engineering practice, and good energy management practice. This is best achieved by increasing the standard of fuel and energy education and vocational training in these countries, together with providing sources of technical information, and technical support. Preferably this should be undertaken in conjunction with a national energy department or similar coordinating body.

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References

1 CARTER J, *Energy Policy*, April 1985, p 117.
2 LAWSON N, Lecture to the International Association of Energy Economists, Cambridge, 1982.
3 FELLS I, *Energy World*, October 1984, p 2.
4 Energy for the Future, Institute of Energy, London, 1986.
5 Energy for the Future, Institute of Energy, London, 1972.
6 World Energy Outlook, Chevron Corporation, June 1985.
7 Fuel Policy, HMSO, 1967.
8 Energy Conservation in the United Kingdom, NEDO, 1974.
9 Energy Policy: A Consultative Document. Cmnd 7101, HMSO, 1978.
10 Department of Energy, Energy Conservation: Scope for New Measures and Long-term Strategy. Energy Paper No 33, HMSO, 1979.
11 FRANKLIN N L, *Energy World*, August-September, 1985, p 5.
12 Digest of UK Energy Statistics, HMSO, 1985.
13 The Rational Use of Energy, Report No 3, The Watt Committee on Energy, 1978.
14 Evaluation of Energy Use, Report No 6, The Watt Committee on Energy, 1979.
15 LEACH G, A Low Energy Strategy for the UK. Science Reviews/IIED, London, 1979.
16 Energy Use and Energy Efficiency in UK Manufacturing Industry up to the Year 2000. Vol 1, Executive Summary and Main Report. Vol 2, Sector Reports Containing the Detailed Analyses of the Industries, their Energy Use and Potential Energy Savings. ETSU (to be published by HMSO, London).
17 EDEN R and BENDING R, Industrial Energy Use Conservation. Energy Discussion Paper 23, Energy Resea Group, University of Cambridge, August, 1982.
18 HARDCASTLE R, *Petroleum Review*, p 29, 1985.
19 Towards an Energy Policy for Transport, Report No 7, Watt Committee on Energy, 1979.
20 Prospects for Improved Fuel Economy and Fuel Flexibilit Road Vehicles, Department of Energy, Energy Paper No HMSO, 1981.
21 PACHAURI R K and PACHAURI RASHMI, En Problems and Policies in Developing Countries, Energy Pol August 1985, p 301.
22 Prospects for Traditional and Non-Conventional En Services in Developing Countries. World Bank Staff Work Paper No 346, 1979.
23 Energy Management System, Energy Technology Series N Energy Efficiency Office, London, 1985.
24 SHAW M R, Expert Systems Building Services, p 71, Febru 1985.
25 COLES K F, Development of Novel Gas-Fired Burners and t Application in Industrial Heating Systems, The Institutio Gas Engineers, Communication 1225, 1983.
26 FRICKER N, HOGGARTH M L and MASTERS J, Effic Use of Energy in High Temperature Furnaces. The Institutio Gas Engineers, Communication 1160, 1981.
27 eg UK Energy Efficiency Demonstration Schemes.
28 Electroheat for Improved Economy. Tenth International U for Electroheat, Stockholm, June, 1984.
29 Energy Technologies for the United Kingdom, Vols 1 an Energy Paper No 39, HMSO, 1979.
30 Waste Heat Management Guidebook, NBS Handbook 1977.
31 Combined Heat and Electrical Power Generation in the Un Kingdom. Energy Paper No 35, HMSO, 1979.
32 ORCHARD W H R and SHERRATT A F C, Combined H and Power. Whole City Heating, 1985.
33 EASTWOOD A R and LINNHOFF B, CHP and Pro Integration. 51st Autumn Meeting, The Institution of Engineers, November, 1985.
34 PICKUP G A and MILES A J, Energy Conservation — F Studies in Domestic Heating, The Institution of Gas Engine Communication 1086, 1979.
35 PICKUP G A, The Efficient Use of Gas for Heating Buildi Energy Show, The Institute of Energy, September, 1977.
36 Energy Conservation in Buildings. Fifth Report from the Sc Committee on Energy, HMSO, 1982.
37 GORDON C, An Energy Management Program for I Developed Countries. Strategic Planning and En Management, **4**, 36, 1985.

ıe Watt Committee on Energy:
th Consultative Conference report:

The role of gasification in the echnological and economic development f the UK

sification as a process for the large-scale production of synthetic fuel is a strategic option that is ely to become increasingly important to the United Kingdom as reserves of oil, in the North Sea and ewhere, decline during the next 20 to 30 years. The state of oil and gas markets in 1986 has reduced economic viability of gasification. However, the development of the technology must be intained, and expanded, if the UK is to take advantage of this important energy resource method. at raises important questions: who should be involved; and from where the finance might be found. e Watt Committee on Energy decided to appoint a working group* of specialists in the field of ification of coal and to include biomass. The group's terms of reference for the examination of the ification issue were based on energy projections for roughly the next 25 years. The group set out to dy economics and technological developments in the UK concerning gasification. Although mostly ncerned with coal the group was to consider other sources, especially biomass. The study was to ncentrate on the UK, considering developments overseas where relevant, summarising and assessing available information

e twentieth Watt Committee Consultative Conference d in December last attracted some 60 delegates from ional energy suppliers, manufacturers and other rested organisations. It had the objective of exploring he issues of gasification by means of a series of informal ers presented by speakers from the fuel and chemical ineering industries.

Geoffrey Pardoe, chairman of the Watt Committee Energy opened the Conference, and said that the elopment of gasification was as important now as en oil prices were high. The prospects of the elopment of many and various gasification schemes source of British fuel supply must not be undervalued. ther should the export opportunities for the equipment olved in such plants. There could also be an expanding uirement for a variety of such schemes in the Third rld.

n the planning of the many types of scheme available ount must be taken of the small user. Clear ntification of the correct scheme for the particular rket and client was essential. There are many histicated processes involving gasification and it was haps self-evident to say that the technology must be tched to the ability of the user to make full and ective use of the scheme. This meant ensuring that the ject was supportive in the most economical fashion. e technology must be right. Maintenance, and the pply of spares, were areas that needed to be correctly portive throughout the lifetime of the installation. d, finally, in all types of gasification schemes wherever d, environmental aspects must be closely examined and shown to be acceptable.

The Conference programme was divided into four sions. The Opening Session was chaired by Dr Olden, *rector, British Gas, Wales/Cymru)* and senior vice-president of the Institution of Gas Engineers. Dr Olden introduced the first speaker and chairman of the gasification working group, Dr Alan Hedley. Dr Hedley's paper on the fundamentals of gasification and the technology was presented jointly with a colleague (Dept, Chemical Engineering and Fuel Technology, *University of Sheffield)* Dr Bustani.

This presentation was a most useful contribution by which to set the basis for the day's events. Dr Hedley began by looking at a number of simple chemical structures leading to what he called the degradation routes: physical, thermal, thermochemical, biological as well as the total degradation of the initial feedstock. A number of fuels offered themselves to a gasification process: coals ranging in constituents from peat to anthracite as well as biomass, cellulose and sewerage sludges.

Dr Hedley examined the basic reactions in gasification and then described the operating characteristics of gasifiers. These fell into three classes: low pressure/low temperature; a second at high pressure/low temperature and a third could be described as a multi-range.

In conclusion, Dr Hedley said that although the gasification process was a complicated process, the chemical thermodynamics side was now reasonably well understood. The main difficulties lay in understanding the chemical kinetics of the system.

The next paper by Conway *(Midlands Research Station, British Gas)* was entitled *The British gas supply industry*. The author described the history of gas manufacture in Britain from its earliest beginnings to the present day, (starting with what was known as town gas), the industry's nationalisation and development after World War II to the tremendous planning and expansion of the system following the discovery of North Sea gas in the late 1960s. Gas demand in the 1950s was low. Certainly very little growth occurred in the industry. Some work was done on gasification; but, in the main, the low price of oil virtually closed down any development work of significance.

The natural gas finds in the North Sea led to an extensive gas-grid system network being laid in Britain;

ıe results of these deliberations of the working group were sented to delegates at the Watt Committee's twentieth Consultative nference at a one-day meeting at the Institution of Civil Engineers London in early December and summarised on these pages. The up's conclusions and recommendations will be published later this r in the full proceedings

the main transmission operating in pipelines at 70 bar. In addition, the distribution network grew quite massively following the commercialisation of North Sea gas.

British Gas were now again becoming more involved in gasification schemes as a major growth area. The projects at present look most promising.

Session 2 contained papers covering a range of topics. The first was by Dr M St J Arnold *(Coal Research Establishment)* and was entitled: *Gasification for the fuel-using industries.* The paper covered types of gas, types of production, economic and commercial practice. Fuel prices influenced the commercial aspects of any gasification process. At present coal was becoming more economical — despite the recent fall in the world price of oil. With natural gas and oil becoming less available, coal will be seen as the fuel stock most advantageous for gasification.

Gasification could be produced for low or medium cv fuels. The author explained that the former type of gasifier would employ an air-blown system at about 175 Btu/ft^3 with a feed at 5 t/h having flame temperatures in the region of 1500-1600°C.

On the other hand, higher values existed for the types of gasifier employing medium cv fuels, although they usually had a steam-blown injected system. The feed was in excess of 15 t/h with outputs at about 300 Btu/ft^3. Another type being favoured was the fluidised bed process which could well become commercially adaptable in the near future.

Underground gasification was discussed. It was important here for the development work to be shown to be economic from the start of the project and cheaper supplies of coal were making that more likely.

The second paper of the session by C J Knight *(British Gas),* dealt with the economics of gas distribution. The paper's main point was concerned with establishing the correct gas demand/capacity profile, with safety as a most important factor. In addition it was necessary to have a high factor of reliability, security, and good quality at all times. This had to be in conformity with the present Gas Acts maintaining the correct degree of safeguard to gas manufacture.

The industry, nonetheless, had to maintain its competitive edge over other fuels and energy sources with the constant requirement to progress through new gasification processes.

The final paper in the session came from an industrial user. Dr Start and Dr Quirk *(Pilkington Glass)* spelt out the viewpoint of the industrial user.

In glass manufacture quality was the first and most important factor. There was a need for exceptional uniformity in the process to ensure a high standard of product. In glass manufacture the energy source was in direct contact with the product. High temperatures were involved and the energy costs represented a significant percentage of the product, thus there was a continuing need to seek every opportunity to reduce these costs to a minimum.

Dr Start described the South African operation, SASOL, begun in 1977. The gas was clean and sulphur free and although variable in composition, burned with great luminosity within the furnace. Dr Start's paper prompted questions on the industrialist's requirements. (It is to be hoped that this important aspect will be well covered in the final report).

The first paper in Session 3 (chairman Prof R G Prince, president, IChemE) was given by A J Connel *(ICI Billingham).* He gave a description of the use of the gasification process in the chemicals industry. He explained the process for the manufacture of ammonia and methanol in particular.

For a 1500 t/d plant, producing ammonia a methanol, Mr Connel showed the process stages in t different methods: one using coal, the other natural g The fact that double the number of stages are requi for coal as for the natural gas method does play a ma role in determining the costs for the process.

It is seen that the natural gas method appears to be preferred one on costs alone, but obviously that is extreme, over simplication. Many other factors neec be taken into consideration, such as availability, reliabil and the need for maintenance, and possible retro-fitti over a lifetime of, say, 15 years.

Gasification for electricity production was the sub of the paper read by T F Smith, *(CEGB)* with M J Sh *(Foster Wheeler).* The authors discussed a number possible plants up to about the 100 MW gas turbine s They illustrated some coal gasifiers working or combined cycle, and they commented upon aspects control emission with the gasifiers and gave sc indication of the use of fluidised bed plants. It did app that there could be considerable potential for scheme this type — overseas rather than in the UK.

The final paper in the session was presented by th authors: Richards of the *Energy Technology Supp Unit, Harwell,* H T Wilson of *Foster Wheeler* and Bridgewater *(Aston University).* The title of this excell presentation was *Gasification of municipal refuse other wastes.*

The main drive behind the technique, as presented, that of securing a return from refuse in the form of energy output. Although small in relative terms, authors illustrated an additional benefit: that of reduc considerably the smell from such sites after landfill. Th stages were described for what is essentially bacteriological process. Given an input of tonnes garbage producing compounds of protei carbohydrates, and plastics, the end product from chemical reactions gives a gas. The gas will have a ma up of something in the order of 50% methane, 4 carbon dioxide and the rest nitrogen and other gases: t a useful energy source.

UK waste per annum would yield something in order of 25 t of gas per tonne of refuse. The site wo be designed to be landfilled, with an installation pipework for abstracting the gas. Ten years was a poss yield, although the output from such a project wo naturally rise to a maximum over the first five or so y and decrease thereafter.

The authors produced a number of schemes alread operation in Britain to show the advantages to munic authorities in gasification schemes of this type. All installations illustrated represented a pay-back of the o of only two or three years, even though the projects capital cost from as little as £20 000 to around £2 M. installations could be designed purely for gas abstract for boilers, or heating schemes; or, in the larger desig could be used for incorporating gas turbines for electri production.

The applications appeared to be numerous, anc beneficial, that it might be wondered why every refuse in the UK hadn't its own gasification plant; and, inde environmental aspects were shown to be positive reducing pollution.

The final session was designed to allow not onl general discussion on the papers, but also to al J Heaton *(Energy Options)* a member of the Work Group on gasification, to pronounce upon the Grou conclusions and recommendations for the Report.

I have already said that the latter will form part of

(continued on p

Conference report:

Fuel additives

Introduction

The objective of this one-day meeting* was to discuss the alleviation of deposits, corrosion and particulate emissions from industrial and hospital boilers. It was organised in conjunction with the Institute of Energy's Yorkshire branch in association with the Institute of Petroleum, the Institution of Plant Engineers, the Institute of Hospital Engineering and the Combustion Engineering Association

The conference was a sequel to the two-day conference entitled *The effectiveness of fuel additives* held at CERL, Leatherhead (September 1983) when, thanks largely to the support of the CEGB, almost 200 delegates attended. The two meetings contrasted in several ways. The first was concerned mainly with large water tube boilers, especially those used in power stations, and was dominated by CEGB personnel in their guises as operators of such plant and as research workers on their problems. The present event was concerned with the operational problems of smaller water tube boilers and of fire tube boilers as usual in smaller industrial and hospital installations. A rough breakdown of the attendance of 72 was:

Fuel suppliers	25%
Additive suppliers	42%
Equipment manufacturers	13%
Others	20%

One would have expected to see a significant proportion of plant operators among the delegates, but there were only 2 or 3. Thus it would appear that the conference failed to achieve its objective, unless there are large sales of the bound volumes of papers to plant operators.

Water injection in fuel oils: (R H Teague)

The possible benefits of emulsifying a small proportion of water in fuel oil before atomisation came to notice over 5 years ago, and it now appears that the beneficial mechanism is the improvement of atomisation caused by the boiling-off of the water droplets producing a second stage of atomisation. This paper described the application of water injection to a Hamworthy rotary cup burner, care being taken to avoid recirculation of the emulsion back to the fuel metering system. A water injection rate of 2.5% is recommended, and reductions of stack solids of the order of 50% were shown in the data presented.

While this was an interesting paper, its value to the reader is limited by the omission of any references to the considerable literature now available on this subject.

Combustion catalyst performance: (J Y Bias)

Whereas the first paper had dealt with the influence of a well defined additive, water, this paper considered the effects of vaguely defined products from the Gamlen range. The paper pinpointed the asphaltene content of the fuel oil as the main root cause of stack solid emission, although the relationship between the two is extremely complex. The problem can be alleviated by dispersion of the asphaltenes thus producing a more homogeneous, stable and compatible fuel. This desirable effect is best achieved by the use of oil soluble additives containing the transition metals — manganese, iron, nickel, cobalt — and products containing 600g/l of metal have been developed. Data were presented showing the preferential adsorption of the additive on the asphaltenes 'a few hours' after dosing. Results were also given indicating marked reductions in particulate emission levels from a large number of tests, but none of these was precisely defined. It is therefore impossible to judge the benefit likely to be achieved in a particular installation.

It was pointed out in the discussion by Byrom Lees that the use of an iron-based additive could have the undesirable effect of catalysing the conversion of SO_2 to SO_3.

4 *The application of magnesia to a highly rated water tube boiler: (B Bell et al)*

This paper was of very great length giving a wealth of detailed information, but it must be asked whether such length was really necessary. The beneficial effects of magnesia were already known from a host of earlier papers (eg at the aforementioned first *Additives* conference). The only point requiring verification was that the reaction time available in a smaller, highly rated boiler was still sufficient; this was shown to be the case, which is not surprising since magnesia had already been shown to be effective under the even shorter residence times of industrial gas turbines.

The cost of treating fuel oil with magnesia at the dosage of 1 kg/ton was quoted as 35p/ton of fuel oil, a very attractive figure.

In spite of the criticism above, this could be a useful reference paper for operators newly confronted by fouling problems.

(continued on p 14)

*19 November 1986. The venue was AHED House, Ossett, Yorkshire which was well suited to the attendance of 72, and conveniently placed, one mile or so from the M1

(The Watt Committee on Energy: 20th Consultative Conference report continued)

Working Group's Report which will be published by the Watt Committee early in 1987 and therefore these will not be given in this Conference report.

The standard of the papers was excellent and time was allowed in the day for some useful discussion to take place. It was a well organised meeting and the only regret is that more delegates were not present in what was for London a very low priced conference event.

JOHN L BINDON (Member)

Editor's note: The final Watt Committee report will contain the full text of all papers presented, together with the discussion at the Consultative Meeting, 3 December 1986. Members and all other readers will wish to note that the Institute of Energy will be holding an international conference: *Gasification status and prospects* over three days in June 1988, for which more than 40 papers have already been submitted. Full details in subsequent issues of *Energy World*.

5 *An evaluation of fouling in coal-fired boilers using the ash sinter strength method: (P J Hands and P E Parkinson)*

The sintering of ash particles is considered to be a critical step in the formation of fouling deposits in boilers. Dearborn Chemicals use sinter strength as a criterion of the fouling characteristics of coal ashes and of additives to counter the problem. Test pellets of the ash (or ash/additive mixture) are prepared under standardised conditions; and, after slow cooling to room temperature, are subjected to a compressive load to assess their strength (and therefore their fouling tendency?).

An obvious shortcoming of this method is that the test specimens are of uniform composition and are prepared at a uniform temperature, whereas in an operational boiler there is a temperature gradient through the deposit and the chemical composition of the deposit varies accordingly. It would therefore appear more logical to form test specimens at temperatures corresponding to those at which each ash composition would deposit in practice. In other words, each deposit would be separated into a number of strata each to be evaluated at its temperature of deposition; this implies that a test technique of attractive simplicity becomes rather time consuming.

The paper presented results showing the influence of various ash components upon sinter strength — alkali metal and calcium sulphate, ferric oxide and phosphates. In particular sodium phosphate yielded very high sinter strength. The overall picture resulting from this work is extremely complex.

Work on the technique continues, and it is planned to use it to evaluate various anti-fouling additives.

6 *Chemical control of solid fuel deposition problems: (A Ritchie)*

Whereas the paper by Monsieur Bias discussed the application of commercial additives to oil fired boilers, this paper covered the use of the NALFLOC Sesca powder to coal-fired plant. The composition of the additive was not revealed but it was stated to contain iron; the patent number was not available. Sesca was also stated to form ammonia and nitrates which block 'some oth reactions', but no details were forthcoming. The resul quoted in the paper indicated that promising results cou be obtained but it was not possible to assess the probabili of success in any particular installation. This paper, lik that of Monsieur Bias, tended to cause an element irritation since there was an air of mystery or secrecy abo the whole operation.

7 *The use of sound for moving combustion deposit (M R Lidgate and M Werthajm)*

This paper had the definite advantage over the rest in th it introduced an element of novelty into the conferenc By means of a quarter wave pipe generator, sour frequencies of from 15 to 350 Hz are produced, and th vibration of the air is used to dislodge deposits from tul surfaces. The aim is to vibrate the deposits, and not th boiler structure so that no damage is done to th installation; how this division is achieved was not reveale Over 1000 sets of equipment have been installed, but r detailed results were quoted.

8 *Round Table Discussion*

Although about 15 minutes had been allowed for th discussion of each paper, the organisers had arranged final general discussion period, during which th conference could range over the whole wide subject fouling, corrosion, exhaust emissions and additives. principle this was an excellent idea, but unfortunately th discussion never really 'took off'. Had it not been for th enthusiastic chairmanship of David Gunn, it might ha been a complete disaster. One's thoughts went back meetings in the past when delegates came armed with the own test results intent at tilting at the authors, ar provoking lively interchanges; now discussion seems rare to go beyond enquiries for amplification of detailed poin of the papers. Do we have too many conferences no or does commercial secrecy inhibit speakers? If the prese trend continues, the expense of travelling to a conferen will become questionable, it being more economic simply buy the proceedings for reference when require

W TIPLER (Senior Fellow)

In reviewing the following three books during the past few weeks I was struck by their complementary nature. Most serious energy analysts will agree that oil will continue to dominate the world energy scene for several decades and yet there are very real concerns about the quality of life, the environment and associated political and economic issues. Each group of authors has tackled these issues in a different way and yet there are recurring themes which deserve to be explored at graduate and post-graduate level. The importance of collaboration and cooperation, not confrontation, is just one example which can be found. I hope you will find them as interesting as I did.
Dr Cleland McVeigh.

European interests and Gulf oil

Valerie Yorke and Louis Turner
Gower Publishing Company, 1986
225pp. £19.50

This report is one of a series of energy papers published as part of the Joint Energy Programme of the Policy Studies Institute and the Royal Institute of International Affairs. Both authors have specialised in issues relating to Gulf Oil during the past decade and have completed several major publications with the Royal Institute of International Affairs, where Louis Turner is a research fellow, and Valerie Yorke was a research associate.

The Gulf states are defined for the purposes of the report as Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates and the Sultanate of Oman. Although both Iran and Iraq have Gulf coastlines, they are treated as neighbouring countries affecting developments in and between the Gulf states. European countries are defined as all Western European countries regardless of their membership of the European Community.

The first chapter gives both an introduction and a summary, pointing out that the intention of the study is both to alert Europe to the potential dangers of permitting policy towards the Gulf region, especially energy related issues, to slip down the list of priorities and to suggest the elements of a 'new European policy' towards the Gulf which may help them through a period of stringency. This is followed in the second chapter with an analysis of the divergences in European and American attitudes and policies towards the Middle East, while the third chapter examines the dependence of Europe on oil imports from and trade with the Gulf.

The next three chapters look in detail at the regional politics of the Gulf, including the Gulf War and Islamic Fundamentalism, the economic environment of the Gulf and its political and social sources of strain. The probable responses of the Gulf states to these problems is analysed and the final chapter returns to the main theme — that unlike the United States, Europe cannot isolate itself substantially from Gulf oil..., 'For Europe to use the short-term softening of oil markets to write off its relationship with the Gulf producers would be a diplomatic and (more arguably) an economic tragedy'.

There are over 100 references in the text with an associated set of notes, three appendices giving the texts of the 1967 and 1973 UN Security Council resolutions on the Middle East (242 and 338) and the European Community Declaration in June 1980. There is also a comprehensive index.

With the rapid changes in the energy scene which have occurred since the text was completed in October 1985, the authors must be congratulated for their accurate forecasts of trends in oil prices and the value of the dollar as well as the prophetic warning that 'nuclear power is still vulnerable to another accident along the lines of Three Mile Island'. Although they warn that predicting what will actually happen in the Gulf is an analytical nightmare, this report will repay the deep study which it deserves and will place both the professional and the informed lay reader in a much better position to assess this vitally important region.

In search of oil

Bernardo F Grossling and Diane T Nielsen
Financial Times Business Information, 1985
Vol 1: The search for oil and its impediments (99pp.)
Vol 2: Country analyses (253pp.)
£193

The authors of this major report leave the reader in no doubt that they challenge the existing 'conventional wisdom' views about the amount of oil and gas still left in the earth. 'There is no question that the bulk of the petroleum prospective areas of the earth are grossly underdrilled and their detailed geology scantily known'. The senior author, Dr Bernardo Grossling, is a research geophysicist and natural resources adviser for the Inter-American Development Bank, and admits that he has been described by some as an optimist because his petroleum estimates are much larger than those of conventional wisdom. Diane Nielsen is a mineral resources analyst and also works with the Inter-American Development Bank. They collaborated some 10 years ago in a previous report for the *Financial Times, Window on oil.*

The broad conclusions from the overall analysis are presented in volume 1 together with a detailed explanation of the basis of the statistics. Pointing out that problems are not simple in the real world, the authors have started from physical facts, such as the geology of the earth and physical laws, and then explored both economic and political factors which have inhibited or fostered petroleum exploration. The first chapter of volume 1 discusses these concepts in greater detail, giving an overall introduction to the whole report. Some idea of the scale of the study is given by their reference to the vast literature — perhaps over 100 000 items, apart from thousands of geological and other types of maps. Some 800 reference sources were used and these are listed in the final chapters of each volume.

The second chapter gives a critical analysis of the methods which have been used to appraise world petroleum resources and includes the time-series of past results of exploration and development for the various countries of the world. It was interesting to note that their figure for world total cumulative petroleum production by the end of 1982 (499 493.4 M bbl) came within 1% of a figure obtained from my independent analysis of over 20 years of data from the British Petroleum Company (Table 3.3 in Energy Around the World, J C McVeigh, Pergamon Press, 1984). The third chapter concentrates on the economic issues, making the point that the availability of substantial petroleum resources beyond the control of OPEC could provide a 'window of opportunity' to perfect the new energy technologies — solar, biomass, nuclear fission and fusion are specifically mentioned. The design principles of contractual agreements between host country and private enterprise for the exploration and development of petroleum resources are reviewed, together with a brief section on inflation and costs. The fourth chapter is in a class of its own — a 'letter' to a private entrepreneur, Jim, described as a rhetorical friend. The situations and perceptions described in the letter have actually arisen from the authors' own experiences and two brief excerpts give the flavour: '...it is well to remember that in a developing country, it is better and even essential to start negotiations at the top' '...there is not much use in pursuing philosophical discussions about the merits of various economic systems. You should work with what there is'.

Two appendices give conversion and other factors and a definition of the concepts of reserves and resources.

The second volume concentrates on a concise profile of the petroleum prospects in 97 different developing countries, classified into three groups: Latin America, Africa and South and South-East Asia. For each region the geological framework, prospective basins and summary petroleum statistics are reviewed. This statistical data includes land areas, prospective areas onshore and offshore, stage of petroleum resource

development, total number of wells drilled, cumulative oil and gas production, proven reserves and current production, based on 1981 or 1982 data. Energy balances for each country are also given and most countries have a list of selected reference sources keyed into the main reference chapter at the end of the volume.

The authors have selected the developing countries in their work because if there were to be no significant petroleum in these non-OPEC countries, OPEC could exert tremendous pressure on world oil markets once more, with the associated uncertain economic effects. The amount of material contained in the two volumes is extremely detailed and comprehensive and the whole work is written in an authoritative and lucid style. Intended for anyone seriously interested in petroleum exploration and production, it can also be used as a source book in energy studies courses and as a background text for the professional courses.

Energy and resource quality: the ecology of the economic process

Edited by Charles A S Hall, Cutler J Cleveland and Robert Kaufmann
John Wiley & Sons, 1986
577pp. £45.65

This major textbook is the latest in a series devoted to the study of the quality of the environment and to the technology of its conservation. Starting from the concept that rigorous criteria of environmental quality must be developed and that civilisation will continue to require increasing amounts of fuel, transportation, industrial chemicals, fertilisers and many other products, the main thrust of the series is that environmental science and technology must quickly come to play a dominant role in designing our social and industrial structure for tomorrow. In this book the authors have examined the ways in which the basic resources of natural and industrial systems interact with energy. Writing as ecologists, they have found that the disciplines of ecology and economics have much in common. They have decided to call all the commercial and industrial enterprises which use fossil fuels 'industrial ecosystems' and believe that the conceptual tools which have been developed by ecologists for the analysis of rivers or forests have new applications in the analysis of industrial ecosystems. They were also concerned that the traditional economic and political theories seemed to be unable to resolve many of the problems resulting from the depletion of high-quality fossil fuels.

The book is divided into five sections. The first section consists of a relatively brief introduction to the different forms of energy and the laws of thermodynamics, followed by an introduction to the biologist's perspective. The second section contains a major analysis of energy and economics. Modern economic theory is attacked for ignoring the physical attributes of the resource base although these resources form the basis for economic productivity and virtually all wealth. This section also introduces the EROI (energy return on investment) concept as the ratio of the gross amount of fuel extracted in the energy transformation process to the economic energy required to make that fuel available to society. The EROI is used throughout the book by the various contributors who note that as lower quality fossil fuel resources are needed, the development of increasingly sophisticated technologies rarely offsets the associated increasing energy requirements for their discovery and extraction.

The third section concentrates on the characteristics and magnitude of energy resource systems in the United States, but the authors point out that many of their conclusions are equally valid for other countries. Extensive use is made of the logistic equation in the analysis of resource depletion. The official Government estimates of the future availability of petroleum in the United States are considered to be 'grossly in error' and the reasons for this are examined. There is concern that even today there is very little recognition or appreciation by the average citizen of the precariousness of the US petroleum situation.

The fourth section deals with the environmental and human health impacts of energy extraction and use. The normal use of energy today 'kills millions of organisms, causes widespread, generally deleterious, changes in the atmosphere and water, and more or less permanently disrupts large land areas'. These issues are reviewed and discussed in detail. The final section looks rather more to the future with the management aspects of the renewable natural resources, again from the United States viewpoint. The physical meaning of resource scarcity and its ultimate impact are clearly spelt out through the text and it is then left to the readers 'to translate this knowledge into mutual restraint for their present and future good'. There are over one thousand references cited in the bibliography and comprehensive index.

Although this is very much a team effort and the individual contributions from many people are acknowledged, the editorial team have managed to achieve a consistent style throughout and the entire text is a pleasure to read.

This is a first class textbook in which all the major socio-economic energy issues are examined in a way which makes the reader reassess his own position and attitudes. Highly suitable for energy-related courses at university level and a valuable source book for libraries.

Combined heat and powe and electricity generation in British industry 1983-1988

I R Schaffer
HMSO
181pp. £13.95

The editor of the weekly journa *Electrical Review*, wrote a first leader o this publication. He called it a 'massiv report', 'the first comprehensive surve into CHP operations in private industry and 'an historic tome'. But he used th word *historic* ironically, for he though the three year old data already scarcel significant in assessing prospects to 198 A few issues later, in another first leade the editor succinctly restated his view c the situation: 'When the Governmer prepared the Energy Bill four years ag with the object of allowing an encouraging the construction of privat (mainly industrial) combined heat an power stations, everyone told it that th purpose of the proposed Act would nc be achieved. The Government did nc listen and the Energy Act 1983 has prove to be one of the more ineffectual statute ever produced'. The only way to giv CHP a chance, according to the editor c the *Review*, is to ensure that electricit boards offer rates related to, and nea the short term marginal costs c generation.

Schaffer's report contains a fir collection of statistics. Covered are plan types, ages, capacities, industrie regions, outputs and fuel consumptior in 1983, changes in capacities and outpu during 1977-83, and expectations fc 1983-88. The work is the fruit of a post inquiry in 1984. Questionnaires were se to the 150 establishments responsible fc about 95% of private electricit generation: only three of them we outside manufacturing industry. The 15 were found to have generated some 1 TWhe with plant of 3.6 GWe capacit thus producing 4.5% of the country electricity. Heat-rejecting plant produce 45% and CHP plant produced 55% c the 13 TWhe. The electrical capacity c the CHP plant was 2.1 GWe or 59% c UK industry's private capacity Steam/power ratios were found to hav dropped markedly in 1984, renderin much of the steam-driven CHP plan superfluous for current needs.

Respondents to the questionnaire ga what Schaffer calls 'very informativ replies on their intentions for the next fi years. He acknowledges that econom circumstances have greatly changed sin 1984 but regards as 'a matter fc conjecture' the difference that th changes might have made to repli elicited now. What the survey did sugge was that about 10 establishments migl abandon private generation by 1988 whi load factors on the other sites continue t decline. An extra 623 MWe of plan might be withdrawn and 378 MWe c new plant commissioned, reducin capacity from the 1983 level by a net 7%

(continued on p 1

Conservation agency Denied Parliamentary time

Despite receiving all party support, a Bill to promote an independent Energy Conservation Agency has been denied parliamentary time for consideration. Backbench sponsors were drawn from all four national parties, together with Plaid Cymru. Among the sponsors were the Liberal and SDP energy spokesmen, Malcolm Bruce and Ian Wrigglesworth; two senior Conservative members of the Energy Select Committee, Peter Rost and Tony Speller; and Neil Kinnock's PPS, Kevin Barron.

The Agency was given a number of new responsibilities, including the promotion of cost-effective investment programmes; proposing alterations; the establishment of an Energy Conservation Investment Bank; and the instigation of a free home energy audit scheme.

Three functional sections were to be introduced covering economic studies; advertising and publicity; and administration and finance.

The Bill received an unopposed First Reading (on 9 July 1986), but no time has been allotted on the floor of the House for subsequent progress.

Source: The Fifth Fuel

European conservation awards

A conservation project in Ballater, Aberdeenshire has been shortlisted by Prof David Bellamy and his panel of judges for one of the Conservation Foundation's British Conservation Awards and is also in the running for the top European prize. The awards have been supported for the five years since their inception by the Ford Motor Company.

The Ballater Energy Project involves studies of insulation, solar design and energy management. It also involves a workshop where a wide range of development work is undertaken involving equipment designed for solar power, wind energy and river turbines.

If eventually selected by the judges as the category winner, the project will become eligible along with the other five category winners for the British Conservation Project of the Year title.

The prize for a category winner is £2000 and a trophy, while the overall winner will receive a cheque for £5000 and a further trophy.

A representative from the project chosen as British Conservation Project of the Year will be invited to represent Britain at the European Conservation Awards in Paris in March, when national winners from eight countries will assemble to be judged for the title European Conservation Project of the Year'. This title carries a further cash prize and a specially commissioned trophy featuring the otter, which is currently under threat across Europe.

Source: The Conservation Foundation

Gas survey UK prices out of line

This year's National Utility Services survey of natural gas prices shows that United Kingdom gas price rises have been significantly out of line with those of other countries. The survey uses data drawn from prices paid by NUS clients at over 750 000 business premises worldwide.

This survey highlights the fact that the UK is one of only two countries among the nine surveyed to have increased its prices in the 12 months to September 1986.

NUS spokesman Andrew Johns says that UK gas prices rose by an average 1.2% over the last 12 months. 'This is significantly out of line with the situation in most other countries, where decreases in the price of oil have generally been reflected in gas price reductions'.

The NUS survey shows that most countries experienced price reductions ranging from a 1.4% drop in Canada to a massive 61.1% cut in Italy. The only other exception, apart the the UK, was Australia.

The average UK price on 1 September 1986 was 34.5 p per therm, the sixth highest in the NUS survey. The most expensive average of 49.6% p per therm was recorded for France, whilst Italy was cheapest at 16.3 p.

The UK stands out as the only country surveyed in Europe to increase its costs for gas in the face of the sharp fall in oil prices. 'With cheaper alternative fuels available, British Gas has been in many cases dragged reluctantly to the negotiating table, losing in the process a large number of major consumers who switched to burning these cheaper alternative fuels', says Andrew Johns. 'It is evident that the British Gas industry, which has argued since 1983 that its prices are not oil-related has been forced over the last 12 months to take note of the prices charged by competing fuel suppliers in order to remain competitive and retain its market share'.

According to NUS, there are indications that British Gas, despite extending its negotiating team to cope with recent market developments, is likely to adopt a new harder line on negotiations in the future.

Gas prices in France have become the most expensive of the nine countries surveyed, in spite of costs having fallen by 14.5% against a Retail Price Index (RPI) figure of 2%.

Due to the fall in oil prices in 1985/86 gas prices have been reduced six times during the year's survey, primarily for large supplies. This is in conflict with Gaz de France's policy over the last three years to increase prices, which they have done by nearly 30%, in an effort to recoup the large losses made in 1981/82.

The French Government has introduced a new tax for medium and large supplies, effective from January 1986.

A massive 61% reduction in Italian gas prices, compared with an RPI figure of 7%, has moved Italy from fifth to bottom place in the price league.

Of the nine countries surveyed, Australia recorded the highest price increase — almost 8%. As predicted in last year's survey, this is in line with retail prices.

The survey is based on prices ruling in September 1986 and September 1985.

Exchange rate conversions are based on the London Daily Telegraph dated 2 September 1986.

Prices for each country are unweighted averages of the individual suppliers' prices.

Sizes of the suppliers are for firm contract gas 100 000 therms/year for process and heating; 1 M therms/year process and heating.

Source: NUS

British Gas Chairman's statement

British Gas's unaudited results for the six months to 28 September 1986 were published recently, Sir Denis Rooke, chairman, made the following comments on the results.

'In view of the seasonal nature of its business, British Gas normally generates its annual operating profit during the winter months and the results of the first half of the financial year usually show a loss. The seasonality of the business is very evident in this first financial report to shareholders which shows that the current cost operating loss for the six months to 28 September, 1986 was £136 M compared with a loss of £147 M for the equivalent period last year.

'The slight reduction in turnover was mainly due to a reduction both in the number of therms sold and selling prices in the interruptible contract market, as a result of changes in competitive conditions due to the collapse in oil product prices, partially offset by a higher volume of sales in the domestic market, in the period under review, April to September 1986.

'The current cost operating results for the six months to 28 September 1986 benefited from a reduction in the cost of gas purchased resulting from reductions in gas supplies from Frigg (following industrial action at the field), which were temporarily replaced by supplies mainly from the lower cost Early Southern Basin Fields, and from the effect of more favourable exchange rates. These lower

gas costs resulted in the current cost working capital adjustments being a credit (thereby reducing the current cost operating loss) whereas in the previous year these adjustments were a charge; a favourable movement of £38 M.

'Net interest receivable increased by £21 M, reflecting a higher level of current asset investments. The current cost pre-tax loss was thus £68 M compared with a loss of £100 M for the equivalent six month period in 1985.

'The outlook for the rest of the financial year to 31 March 1987 is, as always, influenced by weather conditions during the winter months. The results for the six months to 28 September 1986 are consistent with the profit forecast for the full year included in the prospectus and the directors consider that, in the absence of unforeseen circumstances, the results for the year ending 31 March 1987 should also at least achieve that profit forecast'.
Source: British Gas

UK/Soviet venture
Minister signs contract

Mr Peter Walker, Secretary of State for Energy signed a protocol with the Soviet Union on scientific and technical collaboration in the oil and gas sector in January. The Soviet signatory, His Excellency, Mr Vitalii Iosifovich Timonin, the Soviet offshore oil and gas Minister.

The two countries have agreed to collaborate on promoting scientific and technical cooperation in oil and gas exploration and development.

Commenting on the protocol, Mr Walker said: 'The UK has built up a wealth of experience and expertise over 20 years or more of offshore oil and gas exploration and production.

'In the past week the Soviet delegation has visited some of our foremost companies and I know they have been impressed with the breadth of British capability in offshore engineering and technology.

'The signing of this protocol creates an opportunity for us to work together with the Soviet Union both in pursuit of their own oil and gas resources and also to work together in third markets.

'We now have a major opportunity for UK offshore supply companies to build on the considerable experience we have developed on the UK continental shelf (UKCS) to help the Soviet Union develop further its vast oil and gas resources.

'I very much hope that a prominent feature of this collaboration will be joint UK/Soviet ventures in the world's markets'.

The initial cooperation will concentrate on:

- ☐ Subsea technology including production systems and their control; pipelines design and operation and other underwater related activities.
- ☐ Technologies suitable for identifying and extracting oil and gas in deep waters, eg tension leg platforms and subsea systems, with particular reference to conditions involving very low temperatures and other extreme environmental conditions.
- ☐ Low cost production systems.
- ☐ Computer aided design.
- ☐ Enhanced oil recovery.
- ☐ Decommissioning of production systems.

Source: Department of Energy

Scotland/Russia
Export mission

In a bid to tap new oil-related markets in the Soviet Union, the Scottish Development Agency (SDA) is supporting companies in an oil and gas export mission to Moscow.

The central event for the mission, departing late this month, is an exclusive four day exhibition, to be held in the World Trade Centre (Sovincentre, Moscow). Facilities will be also available for companies to give technical presentations and help will be provided in the translation of sales material and the preparation of an exhibition catalogue. The SDA estimates between 20 and 25 companies making the week long trip.

Invitations to the exhibition and technical presentations are being targeted towards key officials in Soviet purchasing organisations, ministries and oil companies. The commercial section of the British Embassy in Moscow, the Russian desk of the Offshore Supplies Office (through the newly formed British-Soviet Energy Working Group), the Department of Trade and Industry's Russian desk, officials of Sovincentre and the British-Soviet Chamber of Commerce are all offering their assistance.

SDA North East director, John Condliffe, said: 'The USSR offers substantial opportunities as their offshore exploration and production moves into hostile offshore environments. It will be a difficult market to break into, but we hope the mission and our financial support for it will give companies the opportunity to reach fresh markets'.
Source: Scottish Development Agency

Battery power
British success in US

A joint team from two British companies* has successfully completed a £316 000 research and development project in which they developed an advanced lead acid battery to power an Escort-sized American car.

The contract called for the development of a battery system that would be compatible with an advanced integrated alternating current power train technology developed by Ford under a $6.8 M programme, funded by the US Department of Energy.

Twelve volt monobloc traction units were designed and built by adapting advanced tubular plate battery technology, optimising the design and further improving the performance of tubular plate lead acid motive power cell. Train and systems expertise were used t construct a two-tier electric vehic battery from the monoblocs, and t develop supporting hardware including battery control system, single poi watering and charger.

The contract called for two batteries t be delivered to Detroit, one for in-vehic trials and the other for laboratory test The test bed was an Escort-sized car wit a specification requirement fc acceleration of 0-50 mph in 20 second top speed 60 mph and range on th federal urban driving cycle of 60 mile

At the recent Electric Vehicl Symposium (EVS 8) in Washington, Fo reported and demonstrated that th LCEVS/CTL battery, when installed ar operated in the test vehicle, successful achieved all targets.

The advanced tubular technology tha proved so successful in the United Stat has been incorporated into two oth electric vehicle batteries now und evaluation in the UK. The operatin range of a Bedford CF electric van ha been significantly increased and a Dod 50 electric truck is meeting all servic requirements on a demanding applian delivery application with an electr vehicle operator.
Source: Chloride Industrial Batteries

Waste disposal
Government urged to ac

The Government should not was further time in processing waste dispos legislation, the Confederation of Britis Industry said earlier this year.

Mr Graham Mason, CBI director c company and environmental affairs, sai 'The CBI has been calling fc improvements in waste disposa legislation for some time. We issued ou own guidelines as long ago as 198 because we recognised that industry ha to take its responsibilities seriously. Th Government have now put forward the proposals and we are urging them t bring in improved legislation witho delay.

'Our members, who are often wrong blamed by the public when waste dispos is unsatisfactory, are concerned and wa to see rapid progress where improvemer is needed.

'As 1987 is European Year of th Environment it would be an excelle time for the Government to tidy up c new waste disposal legislation and ensu the current laws are properly enforced
Source: CBI

More power needed...
...in the Capital

A key facility for London's Dockland came into operation recently with th commissioning of a major new LE

*Lucas Chloride EV Systems and Chlorid Technical

London Electricity Board) substation.
The Rt Hon James Prior MP formally ommissioned the 132/11kV substation iat will provide power to the Isle of ogs. This £3.5 M installation is the first a massive building programme rrently being undertaken by LEB to eet London's growing power quirements. At its height, this rogra·me will see the completion of two ich developments each year.

Mr Prior spoke at the ceremony of his leasure in hearing about LEB's future lanning, which will enable its customers believe and understand that power will e available when required. He praised EB for setting an example by ordering quipment from British manufacturers. nd he talked of the pride which ocklands should generate, as a emonstration of what Britain can do in ne heart of the capital.
ource: LEB

ndia
mphasis on efficiency

he Indian energy sector is to receive bout 30% of the total government unding for the seventh development lan, including power, petroleum and oal.

Emphasis has been placed on the nproved efficiency of the infrastructure prevent shortages of power, coal and ansport. Improved performance of hermal power plants is planned and ncludes a comprehensive renovation and odernisation scheme. This may open up pportunities for UK exporters to supply quipment for power generation. Other pportunities may exist for exporters in planned increase in oil exploration ctivities; the expansion of refining apacity may create a demand for oil and as field machinery.

The demand for freight capacity on ndia's huge railway network is expected increase considerably through the eventh Development Plan (1985 to 990). A possible programme of mprovements is being considered in rder to increase capacity and improve roductivity. It would involve eplacement of old assets, general odernisation and technological pgrading, development of rapid handling terminals and improved maintenance.

Expansion of the country's major ports is planned in anticipation of increased traffic by 1990. The main areas will be capacity increase in handling petroleum and fertilisers and increased facilities for container traffic. Improvements to infrastructure in ports is planned to coordinate the type and size of vessels and the volume and type of cargo. Port facilities will be modernised, particularly in container handling, through the upgrading of technology.
Source: Midland Bank

Australian ROV
Saves oil industry millions

A remotely operated vehicle (ROV) developed in Western Australia by an offshore drilling support vessel skipper could save the offshore oil industry millions of dollars a year. The invention by Marine Officer Ron McGrath has the potential to do away with the need for support vessels at some offshore oil drilling platforms. The five-metre long ROV, complete with six cameras and lights, two climbing and multi-purpose 'claws' and welding equipment can be launched from a drilling platform and perform underwater duties including cleaning cutting and welding. Mr McGrath said his invention can perform duties in conditions that would render other 'free swimming' ROVs ineffectual. It can however operate in virtually any conditions, provide a stable base from which to carry out precision works and can be launched from an offshore platform. It is expected to cost about Aus $1.2 M.
Source: Oil and Gas Review

Australia\ nuclear
Wider applications

The proposed Australian Nuclear Science and Technology Organisation should establish and operate major facilities including nuclear reactors, according to a report.

The Australian Minister for Resources and Energy, Senator Gareth Evans, who issued the report on the proposed organisation, said the aim of the legislation is to establish an organisation which reflected the Government's policy on nuclear activities.

Its functions would reflect the realignment of these activities away from work on the nuclear fuel cycle towards greater emphasis on peaceful applications of radioisotopes and radiation.

Senator Evans said the report supported the Government's desire that the organisation promote the skills which it could make available for applications in industry, agriculture, medicine and other areas.
Source: Australian Information Service

ETHEL contract
UK company overcomes competition

A £10.8 M three year contract to design, construct and commission a new European Tritium Handling Experimental Laboratory (ETHEL) at Ispra, northern Italy, has been awarded.* The turnkey contract covers design, construction, procurement and commissioning.

Funded under the EURATOM treaty by the EEC member countries, Ispra is the largest of the four establishments of the Joint Research Centre (JRC), dealing with research on nuclear and non-nuclear safety, environmental protection, alternative energy sources, etc.

The tritium laboratory will be used in gaining experience on the handling and behaviour of tritium in relation to the development of thermonuclear fusion devices like the *Next European Torus(NET).*

The company is currently involved in major contracts for the electricity generating boards and the United Kingdom Atomic Energy Authority (UKAEA), the company also undertakes work in a variety of areas both in the nuclear and non-nuclear fields.
Source: National Nuclear Corporation

*National Nuclear Corporation

ooks continued from p 16)

r so. Almost half the scrapped plant vould be uneconomic condensing and ass-out condensing sets, and most of the ew installations would be efficient back-ressure steam turbines or gas turbines. he electrical output of the new CHP lant would probably drop only narginally.

The survey finding, with regard to the ast, is that technical uncertainties mpeded the adoption of CHP, but that inancial obstacles were more important. Most companies foresaw better returns n investment in productive capacity or product development than on capital allotted to CHP plant. The Energy Act had not been law for long enough to make any difference at the time of the survey, Schaffer grants, but he suggests that, with more experience of the Act's opportunities, companies currently selling little electricity to area boards might install CHP and expand their electricity exports. 'This prospect may now be better than at the time of the survey', the author concludes, 'both because of the sharp real price fall of energy... and because companies have had a longer time period to evaluate the benefits of the published Energy Act tariffs pertaining to CHP operations'.

That is a more cautious appraisal than one might have guessed from the foreword by the Secretary of State for Energy, Peter Walker, who writes of an important role for CHP 'in the future energy scene'. Perhaps he has foreknowledge of tariff reforms such as those demanded by the editor of *Electrical Review.*
Arthur Conway

Test rig for filters

Farr Europe have designed and installed an advanced test facility capable of testing the company's filters for HVAC and other markets to high international standards. The new test rig performs full arrestance and dust spot efficiency tests to a comprehensive range of standards including BS 6540 Part 1; Eurovent 4/5; and ASHRAE 52/76.

The rig will test all filter sizes up to 610 x 610 mm and up to 900 mm long — and multi-stages of filters — and has an air-flow capacity of up to 1.25 m/s. Testing is controlled from a console desk, allowing filters to be observed either visually or stroboscopically during the test period.

Reader enquiry no 3/1

Extensions and modifications to boiler plant

M. E. Boilers have completed an order to provide extensions and modifications to boiler plant as part of an energy saving scheme on BP Chemical's Grangemouth site. The original economisers were replaced by new, more efficient spiral finned tube economisers. Similarly finned tubular combustion airheaters were incorporated to recover additional heat from hot process fluids.

The economisers were designed to obtain maximum heat recovery, whilst remaining within specific weight and draught loss restraints. Each economiser unit (two installed) recovers approximately 50% more heat from the flue gases — compared with the amount formerly recovered. The airheater (two installed) recover further heat from the hot process fluids in the form of preheated combustion air.

MEB also installed replacement burner equipment on the boilers and complex combustion air ducting modifications were required to incorporate the airheaters.

Reader enquiry no 3/2

Building energy analysis service

A new computer-based service launched by **BSRIA** uses a 'black box' environmental temperature logger to gather information which is later analysed to highlight causes of energy waste.

The temperature logger is a small integral, battery-powered unit needing no supervision, which is simply placed in the building and left to work automatically. After a three-week period, when sufficient information has been accumulated to give a reliable picture of the temperature regime in the building, the unit is returned to Bracknell. The records are computer analysed to produce a confidential report to show what corrective actions need to be taken to save energy.

The service, which uses analysis techniques developed for the Energy Efficiency Office, is aimed specifically at the smaller building where the cost and inconvenience of a survey is not warranted.

Reader enquiry no 3/3

Multi-functional burner control system

Nu-way are adding a new multi-functional control system to their range of gas burners for the heating and process industries. This single unit contrasts with conventional systems where there are separate valves for different functions. The unit incorporates filter, pressure regulator, closed position indicator (CPI) switch and two safety valves including a bypass pilot system.

Adjustment of the output flow and pilot gas rate can all be achieved within a single compact monobloc and a valve sequential proving system (type VDK 300) is available for export markets. The compactness of the system means considerable space saving and also overcomes maintenance problems. The complete unit can be removed by means of a slip-off flange arrangement and a service exchange unit fitted as a replacement within seconds.

Reader enquiry no 3/4

High-sensitivity gas analyser monitors cooling performance in GCRs

Westinghouse Electric's Maihak UNOR-6N NDIR gas analyser is used in the monitoring of cooling CO_2 for gas-cooled nuclear reactors. As the cooling gas circulates around the graphite moderators, CO is formed. To inhibit this reaction, small amounts of CH_4 are added by the control system. The levels of CO and CH_4 are monitored to low levels (0-20 ppm) using the UNOR-6N gas analysers.

Typically, two analysers are employed: one set up to measure the CO and the other to check the level of CH_4 injected into the cooling gas stream. This arrangement gives on-line, fast-response measurement which enables engineers to check conditions minute-by-minute. The CO level is controlled to within 0.9 to 1.1% and the UNOR instrument provides an output control signal that is used to adjust the CH_4 injection to oversee the CO_2-CO reaction.

The UNOR-6N utilises a measurement principle proven in a wide variety of applications.

High sensitivity is a feature. The measurement range is from 20 ppm to 100% (vol) and this is combined with a high selectivity and low cross-response to other gases.

Reader enquiry no 3/5

Flocculent controller

Kent Industrial Measurements have recently completed a licensing agreement with the Water Research Centre for the manufacturing and marketing of the Flocmate controller. This controls automatically the addition of flocculent in water treatment plants, with a pay-back period which can be as short as three months.

A 'Floc blanket' is formed in water treatment to remove suspended particles. First, the pH value of the abstracted water may be adjusted and then a coagulant added, such as aluminium sulphate or a similar chemical. The result is a suspension known as a 'blanket' through which the abstracted water flows. The process is continuous and it is optimised by the correct amount of chemical being added to the abstracted water.

Flocmate has been designed specifically to control automatically the particle size at the optimum level in order to maintain the flocculent blanket at peak efficiency. The controller offers the following benefits: chemical savings can be as high as 20%; the existing tedious method of adjusting and checking manually is eliminated; maintaining the optimum chemical addition ensures effective water treatment; the optimum use of chemicals minimises the amout of carry-over in the treated water.

Reader enquiry no 3/6

Assessment service for process plant

To meet the need for increased plant life and optimum inspection schedules, **ERA Technology** have extended the component assessment service which they provide for the power generation field to include plant operated by the petrochemical and process industry.

ERA's service, which is available worldwide, is aimed at providing plant managers with the information on which to base a 'run or retire' decision. The work involves condition assessment, normally carried out in the field, combined with post-service testing and predictive interpretation at ERA's laboratories. An integrated 'package' of techniques has been developed for the assessment of individual components and component systems, and the field work is carried out by teams of metallurgists and engineers with specific expertise in plant integrity evaluation.

ERA have investigated fluid catalytic cracking vessels and risers, catalytic reforming plant (reactor vessels and furnace heaters) and steam reforming plant. Other types of high-temperature equipment, such as steam power generating plant (boilers, pipelines, turbines) and gas turbine components, have also been assessed.

Reader enquiry no 3/7

Trade publications

TT range of plate recuperators. **Thermal Technology** have published a new eight-page leaflet on the TT range of air to air plate recuperators for air conditioning and heating and ventilating systems. There are four basic models: standard crossflow flanged; diagonal flow; diagonal flow with bypass; and standard crossflow with lightweight casing. The range includes ten different plate sizes from 200 mm square to 2000 mm square. These are available in four different materials: aluminium; aluminium coated; stainless steel; an polycarbonate. Each size c recuperator is available in 50 mr width increments from 50 mm wic to 2500 mm wide giving 50 differer widths. It is therefore possible, it claimed, to select a recuperator t meet virtually any client's needs. new manual method of choosing recuperator has been adopted to de with the large number of selectior available. But computer selections ar also readily available. Apart from th standard range of recuperator Thermal Technology will alway engineer special recuperators to me most requirements.

Reader enquiry no 3/8

The AELETE group. The combine expertise of two companies in th heating, heat recovery and pollutio control sector is highlighted in a ne brochure published by the recentl formed **AELETE group.** Full illustrated, the six-page, full-colou brochure details the products an services provided by the two membe of the group — **Acoustics Environmetrics Limited (AEL)** an **Environmental & Therm Engineering Limited (ETE).** AEL who are based in Surrey manufacture and market a wic range of products used in commerci heating and heat recovery system The Cheshire-based ET complement this commerci expertise with their wide experience c energy conservation and pollutio control in a diverse range c industries. Recent projects hav included the design, supply installation and commissioning c complete systems in the baking process, paper, steel and texti sectors.

Reader enquiry no 3/9

Generating sets powered by Dorma engines. **Petbow** have published new four-page, four-colour brochu featuring the company's range c generating sets powered by Dorma diesel engines. In addition, a separa four-page technical data sheet is als available listing detailed specificatio including ratings, dimensions an weights for the complete range of se suitable for both baseload an standby applications. The four-pag brochure describes 'build specifications and control syster available with the Dorman-powere range of sets, together wit illustrations of plantroor installations.

Reader enquiry no 3/10

ENERGY WORLD — COMMERCIAL
(Photocopy acceptable)

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

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

Name .....

Address .....

.....

Organisation .....

Institute of Energy conferences in 1987/88

The following programme of conferences is currently being organised by the Institute of Energy, and its associated overseas societies, and other UK societies 'in association' for the event.

1987

23/24/25 June — **First European dry fine coal conference**
Venue: Harrogate, Yorkshire
Chairman: Dr J M Topper (BC CRE)
Brochure enclosed in this issue

24/25 Sept — **First European conference on the influence of inorganic constituents on coal combustion in small to medium-sized boilers**
Venue: Imperial College
Chairman: Dr A Sanyal (Babcock Energy)
Brochure to follow: enquiries invited

1988 (June) (dates to be announced) — **Gasification — status and prospects**
Chairman: H B Locke (Cadogan Consultants)
(fuller announcement shortly)

Autumn (dates to be announced) — **Institute of Energy 4th Fbc conference**
(fuller announcement shortly)

Conferences with which the Institute is in association:

In 1987 7/9 April — **Energy options: the role of alternatives** (IEE)
Venue: University of Reading

7/10 Sept — **International symposium on coal combustion**
Venue: Tsinghua University, Beijing, China

16/18 Sept — **Innovation in process energy utilisation** (IChemE S Wales branch)
Venue: University of Bath

19/20 March — **High insulation: impact on building and services design** (CICC) London

21/23 Sept — **3rd European conference on coal liquid mixtures** (IChemE)
Venue: Sweden

23/24 Sept — **Small engines and their fuels in developing countries** (University of Reading)
Venue: University of Reading

— October — **New developments in optical diagnostics**
(Combustion Physics Group of Institute of Physics)

New members

Fellow

Ashwani Kumar Gupta, University of Maryland, USA *(transfer)*

Member

Grahame Vincent Durrant, Bhow Engineering Services, West Bromwich
Clive Martin Robinson
Charles Ernest Thompson, British Gas School of Fuel Management, West Midlands

Technician Engineer

Maurice Rabach Ogwang, African Highlands Produce Co, Kenya

Associate

Robert David Eden, Green Land Reclamation, Reading

Graduate

Kin Yuen Yam, R W Gregory & Partners, Hong Kong

Student

Paul Boswood, University College of Swansea
Stephen John Carver, University of Newcastle
Kevin John Charlton, Polytechnic of the South Bank
Pak Ki Chau, University of Leeds
Patrick Harry Dyke, University of Leeds
Martin Charles Frize, University College of Swansea
Richard Martin Healy, University College of Swansea
George Kourris, University College of Swansea
Andrew John Geens, Polytechnic of the South Bank
Nicholas David Laws, Polytechnic of the South Bank
Simon Derek Matthews, University College of Swansea
James Robert Patterson, University of Leeds
Naeem Atiq Sadiq, University of Leeds
Mohinder Singh Sidhu
Andrew Robert Smith, Polytechnic of the South Bank
Graham Smith, University of Leeds
Michael Henry Smith, Polytechnic of the South Bank
Ali Tehrani, University of Exeter
Simon John Thayer, Polytechnic of Wales
Andrew Thomas Tomb, Queens University of Belfast
Simon Mark Woodward, University College of Swansea
Martin Paul Squance, University College of Swansea
David Stevenson

Collective

Cookson & Zinn, Hadleigh, Ipswich
British National Committee for Electroheat, London

Obituary

David Speight (Fellow) died suddenly on 27 November 1986 aged 50 years. He served the Institute of Energy North-Western branch for many years, during which time he held the posts of honorary secretary and branch chairman.

David started his training as an apprentice mining surveyor with the No 5 Yorkshire area of the NCB from 1952 to 1959. He transferred to the Scientific Branch and served as a scientific technical officer from 1959 to 1962. During this period he obtained an HNC in chemistry and from 1962 to 1965 he studied chemistry at Hull University, where he obtained an honours degree.

He returned to the Burnley area as a Coal Board scientist, and in 1967 he joined the Marketing Department as a fuel technologist in the Sheffield and Leeds area. In 1970 he moved to the North West Regional Marketing Department and became a team leader, the position he held at the time of his death.

David was very hard working in all his duties and was always willing to lend a helping hand to others.

He is greatly missed by all his colleagues on the committee and by many other organisations he was connected with. He leaves a wife and three sons to whom we send our sincere sympathies.

ERIC CURD
(Chairman, North-Western branch)

W Milne (Fellow), a past chairman ar honorary secretary of the Institute's Ne Zealand branch, died on 13 Novemb 1986 at the age of 68.

Bill Milne joined the Institute in 19 and served continuously as honora secretary of the New Zealand bran from 1963 when he took office until 19 when, for the first time since i formation, the administration of bran affairs was transferred to Christchurch the South Island of New Zealand. Ma members at that time expressed th appreciation of Mr Milne's fine servic in looking after affairs during those yea

He served subsequently as Auckla representative on the committee and regional correspondent for that area. 1979 when activities again centred Auckland he became branch chairma He held this office until the annu general meeting in July 1982, when Christchurch-based committee w elected on which he was the Auckla representative.

Institute of Energy

1987 Branch conferences

Midland

29 Apr (W). One-day symposium: *The future of steam.* Univesity of Aston in Birmingham. *Contact R Wainwright (021-749 2400).*
For other Institute conferences please see p 21. For conferences organised by bodies other than the Institute of Energy please see p 24.

1987 April meetings

Midland

2 Apr (Th). Engineering the production of oil and gas offshore UK, by Prof T Patten. University of Aston in Birmingham, Senior Common Room at 1900 h.

South Wales and West of England

8 April (W). AGM. Chairman's address. The Angel Hotel, Cardiff at 1800 h (tea at 1730 h).

Yorkshire

8 Apr (W). Pressurised fluidised bed combustion experiments at Grimethorpe, by S G Dawes (NCB Grimethorpe PFBC Establishment). Post House Hotel, Wakefield at 1930 h.

Scottish

8 Apr (W). 1815 h: AGM; 1930: annual dinner. RSAC, Blythswood Square, Glasgow.

East Midlands

10 Apr (F). Annual dinner. George Hotel, Nottingham.

Yorkshire

23 Apr (Th). AGM. AHED Hous Ossett at 1430 h.

National

28 Apr (Tu). Annual lunch. Inn on t Park, Hamilton Place, London W1 1230 for 1300 h. Principal guest ar speaker: Sir Philip Jones (chairma Electricity Council).

East Midlands

29 Apr (W). AGM and works visi Ruston Gas Turbines, Lincoln.

Midland

29 Apr (W). One-day symposium: *T future of steam* (see above).

nstitute of Energy AGM

ıe annual general meeting will be held at the Institute of ıergy, 18 Devonshire Street, London W1N 2AU on *ıursday 28 May 1987.*

outh Wales and West of England: 5th Idris Jones Memorial Lecture, 988

ease note that the fifteenth Idris Jones Memorial Lecture ll be presented in **1988**.

echnician engineers: leeting and discussion, London, April 1987

meeting and discussion will be held at the Royal Society of ts, John Adam Street, Adelphi, London on Tuesday 7 April 87 at 1430 h (tea 1630 h). Subject: *Technician engineers — eir education, training and role in other countries. How do compare?* Admission free (by ticket only). The chairman ll be *Sir Monty Finniston* FEng FRS.

eakers:

John Lorriman (controller of training, GEC Telecommunications);
Kathy Jackson (personnel manager, W S Atkins);
Bryan Deakin (head of School of Science & Electrical Technology, Thurrock Technical College, Essex);
Bill Cousins (departmental training officer for Department of Environment, Northern Ireland).

Tickets and further information from Colin Rigg, ıgineering Council, 10 Maltravers Street, London WC2R R (tel 01-240 7891).

ligh-tech buildings: Conference and xhibition, ondon, 28-30 April 1987

ıe conference and exhibition will be held at the Barbican ntre, London from 28-30 April 1987.

This conference will highlight the forces, both technological ıd financial, which have moved the industry forward over e past year. It will examine the increased demand for ildings, both new and reburbished, which can accommodate mputer-intensive offices and will look into the financial centives for investment in these properties.

Further information from Online International, Pinner reen House, Ash Hill Drive, Pinner, Middlesex HA5 2AE el 01-868 4466; tlx 923498 ONLINE G).

ax for non-accountants: ourse, London, 8 May 1987

ıis one-day course will be held at the Chartered Accountants' all, London EC2 on Friday 8 May 1987.

ıe course is designed for:

- Anyone who has difficulty filling out a tax return.
- Anyone who feels he or she is paying too much tax, but is unsure how to assess the situation.
- Those who feel lost when tax is discussed in relation to the accounts and feel the need to understand more.
- Anyone who is not sure how VAT works.

Further information from Institute of Chartered Accountants in England and Wales, 399 Silbury Boulevard, Central Milton Keynes MK9 2HI (tel Milton Keynes (0908) 668833 or 01-628 7060; tlx 827502).

Energy cost control by targeting and monitoring: Conference, Stockton-on-Tees, 13 May 1987

The Department of Civil and Structural Engineering and Building, Teeside Polytechnic are holding their sixth annual one-day energy conference at the Swallow Hotel, Stockton-on-Tees on *Wednesday 13 May 1986.* The cost is £30.00 (including VAT and one set of papers), which covers lunch, morning coffee and afternoon tea.

Provisional timetable

0900-0930	Reception desk opens for delegates.
0930-0935	Welcome to hotel by assistant director (resources), D G Leyland.
0935-0945	Opening remarks by chairman for the morning session, *Prof J Swithenbank,* (president, Institute of Energy.
0945-1030	Paper 1 — R Anthony (Department of Energy). *Government help in energy cost control.*
1030-1045	*Coffee.*
1045-1115	Paper 2 — Dr J Barr (NIFES, Glasgow). *The basis for setting realistic energy targets.*
1115-1145	Paper 3 — B C Oliver (superintendent engineer — Works Group, DHSS). *Targeting and monitoring in NHS buildings.*
1145-1215	Paper 4 — Mr Bell-Berry (Industrial Efficiency Systems). *Targeting and monitoring in heavy industry.*
1215-1300	Discussion.
1300-1400	*Lunch.*
1400-1405	Introduction by chairman for afternoon session, *J Barton* (chairman, Teesside Energy Managers Group).
1405-1435	Paper 5 — Dr S D Fawkes (energy manager, London Borough of Tower Hamlets). *Targeting and monitoring in local authority buildings including housing.*
1435-1505	Paper 6 — R Tinson (managing director, Emstar). *Contract energy managment.*
1505-1550	Discussion.
1550-1600	Closing remarks.
1600	*Tea.*

Further information from M G Burbage-Atter (conference organiser), Teesside Polytechnic, Department of Civil and Structural Engineering and Building, Middlesbrough, Cleveland TS1 3BA (tel 0642 218121).

Research grants for European integration

The European Commission is offering 20 research grants to encourage university staff to work in the field of European integration. The grants of around £3200 are aimed at young university teaching staff at the start of their careers and are being offered by the Directorate-General for Information, Communication and Culture. The successful applicants will be expected to produce a manuscript of at least 40 000 words at the end of their work and the Commission may provide additional help towards the cost of publishing it.

Grants are limited to people under the age of 40, and application forms are available from the Press and Information Offices of the European Communities and must be returned, together with a detailed description of the research project and a breakdown of the costs involved, to the Commission of the European Communities, Directorate-General Information, Communication, Culture, University Information, 200 rue de la Loi, B-1049 Brussels, by *31 March 1987,* in order to qualify for an award in July 1987.

CONFERENCES

The following conferences, courses and meetings are organised by bodies other than the Institute of Energ
For Institute conferences please see page 21

April 1987

Can international development in nuclear technology be successful?

Evening meeting, London (ICE), 23 April 1987 at 1730 h (refreshments from 1700 h).
Details from the secretary, Institution of Nuclear Engineers, Allan House, 1 Penerley Road, London SE6 2LQ (tel 01-698 1500).

Fluidised bed combustion technology

Seminar, Graz (Austria), 26-27 April 1987 (visit to circulating FBC plant 28 April 1987).
Details from Seminar Dept, DELTA-H Institute, PO Box 1053, Springfield, New Jersey 07081, USA (tel (201) 654-9633; tlx 238 667 ATT DELTA).

A call to action — the next steps

Conference on *Continuing education and training for engineers and technicians* (sponsored by the Engineering Council). Liverpool, 29 April 1987.
Details from A G Humphreys, Faculty of Engineering, Liverpool Polytechnic, Byrom Street, Liverpool L3 3AF (tel 051 207 3581 ext 2031).

Slurry fuel combustion technology

Seminar, Graz (Austria), 29-30 April 1987.
Details from Seminar Dept DELTA-H Institute (see address above).

Coping with catastrophe

Conference, Birmingham (Metropole Hotel, NEC), 30 April 1987.
Details from Carolyn Lewis, AMI Occupational Health, Priory Dene, 28 Priory Road, Edgbaston, Birmingham B5 7UG (tel 021-440 5640).

May 1987

Biotechnology for fuels and chemicals

Ninth symposium, Boulder (CO, USA), 5-8 May 1987.
Details from Charles D Scott, ninth symposium on *Biotechnology*, Oak Ridge National Laboratory, PO Box X, Oak Ridge, TN 37831, USA.

Health effects of low dose ionising radiation — recent advances and implications

Conference, London, 11-14 May 1987.
Details from Mrs P J Ross, Conference Office, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA (tel 01-222 7722).

Multi-phase flow

Third international conference, The Hague (Netherlands), 18-20 May 1987.

May 1987 (continued)

Details from Rosemary Pickford, conference organiser, *3rd Multi-phase flow*, BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ (tel (0234) 750422; tlx 825059 BHRA G).

June 1987

Oil, gas and petrochemical engineering

Malaysian exhibition, Kuala Lumpur (Malaysia), 8-11 June 1987.
Details from Hugo Johnson, Overseas Exhibition Services, 11 Manchester Square, London W1M 5AB (tel 01-486 1951; tlx 24591).

COAL TECH 87

Sixth international conference and exhibition on coal utilisation, London (Queen Elizabeth II Conference Centre), 9-11 June 1987.
Details from Industrial Presentations (Europe) BV, 's-Gravelandseweg 284-296, 3125 BK Schiedam, The Netherlands (tel +(31) 10 415 82 44; tlx 21423).

LP Gas 87

LP Gas equipment and services exhibition, Birmingham (NEC), 9-11 June 1987.
Details from Industrial and Trade Fairs, Radcliffe House, Blenheim Court, Solihull, West Midlands B91 2BG (tel 021-705 6707; tlx 337073).

Quality assurance in heat treatment

22nd Wolfson Heat Treatment Centre conference, Birmingham (Aston University), 10 June 1987.
Details from Wolfson Heat Treatment Centre, Aston University, Aston Triangle, Birmingham B4 7ET (tel 021-359 361 ext 5212; tlx 336997 UNIAST G).

Poznan international trade fair

Poznan, Poland, 14-21 June 1987.
Details from Catherine Vokey, Exhibitions Department, London Chamber of Commerce, 69 Cannot Street, London EC4N 5AB (tel 01-248 4444; tlx 888941).

Environmental technology

Second European conference, Amsterdam (Netherlands), 22-26 June 1987.
Details from Ms C A Arensman, TNO Corporate Communication Department, PO Box 297, 2501 BD The Hague, Netherlands (tel (070) 496611; tlx 31660 TNOGV NL).

Power plant UK 87

Exhibition, CEGB Barnwood (Glos), 23-27 June 1987.

June 1987 (continued)

Details from Sarah Norman, pre officer, CEGB Generation Developme and Construction Division, Barnett Wa Barnwood, Gloucester GL4 7RS (t Gloucester (0452) 652105; tlx 43501).

Power supply 87

Trade fair for electronic power supp systems, Frankfurt (FRG), 24-27 Jur 1987.
Details from Messe Frankfurt GmbH Project Group 10, PO Box 97012 D-6000 Frankfurt 1. FRG (tel (06 7575-385).

July 1987

NMR spectroscopy

Eighth international conferenc Canterbury (Kent), 5-10 July 1987.
Details from Dr John F Gibson, Th Royal Society of Chemistry, Burlingto House, London W1V 0BN (tel 01-43 8656).

Combustion and firing

Thirteenth German 'Flames Day Göttingen (FRG), 8 July 1987.
Details from VDI-Gesellscha Energietechnik, 4000 Düsseldorf Postfach 1139, FRG (tel (0211) 621 (216).

Cremation Society

Conference, Bournemouth, 7-9 Ju 1987.
Details from Cremation Society of Gre Britain, 2nd Floor, Brecon Hous Albion Place, Maidstone, Kent ME1 5DZ (tel Maidstone (0622) 688292).

September 1987

Energy 87

International salon, Geneva (Switze land), 8-12 September 1987.
Details from Omni-Expo SA, 5 cours d Bastions, CH-1205 Geneva, Switzerlan (tel 22/20 53 50; tlx 422 342 RB YB CH

September/October 1987

Coal

Fourth annual Pittsburgh co conference, Pittsburgh (PA, USA), 2 September-2 October 1987.
Details from Pittsburgh *Coal* conferenc MEMS, One Northgate Square, 2 Gard Centre Drive, Suite 211, PO Box 27 Greensburg, PA 15601, USA (tel (41 836-6813).

October 1987

Techmart 87

Exhibition (and three-day conference Birmingham (NEC), 13-16 October 198
Details from Exhibitions Divisio National Exhibition Centre Lt Birmingham B40 1NT (tel 021-780 417 tlx 336635).