

Degree Day Figures April 2000



The Journal of the Institute of Energy June 2000

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ENERGY RESEARCH -Helping the UK Compete

One-Day Seminar & Exhibition, 4th July 2000 IMechE HQ, Birdcage Walk, London

Organised by the Institution of Mechanical Engineers and the Engineering & Physical Sciences Research Council.

Co-sponsored by InstE, IEE, ESRC, NERC, CIBSE, DTI and DETR

SCOPE

The UK energy sector is currently going through a period of major structural change. For many years to come, it will continue to need highly trained staff as well as cleaner, cheaper, and more efficient technologies to compete in global markets. To meet these needs, the Engineering and Physical Sciences Research Council (EPSRC) supports research in UK universities. It has recently completed an evaluation of its research in the energy sector with the help of AEA Technology and a Panel of industrialists. This seminar, which is expected to attract around 200 participants, will present the findings of this evaluation, as well as some inspirational success stories from industry and university research projects. The event will conclude with a round table debate on future priorities for energy research, featuring senior figures from government, industry and academia, together with contributions from the floor. This seminar offers a unique opportunity for UK

I his seminar offers a unique opportunity for UK industry and universities to share the results of government-funded research.

WHO SHOULD ATTEND ?

The research needs of all energy supply sectors will be addressed, including electricity, oil and gas, clean coal, renewables and nuclear as well as energy users, manufacturers, equipment suppliers, policy makers, planners and consultants.

Participants from government, universities and industry will be able to strengthen their collaboration on energy research. Young graduates and researchers will have the chance to discuss research projects on which they might work with an EPSRC grant. In the Exhibition, about 20 industry and university-based energy research teams will present their work using posters and tabletop displays.

The IMechE contact for this event is Fiona Fulton, Executive Officer Research & Technology, Institution of Mechanical Engineers, I-3 Birdcage Walk, London. Tel: 0207 304 6815, Fax: 0207 973 0182, Email: f fulton@imeche.org.uk





YOUR INVITATION TO THE 2000 SCOTTISH ENERGY LECTURE

The Government's Climate Change Programme - Can it Deliver?



Sarah Boyack MSP Minister for Transport and the Environment Scottish Parliament



Fred Dinning Corporate Environment Director Scottish Power

With record low energy prices and woeful energy conservation efforts over the last 23 years, does the Government really believe it can reduce carbon emissions by 20%? Is the climate change levy the best way of encouraging business reductions in carbon emissions? Or should we be pushing the Government towards alternatives? Who will be the winners? Who will be the losers?

Make your contribution to Scotland's energy debate

Wednesday, 21st June 2000, 6.30pm The Scottish Executive, Victoria Quay, Edinburgh

For details contact: Nicola Sands on Tel: 0141 242 5835, Fax: 0141 242 5808 or email: nicola.sands@scotland.gov.uk

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COVER

The driving forces of change - the Institute's second major energy policy conference was held on 3 May, following last year's highly successful 'Energy, Solving the Policy Jigsaw' event. Speakers (pictured) this year were Environment Minister Michael Meacher MP, John Chesshire from SPRU, energy regulator Callum McCarthy, Jeff Scott from the NGC, John Reynolds of Credit Suisse First Boston, and director of Friends of the Earth Charles Secrett.

See page 18 for a full report.

Clean fuel vehicles - part of the solution

he transport sector is responsible for around a guarter of the UK's output of the main global warming gas, carbon dioxide, and the sector's contribution to total emissions is growing fast.

Current political reality appears to dictate that severe curbs on the demand for transport - particularly restrictions on car use are an unattractive, if not untenable, option for governing powers, so the focus of attention is increasingly on minimising the polluting impact of vehicles.

The motor industry, through the European association ACEA, has made a voluntary commitment to reduce CO₂ emissions from vehicles by 25% (2008 compared with 1995). The UK government is also introducing graduated vehicle excise duty bands to reflect vehicles' CO2 output and thus encourage the adoption of more energy efficient vehicles.

However, these measures are likely to do little more than compensate for the growth in transport demand, leaving CO2 output from the sector (particularly in view of booming demand for cheap air travel) at high levels. More needs to be done

Prescriptions for dealing with the problem are compounded by the fact that CO2 output from vehicles can not be considered in isolation of emissions of local pollutants, such as particulates and NOx, which are implicated in causing up to 24,000 early deaths in Britain (source: Department of Health, 1998). Technical solutions to reduce the output of local pollutants can have undesirable consequences in terms of CO2 so the problems must be considered in tandem.

Alternative fuel vehicles, such as those running on natural gas, LPG, electricity or - in the near future - fuel cells can offer part of the solution to both local air quality and global warming problems

The market for clean fuel vehicles (CFVs) is a major beneficiary of the additional £280 million allocated to transport in the recent national Budget. Powershift, an independent government-backed initiative set up and run by the Energy Saving Trust to kick-start the clean fuels market in the UK has received a three-fold budget increase, to £10 million, while an additional £6million has been allocated to establish a programme to clean up the emissions of older urban vehicles, particularly buses and taxis.

However, it is not always the case that alternative fuel vehicles will always be cleaner and greener than their petrol or diesel counterparts. The fact is that, in order to deliver the desired emissions improvements, the vehicle and (where relevant) the conversion technology used, as well as the expertise of the engineers involved must all meet certain standards. Alternative fuel vehicles are not necessarily always cleaner but, depending on the technology used to burn the fuel, they have the potential to offer significant emissions advantages.

The Powershift Register is the UK's only independent guide to vehicles that have been tested and approved as suitable to run on clean fuels, and the reference also lists approved converters. This impartial information source. coupled with the grants offered to offset up to 75% of the cost of converting vehicles to run on clean Jonathan Murray, Head of fuels, have both been influential in encouraging the growth of the CFV



Transport, Energy Saving Trust

market in recent years. Independent research carried out by Powershift anticipates sales of over 15,000 clean fuel vehicles this year, rising to nearly 25,000 in 2001.

Twelve months ago, Powershift reported that fleet managers had helped achieve the programme's initial objective of converting '1.000 vehicles in 1.000 days' to run on LPG, natural gas and electricity. Now, a year later, a further 1,776 orders for clean fuel vehicles have been stimulated with the support of grants offered to over 450 organisations from both the public and private sectors.

By targeting the fleet sector first, Powershift has aimed to help stimulate the development of the refuelling infrastructure for LPG and natural gas, which has been the single biggest barrier to market growth. The number of LPG refuelling points in the UK has shown encouraging growth, to around 350, and is expected to increase to over 500 this year.

In the latest budget the government also announced further moves that will support the growth of the clean fuel market. These include another increase in the fuel duty differential on gas road fuels and company car tax changes based on the preferential treatment of vehicles that operate with lower CO2 emissions (in addition to the reforms in vehicle excise duty mentioned above). Fuel duty changes over recent years mean that a litre of LPG now costs less than 40 p compared with over 80 p for petrol and diesel.

Major car manufacturers such as Vauxhall, with its growing range of clean fuel vehicles, and Toyota and Honda, with the imminent launch of their hybrid (petrol/electric) vehicles, the Prius and Insight respectively - as well as fuel suppliers - have recognised the growing commercial potential of CFVs in the marketplace. With the entry of many more major players and with the commercial power at their disposal these companies should play a crucial role in bringing scale and competitive economies to the market and, hence, further open up the CFV market to consumers.

For further information about Powershift or its grant scheme, please contact the hotline on 0845 6021425, or visit the web site at www.est-powershift.org.uk



Cutting corporate emissions with Climate Savers

Two of the US's biggest companies, IBM Corporation and Johnson & Johnson have both agreed to cut their energy use and reduce greenhouse gas emissions in the coming years as part of a new voluntary partnership called Climate Savers. The partnership, sponsored by the World Wildlife Fund (WWF) and the Center for Energy and Climate Solutions, will work with companies around the globe to achieve energy efficiency goals and increase the use of clean energy technology. In joining Climate Savers, companies make specific commitments to cut greenhouse gas emissions and participate in an independent verification process.

Johnson & Johnson has agreed to reduce its greenhouse gas emissions to 7% below 1990 levels by 2010. IBM faces a tougher challenge, since it has already used energy efficiency to cut emissions by 20% since 1990. It is now committing to cut energy use by 4% per year through 2004.

Norway to test CO₂-free power generation

Norske Shell and Siemens Westinghouse Power Corporation are to build the first demonstration solid oxide fuel cell (SOFC) power generation facility, which will emit no carbon dioxide, in Norway.

The 250 kW, gas-fired plant will be operated by Norske Shell to demonstrate that the carbon dioxide normally emitted in exhaust gases can be successfully recovered at low additional cost, says Shell, and with the highest electrical efficiency of any fuel cell type in the industry.

The technology is the result of a combination of the fuel cell developed by Siemens Westinghouse and carbon dioxide recovery technology from Shell Hydrogen.

The intention is that this technology will be used to generate electricity from natural gas with all the carbon dioxide emitted being 'captured', and then, in the oil and gas industry, 'sequestered' in underground reservoirs. Smaller scale markets for carbon dioxide can also be served, for example special applications such as fish farms where carbon dioxide can enhance the growth of algae, or agricultural greenhouses where it can enhance the growth of crops.

An additional benefit of the

technology is that nitrogen oxide emissions are extremely low (at less than 0.5 ppm) compared with other power generation technologies.

One of the early applications is likely to be offshore oil and gas operations, which require huge amounts of electricity. This is particularly important in Norway where 20% of the country's carbon dioxide emissions come from lits offshore activities.

Denmark to double green electricity by 2003

The share of electricity produced from renewable energy sources in Denmark will be doubled to 20% by 2003, as a result of new Danish electricity market reform – reports the IEA's CADDET renewable energy newsletter. A green certificate market with quotas will also be introduced, along with measures to protect small renewable energy producers and ensure the continued development of less mature technologies.

Land-based wind turbines and offshore wind farms will supply the bulk of the shortterm expansion, with significant contributions from new largescale CHP plants based on biomass. The green market for renewable electricity from 2003 onwards will be designed after consultation with relevant parties in the field, including organisations and professional experts, says CADDET.

First commercial fuel cell buses by 2002

DaimlerChrysler plans to supply the first commercially available fuel-cell-powered vehicles – 20 to 30 fuel-cellpowered buses to be sold over the next three years.

EvoBus GmbH, a subsidiary of DaimlerChrysler, will supply the Mercedes-Benz Citaro city buses with fuel cells at a price of \$1.2 million each. The price will include comprehensive technical consulting and onthe-spot maintenance by EvoBus for a period of two years. DaimlerChrysler will provide the transport operators with guidance and expertise on preparing a fuel infrastructure.

The Citaro's fuel cell unit delivers more than 250 kW of power. It was developed and manufactured by the DaimlerChrysler subsidiary XCELLSIS Gmbh, with fuel cell stack provided by Ballard Power Systems. Gas pressure bottles containing compressed hydrogen are mounted on the roof of the bus, which can travel up to 186 miles at a top speed of 50 miles per hour and carry 70 passengers.

Ballard, XCELLSIS, and the Chicago Transit Authority have completed a successful two-year demonstration and testing program for fuel-cell buses. Three buses there covered 30,000 miles while in service for more than 5,000 hours.



Nuclear power 'not a solution' to climate change

Strategies to reduce global warming gases from electricity generation should not be based on nuclear power, according to a new report published by conservation organisation WWF. Commissioned from the World Information Service in Energy (WISE), in Paris, the report looks at the status of nuclear power programmes worldwide, and compares technological options for cutting back on dioxide emissions.

It suggests that more nuclear power does not necessarily mean lower carbon emissions. This is partly because reliance on large-scale power plants tends to boost electricity consumption and not only of nuclear origin rather than promote improvements in efficient supply and use of energy, says WWF.

Nuclear power only generates electricity, whereas most energy is required in the form of heat, says the report. This means additional fossil fuels have to be burned, increasing carbon dioxide emissions to the same level as in CHP systems using natural gas.

"Decision-makers would be wise to avoid nuclear power both in their domestic climate policies and in the mechanisms of the Kyoto Protocol," said Jennifer Morgan, Director of WWF's Climate Change Campaign, "Governments should not allow carbon credits for the construction, upgrading, retrofitting or maintenance of nuclear power plants. The Protocol must be a vehicle for driving innovation and the market expansion of truly clean and efficient sources of energy."

The nuclear nations Canada, France and Japan have been keen to promote nuclear power to developing nations under the Kyoto Protocol's 'clean development mechanism' (CDM). However, the example of China shows that improving energy efficiency is a more effective route for the developing world than installing nuclear capacity, says WWF. Energy saving in China meant the country avoided emitting over 430 million tonnes of carbon between 1980 and 1997.

The report also paints a picture of the nuclear industry in decline, rendered uneconomic by the liberalisation sweeping the power sector, side-lined by the trend away from large power plants and towards small, efficient gas-fired plants and competitive wind power, and still beset by safety problems.

Meanwhile, another new report: Dilemma, by ERM Energy, a part of Environmental Resources Management (ERM), highlights the difficult choice facing nations struggling to choose between nuclear and alternative fuel sources.

A six-month project for the European Commission, Dilemma compared nuclear options with gas-fired, coal-fired and renewable energy alternatives to examine the risks and benefits of each. While nuclear power can significantly reduce emissions of carbon dioxide, it also generates nuclear waste which requires proper disposal. This consideration, along with the high implementation and operating costs of nuclear power, has made its future appear bleak, says ERM.

But this situation may be changing. ERM senior consultant Peter Wooders said. "Given that the power sector is responsible for 30% of EU carbon dioxide emissions and that caps on emissions have been agreed under the Kyoto Protocol, the future role of nuclear power must now be re-evaluated".

Official EC projections show that in a 'business as usual' power sector, carbon dioxide emissions will exceed the Kyoto cap by 13%. Maintaining the nuclear share of generating capacity at current levels would reduce this excess to 8%, while early retirement of 22 nuclear plant means the cap would be exceeded by 22%.

With an average 40-year life-cycle, most nuclear power stations in the EU are now approaching the time when they will have to be decommissioned. According to Peter Wooders, "If you want to maintain the current nuclear share of power generation in Europe in 2025, you will have to build another 80 Sizewell Bs."

The dilemma that countries face is that, while retaining nuclear's share of EU power generation at current levels could reduce EU carbon dioxide emissions by 250 million tonnes in 2025, it would create an extra 1550 tonnes of high level nuclear waste, says the report.

Shell has launched a new, easy to install, biomass heating plant concept in Denmark. Developed with the assistance of the Herning Municipality, the fully automated, modular units can supply 100-300 kW and include fuel storage and all necessary connection points, allowing rapid installation of additional units as needed.

The units are most suitable for small industrial consumers, offices and schools, replacing existing fossil-fuel fired heating systems and will be targeted at Northern European markets initially. The heating unit is fuelled by 8 or 10 mm wood pellets manufactured from sawdust to recognised industry standards and from wood grown in sustainably harvested forests. Using a guaranteed quality fuel ensures that the unit can operate fully unattended.

Shell will be responsible for installing, maintaining and helping to arrange the finance to bring a network of these plants to the market as customer demand grows. Customers will pay on a monthly 'fee for the service' basis as they do for conventional, grid supplied energy.



Gas moratorium to end in October; new aid for coal



seeking aid for coal

The Government plans to lift its moratorium on new gasfired power stations earlier than expected; in October, as soon as new electricity trading arrangements (NETA) are put in place, according to Trade and Industry Secretary Stephen Byers. The restrictions were put in place to "provide a level playing field [for coal] whilst reforms were being put in

place to end distortions in the electricity market".

Ending of the moratorium, which may result in a flurry of new gas power station proposals, had been expected to be delayed until the new arrangements had bedded in, perhaps next spring.

However, Mr Byers sweetened the pill for coal by announcing a new aid package for the coal industry, subject to EC permission, to help the industry through the transition to new arrangements. The Government is "exploring with the European Commission how state aid might be offered to help the coal industry through this period", he said.

The new state aid might total £100 million, said Byers, but will depend on market conditions, and negotiations with

the industry as well as Brussels. It will also end in July 2002 at the latest, with the termination of the European Coal and Steel Communities agreement.

Ending the moratorium, or stricter consents policy as it was called by the Government, will, says the DTI:

- · ensure full competition in the electricity market and ensure minimum electricity prices,
- · allow viable new power station development to go ahead, creating jobs,
- · allow new CHP plants to contribute, and
- · be welcome to the offshore gas industry.

The UK Offshore Operators Association duly welcomed the announcement, saying that it will end three years of uncertainty which has hit both iobs and investment offshore. The CHP Association also welcomed the move particularly Byers' statement that the Government will expect power station developers to show that they have explored opportunities to use waste heat from their proposed stations, before granting consent.

Byers added that the British coal industry is "by far the most efficient in Europe Germany produces about 20% more coal than we do with nearly 10 times the labour force".

· Meanwhile, RJB Mining has announced sharply reduced turnover and profits for the year ended December 1999. Turnover was down 15% to £699 million; profit before tax down by fourfifths to £11 million.

British Energy cuts costs to survive; output down

British Energy has announced a series of savage cost-cutting measures intended to enable the company to compete in what chief executive Peter Hollins calls the "tough" electricity market in the UK. The measures should produce cost savings sufficient to allow the company to become one of the lowest cost generators in the UK, says the company.

The package includes proposals to relocate company headquarters from Edinburgh to existing offices at East Kilbride by the end of the year, and the closure of its six visitor centres located at its power stations around the country.

The company is also discussing a proposed pay freeze for its entire staff with trade union officers, and proposing a lower-cost pension arrangements for new entrants into the company. It is already implementing a

programme to reduce business support staff by 250 over the next two years.

Hollins added in a staff newspaper that the company is "operating in a hostile environment in which electricity prices have fallen more quickly than we anticipated coupled with the over-capacity in the electricity generation market, it's going to be survival of the fittest".

The cost-cutting campaign follows disappointing end of year output data. Total electricity sales to customers in the year to the end of March was down 9% to 63 TWh compared to last year. Average load factors for the company's eight nuclear power stations was also down seven percentage points at 74%.

Reduced output was principally due to extended repair and inspection outages.

Project WAGR reaches hot box

Project WAGR, the UK's lead power reactor decommissioning exercise, has reached a new landmark as it begins the task of removing the hot box from the long-closed AGR station at

Windscale. The various parts of the hot box are cut into manageable pieces for packaging and disposal.

Project WAGR aims to show that a full-size reactor can be decommissioned safely, cost effectively and with minimum risk to the environment.

This phase of the programme will use plasma arc cutting techniques, carried out

semi-remotely, with equipment being assembled manually and the operation controlled from remote stations. It will take approximately eight months to complete.

UK's largest landfill gas project uses | MW engines

Clarke Energy has supplied 18 Jenbacher containerised gas engine generators to 3C Waste, part of Waste Recycling Group plc and operators of the Arpley Landfill site in Warrington, believed to be the largest landfill gas power generation scheme in the UK.

The I MW engines have been specified by 3C Waste and the Gengas division of CPL Industries, which manages the power generation plant on behalf of 3C Waste.

Following competitive tender, Clarke generators were purchased to enable the generation of 16 MW of electricity under a NFFO 4 contract. CPL also intends to use Jenbacher equipment on at least five other new UK landfill gas schemes, a potential total of some 40 engines.

The 2 km² Arpley landfill site currently takes over one million tonnes of waste each year. At full capacity the plant extracts some 9,000 m³/h of landfill gas at 50% methane, via a network of wells and extraction pipes.

Despite the overall size of the site, the space available for power generation plant is very confined and the standard Jenbacher engine package was specially designed specifically to make it more compact. As a



The gas engines at Arpley, with transformers on top

result, the 18 containers are installed very close together, with the transformers and switch gear which connect to the grid, built on top of the containerised units. Arpley run for 15 years but 3C Waste and CPL believe the site could potentially continue to generate power for up to 30 years and the generating plant has been designed and planned on that basis.

The NFFO contracts at

Economic instruments 'not too difficult'

The Government must be bolder in moving the economy in more sustainable directions, says the UK Round Table on Sustainable Development in an new report on using economic instruments to promote sustainable development. The Round Table called on the Government to set clear goals for transforming society over the next two decades, recommending:

- integrating the Sustainable Development Strategy more closely with the Budget and spending processes;
- work to overcome

objections to economic instruments;

- assessment of economic instruments to determine their effectiveness in delivering sustainable development objectives;
- establishing an independent advisory body on economic

instruments, reporting to the Treasury.

Introducing the report: Not Too Difficult, Chairman of the Round Table Derek Osborn said: "The Government must be bolder with its powers to move the economy in more sustainable directions".

BNFL responds to safety criticism

BNFL's new Chief Executive, Norman Askew has pledged to deliver significant improvements in safety and quality management at BNFL's Sellafield site. Speaking at the launch of the company's response to two damning reports published by the Health and Safety Executive (see Energy Warld April issue), Mr Askew pledged to deliver on all of the recommendations in both.

"I will personally guarantee that each and every one of the HSE's recommendations are met in full and that whatever resources necessary to achieve this are made available. To do otherwise is not an option. We have already completed a number of them and there are deadlines against every one where we still have more work to do."

The company has already started strengthening the safety organisation structure at Sellafield. More than 70 new jobs have been identified but the review of manning levels could result in more being created. The HSE had criticised BNFL for its "lack of a high quality safety culture", and poor management which allowed falsification of quality data on MOX fuel pellets.

The company says it now intends to improving safety management systems and structure by:

- implementing a comprehensive overhaul of the safety management system across the company, particularly at Sellafield,
- · undertaking a major

organisational change to ensure clear and unambiguous accountability for safety and operational performance,

- appointing Brian Watson, the Head of the Sellafield site, to the new post of Director of Operations with full accountability for safety and operations across the entire site, and
- spreading the positive initiatives and good safety practices identified in the HSE report across the site.

Coalgas opens 9 MW methane power plant

Energy Minister Helen Liddell has opened the £5 million Shirebrook Green Energy Park in Derbyshire, at which methane gas captured from old coal workings is producing sufficient electricity to supply 10,000 homes – and making a valuable contribution to reducing global warming.

Ms Liddell said the Energy Park, developed by Mansfieldbased Coalgas (UK) Limited and Independent Energy (UK) Limited was harnessing a resource, the full potential of which in old mine workings and unworked coal seams, had yet to be tapped: "Projects such as this fulfil the Government's ambition to see more small business initiatives do well, as well as regenerating the Coalfield Communities".

Extraction plant at the pithead of the former Shirebrook Colliery – where British Coal ceased coal production seven years ago – captures coal mine methane gas (CMM) from miles of abandoned workings. The gas is burnt in engines to generate electricity which is fed into the local supply system.

Dr Cameron Davies, Managing Director of Coalgas, said: "Our technology has enabled us to turn what was a waste product being released to the atmosphere for safety harnessing coal mine methane emissions throughout the UK coalfields, greenhouse gas equivalent to several million tonnes of CO_2 would be saved every year. It would also attract inward investment and jobs into economically deprived coalfield communities and help kick-start economic regeneration.



reasons, into a valuable commercial asset. The Shirebrook scheme adds significantly to the company's proven gas reserves, and will also help the UK meet its greenhouse gas reduction targets."

Coalgas believes that if its technology was applied to Coalgas is currently planning further coal mine methane projects on abandoned mines within its portfolio of petroleum exploration, development and production licences. One of the next projects will be at Allerton Bywater in Yorkshire to fuel the Green Energy Millennium Village being developed by English Partnerships.

Added Dr Davies "Coal mine methane is a sustainable source of energy, similar to the traditional renewables. There are sufficient reserves to last for at least 50 years, with vast resources of coal, the primary energy source, still untouched."

The Shirebrook site – being developed by East Midlands Regional Development Agency as a business park – produces 9 MW of power.

In addition to the Shirebrook scheme, Coalgas operates two other Green Energy Parks at the abandoned Markham in Derbyshire and Steetley in Nottinghamshire, coal mines. The Steetley plant, a joint development with Independent Energy, generates up to 6 MW of electricity, while gas recovered from the former Markham Colliery is supplied to the nearby Coalite plant for use in the production of chemicals

'Carbon-certified' electricity for business

Greenergy Carbon Partners Ltd has launched 'Carbon-Certified Electricity'; said to be the world's first electricity package aimed at enabling businesses to manage their emissions of carbon dioxide.

Carbon-Certified Electricity is created by drawing from a pool of almost 50 types of electricity, from low carbon footprint renewable sources (eg wind and solar) through medium sources (eg gas) to higher footprint 'black' sources (eg coal and oil). In response to the customer requirement, the electricity is 'blended' from the various sources to achieve the required carbon intensity for the final electricity supplied.

Businesses therefore have the option of acquiring their full energy requirement at a pre-selected carbon intensity and at a cost effective rate, says Greenergy, giving them certainty to fulfil any stated emission reduction targets.

The CO₂ emissions

associated with the product is certified on a g/kWh, tonnes per month or per year basis. The certified carbon emission ensures that at any time an accurate statement can be made on the amount of CO₂ being emitted, and reductions being achieved.

As Andrew Owens, Chairman of Greenergy Carbon Partners, comments: "Current estimates suggest that for the next decade as much as 90% of our power will continue to come from However, within these sources, there is as large a range of carbon intensities as there is between conventional and renewable sources. As a consequence it's vital to integrate both conventional and renewable energy sources into business carbon management plants. 'Carbon Service Provision' delivers the knowledge and know-how to establish, manage and deliver a best fit business energy and CO₂ management package."

conventional sources.

The future for oil - predicting

by Norman Selley, Royal Institute of International Affairs

Global oil production will peak very soon, perhaps as early as this year, when the world will start to "run out of oil", according to an article by Colin Campbell published in the June 1996 issue of Energy World. The production peak will be followed both by rising prices and a rapid fall-off in supply volumes, he added. Campbell's article produced a flurry of responses, most of which suggested that his view of world reserves was pessimistic; that future extraction of 'unconventional' oil would soften the blow; and that peak conventional production would occur considerably later than 2000 anyway.

Black gold, as oil is sometimes called, bhas a double image: on the negative side crude oil is typically seen only when accidents occur – when it spills from ships, pollutes beaches or kills wildlife. The positive is taken for granted. Users rely on oil's refined products to invisibly power transport and heat or cool homes as required. The twentieth century has progressed hand in hand with increased usage of oil, in times of both war and peace, and can justifiably be described as the 'oil era'.

Oil's role as a fuel in the twenty-first century is less clear. In the developed world, air pollution caused by burning oil is falling, despite increasing use, as products are cleaned of pollutants and more thorough combustion systems are introduced to boilers and vehicle engines. A new threat is emerging, namely the global warming effect of CO2 that is released to the atmosphere when fossil fuels like oil are burnt. Concerns about climate change are beginning to influence policy relating to energy generally, and transportation in particular. Questions are being asked again about how much oil remains to be produced. There is a paradox here: the less oil remains, the less of a threat its extraction is to the climate, but the greater the probability that alternative fuels will be either more environmentally damaging (coal), more expensive (nuclear), or require massive investment in infrastructure (gas for developing countries).

The current consensus is that the world's conventional oil production will peak during the 2010-2020 period, and inevitably decline thereafter, although some see the peak before this date, and others as far away as 2050. The key factors influencing supply side economics are:

- · Underlying geological knowledge.
- How far technology will increase the recovery of discovered oil, and aid discovery of further reserves.
- The extent to which technology and managerial change will continue to decrease the costs associated with exploration, production and transportation.
- The abundance of unconventional oil (synthetic oil, oil sands, and oil shale), which already forms part of world production.
- The policy conditions and trends in taxation that increase or reduce the demand for oil.
- Constraints on accessing oil that may lie in environmentally sensitive areas.
- How the structure of the industry affects investment and the development of supply. In most oil exporting countries the industry is under government ownership or control, but in recent years most of the expansion of capacity has come from private sector companies.

THE RESERVES DEBATE

Sensible policy depends on an understanding of remaining reserves, yet this number can't be known for sure. Indeed, the degree of uncertainty inherent in any estimation of oil reserves is compounded by the poor quality of data on which this is based. Also there can be little doubt that reserves estimates, given their very nature, have been, and will

The reserves debate, which continues today, is important for many reasons, not least in the context of current discussions on how world carbon reduction targets are to be met in the next decade and beyond.

Now, the RIIA has added its contribution in a new briefing paper: Changing Oil. In the following extract, author Norman Selley guides readers through conflicting views of world oil reserves – including the consensus view that peak production of conventional oil will probably occur, not this year, but between 2010 and 2020.

> continue to be, subject to the political manipulation of governments and to the commercial considerations of companies. The clearest example of this was the restatement of OPEC reserves in the late 1980s. In 1987 alone world proved reserves increased from 700 Gb to 900 Gb as a result of substantial revisions by Iran, Irag, Abu Dhabi and Venezuela. Saudi Arabia followed suit in 1989, adding another 85 Gb by itself. Was this a correction by Governments of previous figures that had been understated by the oil companies who held concessions prior to the 1976-79 'participation'? Or were Governments leaning towards optimism in declaring reserves for the purpose of negotiating OPEC quotas?

The problem is partly definitional. Remaining reserves mean that quantity of the in-place resource that can be recovered economically. In the US the definition is strict, based on drilled reservoirs and current prices. Elsewhere the owners or estimators have more discretion in what they declare.

Proved reserves – the definition of reserves used in the US - are those known to exist with a high degree of certainty. This typically does not allow for additional reserves recovered through secondary or tertiary recovery techniques unless this mechanism has been shown to work locally. As a general rule, this method makes for good estimates of reserves in fields where production is already in decline, but tends toward p90 estimates (ie those with a 90% chance of being too low) for fields not yet in decline. The standard also requires an economic test: only those

the global production peak

quantities that can be produced at today's price and costs can be included. Thus, when prices fell in 1998, so did estimates of proved reserves. Indeed any reserves estimate depends on assumptions made regarding future price and costs.

This definition is very conservative and not universally applied. The US Geological Survey (USGS) considers that more than 90% of world reserves (those of OPEC countries, the Former Soviet Union, China & Mexico) are reported not on a proved but on a proven, probable and possible basis. They state they have "some confidence that he world value ... for Identified Reserves (ie 2300 Gb) is a reasonable maximum value for known fields and greatly exceeds reserves developed for production".

A useful concept is to think of resources as a pyramid with a small volume of prime resources at the top that are of high quality and easy to extract, and a large volume below of lesser quality and more difficult or expensive to extract. At any one time the price of extraction

increases as one goes lower in the pyramid, but advances in

technology tend to decrease the costs of extracting all fuels. This concept also has the advantage of suggesting that reserves are not fixed, but move up or down over time with changes to price assumptions or brought about by technological progress. In this sense reserves are 'cut' at different heights of the pyramid. What remains above the cut is deemed to be a producible reserve, and below the cut a resource that will remain in the ground. Since reserves are like stock in a warehouse, continuously being replenished from resources, it is wrong to think of reserve/production ratios as indicators of when oil will 'run out'. Whilst these ratios are useful comparative measures, they have little meaning in an absolute sense. Oil production will peak when cheaper alternatives become available. The shape of the production curve is thus as much controlled by the demand for the energy source as its availability.

THE PESSIMISTIC VIEW

Colin Campbell and others of his school (referred to as pessimists in the IEA's 1998 World Energy Outlook) estimate the world's ultimate conventional oil reserves to be around 1800 Gb. This number could be stretched to 2000 Gb if higher FSU and Middle East figures were accepted. The views of the pessimists are grounded in the accepted belief that oil resources are nonrenewable and finite. Reserves are seen essentially as static, the peak period for making new discoveries (the 1960s) being long past and estimates of reserves yet to be found are low. Furthermore, the rate at which discoveries are currently being made (<10 Gb pa during the 1990s) is too slow to affect significantly the time when production will start to decline. It is argued that improvements in recovery rates merely bring forward the time in which ultimate reserves are exhausted.

Key to the pessimists' view is that production will follow a variant of the Hubbert curve, ie must inevitably start to

whilst reserve/production ratios are

useful comparative measures, they have

little meaning in an absolute sense

decline once around half the reserve has been produced, as has actually happened in

the US. In an individual reservoir, there are technical reasons why production might follow this curve and eventually become uneconomic. Note that this implies an economic, rather than a physical limit to reservoir production.

In the Lower 48 United States, the combination of falling new discoveries and most known reservoirs having past half way in their recovery meant that, as Hubbert correctly predicted, production began to decline in 1971. Only the discovery and development of a new province (Alaska) and the technology permitting the development of the deepwater reserves (Gulf of Mexico) temporarily reversed the decline. The US is a paradigm: Alaska is now also in decline. Large areas of potential are closed to new exploration for environmental reasons. The world is following the US as mature provinces (eg the North Sea) face decline, not enough

new discoveries are made, and eventually all likely potential areas will have been explored and developed. There is a long list of areas where the industry held high hopes of discovering large new sources of supply, but where dreams have disappointed: China's Offshore and Tarim Basin, Vietnam, the Atlantic Margin, Offshore Brazil and the Falklands. There are only a finite number of basins in the world.

With cumulative consumption by the end of this millennium estimated to be close to 900 Gb, this logic has it that the peak of production will be reached between 2000 and 2010. Oil supply will stall and the world will have to cope with a future of fairly rapid decline in supply.

THE IEA VIEW

The IEA's current supply outlook may be characterised by the term 'relative abundance'. Their latest assessment of reserves takes 1800 Gb as a starting point, but recognises that technological progress is likely to increase this to between 2000 Gb and 3000 Gb, with a most likely figure of 2300 Gb. This central value is also supported by the USGS, who state a range between 2100 and 2800 Gb. Based on these numbers the IEA "do not foresee any shortage of liquid fuels before 2020, as reserves of unconventional oil are ample, should the production of conventional oil turn down". This decline will coincide with that of the OPEC producers of the Middle East who are currently the world's residual suppliers. In the IEA projection, Middle East production is not projected above 48 Mb/d, although this itself depends on the investment required to double current production of 20 Mb/d to 40 Mb/d by 2010. By 2014, the year of peak production in this central case, Middle East OPEC's share of world production will be approaching 50% but is then expected to decline as unconventional oil becomes increasingly needed to replace and augment declining conventional supply. In the reserve sensitivity cases (2000 Gb and 3000 Gb) peak production is in 2010 and 2020

respectively. A growing supply of oil thus depends on unidentified developments of unconventional reserves.

THE OPTIMISTIC VIEW

To Peter Odell, one of the leading optimists, 3000 Gb is just the starting point. His published work on this subject dates back to the 1970s, to the era of Limits to Growth, when he was one of the few to stand against the conventional thinking of the time that said we were running out of oil. The peak of conventional oil production, he contends, will not occur until around 2030. There are a further 15000 Gb of known unconventional reserves - oil shales, tar sands and other hydrocarbons, so the real peak will be delayed until around 2060. The total resource base is simply enormous. Whilst he does not include them in any of his figures, Odell also points out the existence of a large body of geological science in the FSU which claims that oil reserves are inorganic in origin and renewable. There are few in the West that take seriously this notion that reservoirs are being replenished from deep within the Earth but since it

cannot be disproved it must remain, at least, a possibility. Michael Lynch's

1989 assertion that

oil prices would actually fall in the 1990s

with growing non-OPEC supply - called 'heretical' at the time - fits what has actually

supply functions in over 40 countries has

competition from non-conventional oil will limit price increases from 2020 onwards just as conventional non-OPEC oil did in 1980-2000

production, and growing as costs reduce and the difficulty of extracting yet more from conventional

reservoirs increases. This is also expected to occur in the period 2010-20.

· About two-thirds of current world exports originate in countries where production is owned or closely controlled by the state, and where oil export revenues and rents are critical to a country's balance of payments and budget. On mainstream present projections of demand and supply, most or all of these countries, principally in the Middle East, will reach peak production by 2010-20 or soon after. At that point they will no longer need to limit competition between each other. The threat or hope of 'cheap oil' will have disappeared forever. However, it will not be replaced by a threat or hope for high price oil. Competition from non-conventional oil,

future technology or prices, so we cannot quantify reserves.

CONCLUSIONS

- Reservoirs of 'conventional' oil are finite. Discoveries of new reservoirs are only replacing a fraction of what we currently extract, but the fraction of the reserve – is increasing. At some point in the life of a reservoir production will decline and at some point in the life of a region the sum of these declines will outweigh the sum of the new discoveries and increases in recovery. Eventually the world may replicate the declines of the US, its most mature oil producing area. The IEA expects this to occur in the period 2010-20.
- However, reservoirs of 'unconventional' oil – heavy oil, tar sands and oil shale – are known to be very large, with oil in place many times that of conventional oil. The key question is the economics of extraction and conversion to oil products or synthetic crude. This is likely to follow a supply curve starting with present

from different countries, with private investment, will limit price increases from 2020 onwards just as conventional non-OPEC oil did in 1980-2000.

- It may be that oil production will peak not because of natural depletion of the resource base itself but as a result of environmental policy and/or falling demand, due in part to the replacement of oil by natural gas. "There is now widespread agreement that resources are not a key constraint on world oil demand to 2020. Rather more important are the political, economic, and environmental circumstances that could shape developments in oil supply and demand."
- · Key uncertainties include:
- The timing of peak production, but 2010-2020 appears the key decade.
- Whether politics will permit the increase in Middle East production that economics suggest should happen.
- What kind of commercial and technical momentum develops for nonconventional oil production: will it be in time to pre-empt a temporary period of high prices or will it only follow the stimulus of such a period?
- The shape of the industry in 10 and 20 years' time. The rate of change is accelerating, but uncertainties abound. For the state companies, the national imperative to support growing populations whilst seeking to diversify the economy and develop the industry will force changes to be made. The private sector will be challenged to meet shareholders' expectations whilst redefining the limits and linkages of their businesses to the financial, utility and vehicle manufacturing sectors and responding to increasing social and environmental demands.

Norman Selley spent 20 years in the oil and gas industry - with Conoco and then LASMO, where he headed the Group's economics department before joining the RIIA last year.

Copies of the RIIA Briefing paper 10: Changing Oil are available from the RIIA, tel: 020 7957 5700, website: www.riia.org

happened. As a result, pessimists have had to defer their estimates of the date of peak production. Furthermore, a 1997 study of

shown that there is as much evidence of supply expansion as of contraction, with findings providing little or no support for the notion that the world is 'running out of oil'. Lynch has argued that the Hubbert method fails because it takes recoverable reserves as fixed. The dynamics are rather more complex: it is the total resource base that is important, with reserves dependent on the interaction of continued technological progress, government policies and, ultimately, the price people are willing to pay for oil products. We cannot know



999 was a crucial year for The Institute of Energy. The Institute appointed a new Chief Executive, agreed a new Business Plan - probably the most comprehensive it has ever had and achieved a new sense of purpose and direction. Most notably, the Institute also achieved re-nomination and several new licenses from the Engineering Council for its activities for the next five years. The outlook for the year 2000 is thus one of the best that the Institute has had for many years.

The Business Plan was put together after a wide ranging consultation with Committees and Branches. The work of the Institute for the year ahead now has a clear and agreed direction. All of the committees have action plans and the Executive Committee, under Professor John Chesshire's chairmanship, has detailed and active monitoring processes in place. The work of the Branches has also been given additional emphasis with much closer working with Devonshire Street. Individual staff members have been allocated

Presidential Review 1999

to a series of important and interesting initiatives under way in several branches across the country and it is hoped that increased communication and coordination between branches will facilitate learning and interchange.

Re-nomination from the Engineering Council was achieved after a long and "The outlook for the year 2000 is thus one of the best that the Institute has had for many years"

detailed preparation for an intense auditing procedure. The Institute's thanks go to Mark Baker, the licensing group and the staff who worked so diligently on this.

Another key achievement for the Institute is the turn around in membership that we are currently experiencing. After years of slow decline membership numbers are looking up with both individuals and companies joining in increasing numbers. Thanks go again to all those on the various membership committees and to Louise Evans.Tracey Fisher and the membership team. This continues to be a key area of activity and achievement and will be a central part of our efforts in the coming year.

The Institute also had a marked success in its major policy event during 1999: "Energy: Solving the Policy Jigsaw" the CBI conference centre. The Institute will continue to act as a facilitator of such major exchanges. A follow up conference for the millenial year is planned and

a very well attended conference held at

The Melchett lecture in June 2000 will feature a very forward looking and broad view of

energy matters by Walt Patterson, Senior Fellow of the Energy and Environment Programme at the Royal Institute of International Affairs.

The Institute, with its wide-ranging portfolio of interest across the energy agenda, has many opportunities over the coming year. With clear direction, a new sense of energy and a strong central staff team the Institute has a major role to play in the energy environment, in policy development, in technical exchange and in life long learning.

A lecour

Mr Richard Coldwell FinstE President

Statement of the Trustees

The summarised financial statements for the year ended 31 December 1999 set out on pages 12 to 13 are a summary of information extracted from the annual accounts which may be obtained, together with the reports of the auditors and trustees, on application in writing to the Secretary and Chief Executive at 18 Devonshire Street, London, WIN 2AU. These summarised financial statements may not contain enough information to allow for a full understanding of the financial affairs of the fund. For further information the full annual accounts, the auditors' report on these accounts and the trustees' annual report should be consulted.

The annual accounts were approved on 2 May 2000, will in due course be

submitted to the Charity Commission and have been audited by Kernon & Co.

Signed on behalf of the Trustees

123-5-

John E Ingham CEng FInstE Honorary Treasurer

Statement of Financial Activities

year ended 31 December 1999

year ended 31 December 1998

			Restricted					Restricted		
	U	Funde	Income I	Endowment	: Total	Un	Funde	Income I	Endowment	Total
INCOME AND EXPENDITURE	£	L L	L	L	L	£	L	L	L	Ĺ
Incoming resources										
Subscriptions	269,919					298,816				
Less: receivable in advance	(4,493)					(58,944)				
		265,426			265,426		239,872			239,872
Project and training event management		129,778			129,778		116,533			116,533
Conferences		33.348			33.348		27.929			27.929
Journal and other publications	78,395					77,956				
Less: receivable in advance	(23,135)					(25,869)				
		55,260			55,260		52,087			52,087
Branch income - local activities		49,656			49,656		31,426			31,426
Investment income		14,621		1,647	16,268		16,320		1,837	18,157
Rental income		12,800			12,800		12,800			12,800
Royalties - FACTS		5,206			5,206		5,265			5.265
Educational income		9,033			9,033		2,614			2,614
Room Hire		7,133			7,133		4,357			4,357
Donations			750		750			1,000	125	1,125
Miscellaneous income				_			2,859	<u>.</u>		2.859
TOTAL INCOMING RESOURCES		582,261	750	1,647	584,658	-	512,063	1,000	1,962	515,025
Direct Charitable Expenditure										
Project and training event management		96,331			96,331		97,058			97,058
Conferences		25,367			25,367		13,424			13,424
Journal and other publications		83,944			83,944		83,389			83,389
Branch expenditure		50,435			50,435		37,113			37,113
Educational		40,431			40,431		20,829			20,829
Membership		2,085			2,085		3,712			3,712
Awards		3,015	750	1,200	4.965		1.652	1,000	5.855	8,507
		301,609	750	1,200	303,559		257,177	1,000	5,855	264,032
Other Expenditure										
Publicity		13,062			13,062		8,116			8,116
Administration										
Salaries and related staff costs		163,287			163,287		160,961			160,961
General communications		60.892			60,892		52,768			52,768
Accommodation and related costs		31,007			31,007		24,968			24,968
Professional		14,885			14,885		15,788			15,788
Other		24,715			24,715		29,730			29,730
		307.848	8	_	307,848	-	292,332			292,332
TOTAL RESOURCES USED		609,458	750	1,200	611,408	-	549,509	1,000	5,855	556,364
NET INCOMING/(OUTGOING) RESOURCES		(27,196)	-	447	(26,749)		(37,446)	2	(3,893)	(41,339)
OTHER RECOCNICED CAINS AND LOSSES										
In the recognised Gains and Losses										
Realized min		(37)			(32)		10.534			10.534
Rearsed gain		99.451			99.451		45.647			45.647
Relation of Development Fund										
Release of Development rund	-	99,419			99,419	-	56,181			56,181
NET MOVEMENT IN EUROP		72 222		447	72.670		18 735		(3.893)	14.842
Interfund transfers		(53)	53		12,070		-	- t/		
Total funds at 1 January 1999		492,069	3.990	33,603	529,662		473,334	3,990	37,496	514,820
TOTAL FUNDS AT 31 DECEMBER 1999		564,239	4,043	34,050	602,332	-	492,069	3,990	33,603	529,662

No operations were acquired, commenced or discontinued during the above two financial years

Statement by the Auditors

In our opinion the summarised financial statements of The Institute of Energy for the year ended 31 December 1999 on pages 12 to 13 are consistent with the full annual accounts on which we gave an unqualified opinion on 5 May 2000. Kernon & Co

(formally Lawford Kernon & Co) Chartered Accountants and Registered Auditor

ACCOUNTING POLICIES

I.Accounting Convention The accounts are prepared under the

historical cost convention, modified by the revaluation of quoted investments at market value; with the application of the fundamental accounting policies of going concern, accruals, consistency and prudence and in accordance with applicable Accounting Standards and the Statement of Recommended Practice 2.

2. Depreciation of Tangible Fixed Assets

Tangible fixed assets are stated at cost less depreciation. The costs of leasehold property and improvements thereon are depreciated evenly over the terms of the lease (expiring in 2009) and its carrying value does not necessarily represent the market value. Other tangible fixed assets are depreciated on a straight-line basis over their estimated useful lives at the following rates:

> Fixtures and fittings 10% Electrical Equipment 25%

3. Quoted Investments

Quoted investments are included at market value, calculated on a portfolio basis. Gains and losses on realisation are recognised in the year they arise. Proceeds from sales of investments are reinvested by Singer and Freidlander Investment Management Limited on behalf of the Benevolent Fund and are included in the portfolio of investments.

4. Branches

The accounts incorporate branch transactions including those arising in respect of funds generated by the branches themselves.

5. Development Fund

This is funded by transfers from the

The Institute of Energy

Balance Sheet at 31 December 1999

1999		1998		
£	£	6	6	
102,905		59,781		
509,310		475.164		
	612.215		534,945	
2,770		1,995		
72,884		65,387		
51,822		75,542		
127,476		142,924		
56,239		105,683		
76,467		37,871		
4,652		4,653		
137,358		148,207		
	(9,882)		(5,283	
	602,333		529,662	
	34,050		33,603	
	4,043		3,990	
63,000		52,640		
174,493		137,774		
326,747		301,665		
	564,240		492,069	
	602.333	_	529,662	
	- monore and a second			
	19 £ 102,905 509,310 2,770 72,884 51,822 127,476 56,339 76,467 4,652 137,358 63,000 174,493 326,747	1999 £ £ 102,905 509,310 612,215 2,770 7,884 51,822 127,476 56,239 76,467 4,652 137,358 (9,882) 602,333 34,050 4,043 63,000 174,493 326,747 564,240 <u>607,333</u>	1999 6 6 6 102,905 59,781 475,164 102,905 612,215 475,164 2,770 1,995 75,824 7,844 65,337 142,924 56,239 105,683 7,6447 7,6447 37,871 142,924 56,239 105,683 148,207 9,052 4,653 148,207 9,0543 34,050 4,043 63,000 52,640 137,774 326,747 301,665 564,240 602,333	

Accumulated Fund, either directly or by allocation of a proportion of Project Income, and expenditure of a developmental nature is, where so authorised by Council, supported from this fund.

6. Liability for Dilapidations at Expiry of Lease in July 2009

An amount equal to the eventual liability for dilapidations as estimated at each year end, less amounts specifically provided and available free reserves, divided by the number of full years remaining on the lease has for a number of years been set aside annually by transfer to the Dilapidations Fund, in order to ensure that existing free reserves and the eventual Dilapidations Fund will together meet this liability when it falls due. Council has taken professional advice on this matter and presently estimates that the maximum yet to be retained from future operations at anticipated 2009 prices will not exceed £240,000. Accordingly £13,375 has been allocated in 1999 to the Dilapidations Fund (1998: £19,000).

7. Pension Arrangements

The Institute contributed in the year to

personal pension plans for eligible employees, funded on a money purchase basis and invested in insurance policies. Contributions are charged as expenditure in the year they fall due. All funds are independently administered.

8. Engineering Council Fees

The Institute acts as collecting agent for the Engineering Council in respect of fees, and accounts to it for such fees on the basis of annual estimates, which are subsequently adjusted to actual. Fees collected in the year were £43,851 of which £106 was collected in advance at 31 December. Fees paid over to the Council were £41,444. Balances between the Institute and the Council and amounts received in advance are included in debtors and liabilities due within the one year as appropriate.

9. Allocation of Salaries and Related Costs

Salaries and related costs have been allocated between administration and the major direct activities as shown in note 5 to the accounts on the basis of estimates made by the management team.

Benevolent Fund

ACCOUNTING POLICIES

I.Accounting Convention

The accounts are prepared under the historical cost convention, modified by the revaluation of quoted investments at market value; with the application of the fundamental accounting policies of going concern, accruals, consistency and prudence and in accordance with applicable Accounting Standards and the Statement of Recommended Practice 2.

2. Investments

Ouoted investments are included at market value, calculated on a portfolio basis. Gains and losses on realisation are recognised in the year they arise. Proceeds from sales of investments are reinvested by Singer and Freidlander Investment Management Limited on behalf of the Benevolent Fund and are included in the portfolio of investments.

The Institute of Energy The Institute of Energy Benevolent Fund **Statement of Financial Activities**

	1999	1998
	Unrestricted	Unrestricted
	Funds	Funds
INCOME AND EXPENDITURE	4	£
Incoming resources		
Donations and bequests	704	1,162
Investment income	2.041	2.177
TOTAL INCOMING RESOURCES	2,745	3,339
Direct Charitable Expenditure		
Assistance to members		890
Other Expenditure - Administration		
Investment managers' fees	603	511
TOTAL RESOURCES USED	603	1.401
NET INCOMING/(OUTGOING) RESOURCES	2,142	1,938
OTHER RECOGNISED GAINS AND LOSSES		
Realised gain	(857)	502
Unrealised gain	24,151	2.379
	23.294	2.881
NET MOVEMENT IN FUNDS	25,436	4,819
Total funds at 1 January 1999	90,196	85,377
TOTAL FUNDS AT 21 DECEMBER 1999	115.632	90,196

The Institute of Energy Benevolent Fund Balance Sheet at 31 December 1999

	1999		199	8
	1	£	4	£
Fixed Assets				
National Savings deposit bonds	9,985		9,464	
Quoted investments	95.301		72.207	
		105,286		81,670
Current Assets				
Debtor - The Institute of Energy	4,653		4,653	
Cash on deposit	4,170		2,605	
Cash in bank current account	1.523		1.267	
Net current assets		10,346		8,525
Total net assets		115,632		90.196
Representing:				
Unrestricted funds				
- Accumulated fund		74,571		73,127
- Revaluation reserve		41.061		17,069
		115,632		90,196
Approved on behalf of the Trustees				
Jess Hon	orary Treasurer	Dated	2/5/2000	

STATEMENT BY THE AUDITORS

In our opinion the summarised financial statements of The Institute of Energy Benevolent Fund for the year ended 31 December

1999 as set out on this page are consistent with the full annual accounts on which we gave an ungualified opinion on 5 May 2000.

Kernon & Co (formally Lawford Kernon & Co) Chartered Accountants and **Registered Auditor**

STATEMENT OF THE TRUSTEES

Year anded Het December

The summarised financial statements for the year ended 31 December 1999 set out on this page are a summary of information extracted from the annual accounts which may be obtained, together with the reports of the auditors and trustees, on application in writing to the Secretary and Chief Executive at 18 Devonshire Street, London, WIN 2AU.

These summarised financial statements may not contain enough information to allow for a full understanding of the financial affairs of the fund. For further information the full annual accounts, the auditors' report on these accounts and the trustees' annual report should be consulted.

The annual accounts were approved on 2 May 2000, will in due course be submitted to the Charity Commission and have been audited by Kernon & Co.

Signed on behalf of the Trustees

John E Ingham CEng FInstE Honorary Treasurer

Safety first – storing LPG

by Don Barber, FinstE, Enmat International

Although relatively little used in Europe, LPG is a major fuel in several other parts of the world. Here, Don Barber describes the principal types of storage used for liquefied petroleum gas. While the article is not intended as a design study, it highlights some of the key parameters to be considered if LPG is to be stored and handled safely.

Unlike natural gas, LPG is normally stored at a number of stages in the distribution chain; the type and size of the individual storage being dependent on where the requirement is located. The largest storage is likely to be an underground well or cavern, the smallest the pocket cigarette lighter.

The amount of LPG being used globally is around 200 million tonnes per annum. When used as a fuel it will be butane, propane, or a mixture of these gases. As a chemical feedstock the LPG used will include other gases such as propylene, but the storage requirements of all these gases are essentially the same.

Before considering the individual storage types it is essential to understand the properties of LPG that determine the design criteria.

LPGs are defined as petroleum gases capable of being liquefied by the application of moderate pressure, or by refrigeration. When contained in a storage system the resultant liquid will remain under pressure, the actual pressure depending on the composition of the gas and the storage temperature. This is known as the vapour pressure. Propane has a significantly higher vapour pressure than butane.

When refrigerated the vapour pressure falls to zero at the atmospheric boiling point of the gas. This temperature is around -2°C for butane, and -40°C for propane. Under sub-zero conditions some butanes will exhibit negative vapour pressures, a factor that has to be taken into account in the design of the storage and the operating procedures.

The water-white liquid phase LPG has a low density, approximately half that of water, and a low viscosity. It also has a very high coefficient of thermal expansion. For this reason, to avoid overflowing, all types of LPG storage are never filled to capacity. The maximum permitted fill is determined by a factor known as the 'filling ratio'.



Accurate systems for the measurement of the tank contents are thus an essential feature of all LPG storage systems.

To allow for the different densities of butane and propane, storage capacities are normally referenced in volume terms, typically in cubic metres or litres.

The volume relationship between the liquid and vapour phases of LPG is used advantageously to store large quantities of this vital social fuel. Approximately 250 volumes of vapour can be stored as a single volume of liquid. The actual ratio is around 270 to 1 for propane and 230 to 1 for butane.

UNDERGROUND STORAGE

This form of storage includes the largest individual inventories for LPG. Two types are used - storage in natural reservoirs or leached salt wells, and in excavated rock caverns. Unquestionably, underground storage is the safest storage.

The USA, which consumes approximately half of the world's LPG, has the largest complex of underground systems. More than 1070 wells have a capacity of around 40 million tons of LPG. This strategic capacity is often a controlling factor in the supply and demand influence on world prices for LPG.

Mined storage is also becoming increasingly used, in locations where the geological structure is suitable. Scandinavia and France have the largest concentration of excavated rock caverns. Major mined cavern projects are also being developed in China, Korea, Australia, Portugal, and Spain. Underground storage is expensive and therefore only competitive in very large sizes.

REFRIGERATED STORAGE

When LPG is stored at a temperature equivalent to its atmospheric boiling point it exists in the liquid phase at zero vapour pressure. The design of the insulated containing vessel is therefore dictated by the temperature conditions and not by the pressure, other than the hydraulic head in the tank. After underground storage refrigerated systems are the largest individual units in use around the world.

Terminals with refrigerated storage are normally found at locations exporting or importing large parcels of LPG by sea. The ships involved in this service also carry the cargo in the refrigerated state. In the UK Calor Gas have refrigerated storage at Felixstowe and have recently acquired and re-commissioned the refrigerated storage at Canvey Island. They also operate a mined LPG cavern on Humberside.

A typical refrigerated storage tank, nearing completion at the new Reliance refinery in India, is shown above.

Refrigerated storage is also used



1923: the first Hortonspheres

extensively for handling North Sea LPG, where some of the propane tanks have been constructed of nickel steel which also enables them to be used for LNG service.

PRESSURISED STORAGE - SPHERES

In 1923 Chicago Bridge and Iron built the first pressurised spheres, known as Hortonspheres (above). Since that date this type of storage has been used for LPG in almost every refinery and storage complex around the world. This type of storage is always site fabricated.

Although in most installations spheres have been used to store LPG without any problems arising, the tragic 'BLEVE' accidents at Feyzin and Mexico City have resulted in some countries effectively banning this form of storage. This has been achieved by either limiting the size of storage vessel permitted, or by the introduction of prohibitive cordon sanitaire safety zone requirements.

BLEVE, an acronym for boiling liquid expanding vapour explosion, describes a unique failure mode of pressure vessels that contain a liquid and are subjected to external heat, usually that of a fire. BLEVEs can, and are known to, occur with containers containing a wide variety of products including water. However they are generally identified with propane or other liquefied gas containers. When a vessel containing a flammable fluid , such as propane , BLEVEs there is usually a concomitant release of 'flashing' liquid which quite often results in a spectacular and dangerous fireball.

Effective legislation and codes of safe practice for LPG storage are certainly required, but they should not be too specific and should allow flexibility in the use of new ideas and designs. Such legislation, and codes, should always be considered as the minimum standard.

For a new project where LPG is to be stored, all of the systems potentially available should be evaluated, and the final decision on how to proceed should be made

according to the circumstances of the individual case. The safety and environmental issues are the important elements in making such a decision. Project costs, whilst clearly important in the viability of any proposal, must not be allowed to dominate against the safety case.

PRESSURISED STORAGE -HORIZONTAL CYLINDRICAL TANKS

Like spheres the cylindrical tank is a pressure vessel, with a design pressure determined by the type of gas and the operating reference temperature. The cylindrical tank is normally fabricated at specialised production facilities before being transported to the required location where it is used. By using factory systems the quality control during manufacture is made much simpler. The typical sizes of these tanks range from small domestic units up to tanks of 250 tonne capacity, although larger tanks have been constructed to meet special circumstances.

BLEVEs involving LPG can be avoided - if good design practices, and sound operating procedures, are employed.

Traditionally LPG spheres, and other large above ground pressure storage, have been protected by water deluge systems. To be effective these systems require large volumes of water, strategically applied, and they must be well maintained. They are therefore very expensive to provide and to operate, and in some locations suitable water reserves are not readily available.

These factors have led users, and designers, of large pressurised systems to seek alternative means of protecting LPG storage against fire engulfment.

One major company has achieved this

by the application of a passive fire cement coating to all their vessels containing pressurised gases. Others have applied rock wool, or intumescent, protective coating systems to achieve the same effect.

Today the system being used on most major new installations is mounded storage.

PRESSURISED STORAGE - MOUNDED

The main advantages offered by this method are the reduction in the required safety distances from other facilities, and the almost complete elimination of the requirement for the firewater deluge systems. On a suitable site these reductions will normally offset the additional cost of the vessel structure.

The technology for mounded systems is now well established, but all projects should be approached with caution. Experience has indicated that certain design features are of paramount importance, as well as showing areas where further improvements can still be made. As with any such highly specialised facility handling hazardous material the work should only be carried out by 'competent persons'.

Mounded tanks are normally semiconventional pressure vessels, which have been adapted in their design and construction to allow them to be covered by a superimposed layer of soil or sand. Tanks installed underground will be similar in construction to mounded tanks as are many of the installation requirements.

On the larger projects it is particularly important that the storage facilities should be treated as a system.

Due consideration must always be given to the geotechnical conditions, and to the operational needs of the facility. Factors such as the level of the water table, and the anti corrosion measures necessary, should be evaluated carefully.

There is no such thing as a standard mounded tank, except possibly for some of the smaller installations. Where problems have arisen they have invariably resulted from the use of unskilled parties during the design phase, leading to the adoption of unsuitable features or practices.

Mounded tanks have been constructed in individual capacities up to around 4,000m³. This is probably the optimum maximum as it represents a cylinder 90 m in length by 8 m in diameter. Six tanks of this size, on a simple sand bed foundation, have recently been commissioned in the Philippines.

Another recently commissioned terminal, at Gdansk in Poland, includes 16 mounded tanks each around 1,600 m³ in capacity, located on a sandbed over a piled concrete raft.

In order to transfer the LPG from mounded storage vessels a pumping system is essential. Pumps can be mounted internally, as described earlier, or external to the tank. Where external pumps are used great care has to be taken in the design, and installation, of the bottom outlet pipework to ensure that it is not overstressed as the tanks move during settlement.

Tanks of the size described above are normally constructed on site, but in several instances factory built vessels up to 90 m in length have been transported long distances prior to being installed.

Smaller mounded and underground tanks are now being extensively used in the domestic LPG market, serving private dwellings or small commercial requirements. Tanks for this duty are typically around 2 to 4 m³ in capacity (1 to 2 tonnes). They are factory prepared ready for installation and are equipped for vapour service only.

Similar tanks are also used to store LPG at service stations where it is dispensed for use as automotive fuel.

For all mounded and underground

tanks effective anti corrosion measures are required. This is achieved by the use of a suitable protective coating, supported by cathodic protection.

Whichever storage system is chosen, designers and operators of all LPG facilities should take full account of the hazardous

nature of the material stored. As such, the design and layout of the whole LPG system must be soundly based and maintenance during operational service should always be of a high standard. HAZOP studies should be carried out during the design phase of a facility, and periodic operational and safety reviews should be conducted during its operational life.

Clearly defined operating procedures should be prepared before the facilities are commissioned and all management and operatives should be trained to have the required level of competency for the work they carry out.

Fellow of the Institute of Energy, Don Barber is the senior partner and principal consultant of Enmat International, a consultancy specialising in LPG, natural gas, and petroleum fuels activities.

He worked on LPG for the Shell Group for 34 years until 1991, during which



Mounded LPG storage vessel under construction in Malaysia

time he was chairman of the LPG Industry Technical Association (UK) Safety Committee, and the LPG industry representative on the UK Government Health and Safety Executive major hazards liaison groups. He was co-author of guidelines for the handling of LPG emergencies used by fire services in the UK. He is the immediate past chairman of the London and Home Counties Branch of The Institute of Energy, and a member of the Institute's committee responsible for membership and education development activities. Don has been elected to become Hon Treasurer of the Institute, taking office following this year's AGM. Contact Don Barber at Enmat International, tel: 01494 783142, e-mail: rufusred@aol.com

A version of this article first appeared Gas Engineering & Management.

Liquefied petroleum gas

Liquefied petroleum gas often receives less recognition than natural gas although more LPG is consumed in the world than liquefied natural gas. In some countries the gas marketed is a mixture of butane and propane, in others there are dedicated systems for each of these gases.

World consumption of LPG has reached around 200 million tons per annum and will continue to grow. The major producers have recognised this growth and new supplies will become available to meet the demand.

In the UK, and in much of Europe, natural gas networks are well developed. For this reason the consumption of LPG is unlikely to show much growth, and may even decline. Major companies marketing LPG in these areas are looking for new outlets and piped, and small bulk, supplies of LPG to consumers beyond the economic network of natural gas are being developed.

The use of LPG in large commercial

vehicles, replacing diesel fuel, shows significant environmental benefits. This latter application requires serious support from member governments, in reducing penal levels of taxation, if it is to succeed.

In developing countries LPG is an essential domestic social fuel, aiding steps to counter deforestation and providing an economic means of cooking food and heating water in many of these developing areas natural gas, and often electricity, cannot be provided.

The energy policy debate – switching to demand side services

"The driving forces of competition and innovation underpin our energy policy to ensure secure, diverse and sustainable supplies of energy at competitive prices". So says Energy Minister Helen Liddell in her foreword to the 1999 Energy Report. But does Britain need something stronger and more specific than the oft-repeated secure, diverse, sustainable mantra?

gnoring, for a moment standing charges, energy bills comprise a quantity used (let's call this q) and a unit price (p) multiplied together to give the total due. UK energy policy in recent years has concentrated almost exclusively on p, the price; but ought now to shift towards balancing both sides, including q, the quantity used. So said John Chesshire, from the SPRU's Energy programme.

Chesshire was talking about energy services, that still poorly understood concept whereby energy suppliers supply energy management and energy efficiency measures instead of just kilowatt hours of gas or electricity. Done properly, suppliers are challenged to (and rewarded for) supplying what their customers want – heat, light, motive power etc – at minimum financial and environmental cost.

So energy companies, which currently supply, alongside kWh of energy, a few extras such as: mandatory services, eg for blind consumers; brand-building services, eg air miles for loyal consumers; dual fuel, maybe even green energy for consumers who want it; should be looking also to supply active energy services; the sort of services labelled as contract energy management in industrial markets.

For homes, for example, the supplier could insulate and draughtstrip its customers' houses and supply the most efficient heating appliances – thus offering consumers heat and light at minimum cost. Using their enormous buying power, some of the market barriers to efficiency would be overcome at a stroke – unit price, for example, and heating engineers would no longer be able to complain that condensing boilers are too complicated, if these formed the great majority of boilers being installed.

Energy services are hardly a new

concept, and a few suppliers have made tentative moves towards supplying more than just metered energy, but Chesshire saw the move to services as a major part of the way forward for UK energy policy. We must extend the careful control of investment from the energy supply to the demand side, he said, only this way will we be sure that we take up least cost options.

Many industrial energy users are familiar with contract energy management, but think of the power of extending the concept to what Chesshire called the 'non trading' commercial sector (schools, local authority buildings, etc) and to homes. The supply side will remain important, of course, but it is far better to consider energy supply and use as a whole system with policy evolving accordingly.

WAP-ENABLED FRIDGES

Take fridges for example, said Chesshire. In a few years many of us are going to have 'WAP-enabled' fridges at home, ie machines which can be controlled remotely and without hard wires. Now roughly a third of UK energy is used in homes; a third of this by fridges, which are switched on and off by thermostats. They don't need to be switched on all the time; indeed can maintain low temperatures for several hours. With WAP, there would be scope to load manage nearly 10% of UK electricity by switching fridge motors on and off remotely according to wider demand. This sort of demand management would remove the need to invest in and build a new merchant. power plant - the peak is levelled-off.

This is an example of treating energy supply and demand as a system, said Chesshire, tweaking the whole system to increase overall efficiency.

John Chesshire had had perhaps 50

Last month saw the second of the Institute's conferences on energy policy: Energy Policy – the Driving Forces of Change – held at the CBI's Centre Point in London, following the very successful 'Energy, Solving the Policy Jigsaw' conference of last year.

Steve Hodgson reports.

approaches from energy suppliers offering to lower his energy bill by cutting the unit price, in recent months, but next to none offering to cut his consumption and none at all suggesting ways he could reduce his carbon emissions. So following market messages, working with 'the grain of the market' was achieving nothing for efficiency or the environment, he concluded.

Look at the carbon intensity of the electricity generating industry – this has been falling nicely with the switch from coal to gas, but the trend is guaranteed to reverse as nuclear plants are retired, in a very short period from now. At that point we will have to transfer the burden to other sectors and the demand side, said Chesshire.

Chesshire's talk followed the opening presentation by environment minister Michael Meacher, who rounded-up some of the better things this Government has done in the last three years. During questions, Meacher displayed a thorough grasp of the ever-shifting picture of energy and environmental policy, and some sympathy with the green interests in the audience, admitting that energy is simply too cheap to make efficiency important any more.

It is essential that China eventually signs-up to Kyoto, said Meacher; almost certain that climate change is real (and could get very much worse if natural feedback mechanisms kick-in); and impractical to require businesses to report their environmental performance in a rigid structure.

Regulator Callum McCarthy closed the morning session, arguing (as he had done at the Institute's first policy conference last year) that most of the interesting questions were outside his tightly defined remit. But he did run through progress made against Ofgem's current programme of work. Apart from having completed preparation for the Y2K problem-which-never-appeared, his main message was one of continuity.

SWITCHING TO NETA

The National Grid Company's Jeff Scott reopened proceedings after lunch with a detailed description of the new electricity trading arrangements (NETA) due to take over from the electricity Pool from October. The switch to NETA represents a more fundamental change for NGC than the establishment of the Pool to take over the CEGB duties back in 1990, said Scott. But the company will continue to play a central, but rather different role in the new arrangements.

Perhaps the key difference which NETA will bring is putting an end to paying all successful bidders to the Pool the same unit price, the 'system marginal price'. Instead, NETA relies on 'pay-as-bid' pricing.

But there are many other differences, said Scott, to a system which will use a series of mechanisms to match electricity supply to demand: long-term forward markets for electricity: a power exchange for the 24 hours before the period where power is supplied; a balancing mechanism for 'T-3_ hours'; and, operated by NGC, a mechanism for settling remaining imbalances.

The key principles of NETA are, said Scott

- freedom of action by generators 'self despatch',
- · pay-as-bid for firm commitments,
- a single price (ie no capacity element), and
- security of supply to be maintained: in the long-term by market economics and, in the short-term by NGC balancing options.

The banker's view was next, with John Reynolds of Credit Suisse First Boston running through some financial and marketing aspects of the new electricity regime. Looking back to Jeff Scott's presentation, Reynolds said that the principles within NETA could have been put in place at electricity privatisation ten years ago, except that the very tight schedule imposed by politicians mean that the necessary systems simply could not be fully



Anna Walker, Energy Director General at the DTI and Dick Coldwell, President of the Institute who chaired the conference.

developed and tested in time. So the Pool was merely a codification of the CEGB had always done in despatching generating plant.

John Reynolds said that use of the internet in electricity trading would quickly become crucial, as it offers the cheapest transaction option. He predicted that telecom and financial services would be added to power supply contracts in the near future, with high street banks surely getting involved. Reynolds also spoke of the enormous scope for 'super mergers' of large companies in the UK electricity industry to take place, following similar activity in Germany recently.

ENVIRONMENT WISH LIST

It was left to the Director of Friends of the Earth (FoE), Charles Secrett, to return to the wider energy policy agenda. Secrett delivered a lengthy and wide-ranging speech, ending with a FoE 'wish list' for government action, calling for:

- extension of the new electricity standards of performance beyond 2005.
- energy regulation to take more account of social and environmental objectives,
- new minimum efficiency standards for appliances,
- a clause in the Utilities Bill to establish 'net metering' (where small renewables generators are paid the same rate for exporting excess power as importing top-up electricity),
- 'polluter pays' legislation for both carbon and nuclear material emitters,
- the ending of remaining subsidies for oil and gas exploration,
- further tax reform around meeting environmental objectives,
- a nationwide domestic energy conservation programme – Secrett applauded Government support for the Warm Homes bill currently in Parliament, which would establish a

15 year programme to end fuel poverty.

Earlier, Secrett blamed the lack of a national energy policy for the current climate change "crisis", where long-term strategies have been sacrificed for shortterm gain. But he also praised what he called the latest draft of Britain's climate change strategy and the extensive consultation which had led to it, adding that sooner or later consultation and drafts would have to be replaced with action.

He referred to a new book, Tomorrow's World, from FoE in which it is calculated that, if the developing world is to 'catch-up' with western levels of energy consumption and waste, we would need 8.5 skies to cope with the resulting pollution. Put another way, the UK and similar countries will need to cut emissions of carbon dioxide not by 12.5 or 20%, but by 95% by 2050 in order to stabilise the climate.

Energy is too cheap, and it is often cheaper to continue wastage than to invest in new efficient goods, said Secrett, so he welcomed the Chancellor's recent cut in VAT for thermal insulation and solar products to match VAT on fuel at 5%. He echoed themes from John Chesshire's talk by advocating energy services rather than energy supply.

FoE's renewables target is 20% in the next 20-30 years, said Secrett, but current policies are not robust enough to deliver even the 10% by 2010 government hope. We need to improve the rate of success for windpower planning applications and create a public awareness of the benefits of wind and other renewables, said Secrett, who also spoke about wider environmental issues, concluding that: "We cannot create wider sustainability without getting energy right".

Conference proceeding are available from Sam Cobbina at the Institute for £5.00 for non-members and FREE for members.

Putting the lid on "world's largest" LNG storage tanks



The roof of one of the biggest liquefied natural gas tanks in the world, which is being constructed in a remote area of India by Kvaerner, has been blown 40 m into position by two massive electric fans.

In an unusual operation in the isolated west coast region of Dabhol, south of Mumbai, the company has completed lifting into place a 770 tonne steel roof for the tank. Because of its immense size cranes could not be used, so Kvaerner brought in two giant fans to blow it into position in a seven hour operation.

Kvaerner built the tank roof inside the tank base while its walls were being simultaneously constructed. The domed roof is 80 m in diameter, stands 14 m high and was built from 600 separate steel sections.

The £175 million turnkey project is the first fully integrated partnership between Kvaerner Construction and Kvaerner £&C, who are responsible to ENRON affiliates which are managing the construction of the LNG facilities for the Dabhol Power Company. Kvaerner's contract is to supply. construct and equip facilities to offload LNG from ships in -160°C liquid form, pipe it to a storage centre where it is vaporised into gas and then pumped into the power station. The task involves:

- fitting out a new LNG offloading jetty with mechanised LNG unloading arms;
- installing insulated supply pipelines running 2 km from the jetty-head to a storage and processing area closer to the power station; and
- building an LNG storage and processing area, consisting of three concrete and steel insulated storage tanks each with a 160,000 m³ capacity as well as vaporisation and pumping process

facilities to feed the new power station. The towering scale of the storage tanks dominates the site. They are built at three levels into a hillside in a narrow, rocky valley surrounded by 100 m high cliffs. Kvaerner is

constructing the first three of six planned LNG tanks that are believed to be the world's biggest.

The design of the tanks is based on proven technology from Whessoe LGA. The outer shell of the first tank is now complete with the roof of the second also due to be blown into position before the monsoon season.

Internal workings for the tanks will follow during the rainy season including a I m wide layer of expanded perlite insulation sandwiched between the outer wall and an inner steel casing. A suspended deck under the roof of each tank will contain a metrethick blanket of fibreglass insulation. A layer of foam glass is already installed beneath the base, with tank-base heating to prevent the surrounding earth from freezing. In procurement terms the project has

been a global challenge, combining the technologies of four continents to achieve co-ordinated and timely support to meet a tight programme. About 80% of the materials and equipment has been shipped in from Europe, the USA and Japan. This includes highly-specialised LNG plant such as pumps, pipe supports, bellows, vaporisers and boil-off gas condensers.

aporisers and boll-on gas condensers.

The project's main focus until recently has been in London where procurement and engineering has originated. It is now moving to Dabhol where the emphasis is on process installation. Some 15 km of stainless steel pipework has to be cut and prepared in a fabrication yard set up on site. Integrated working with suppliers is especially important as everything connected to the LNG pipe-runs must be designed to be thermally insulated, including cold supports fixed into the ground.

Finally, each storage tank must be hydrotested, requiring at least 100,000 m³ of water.



June 2000

UK generation markets Course, 5-7 June, Brighton, £1195 + VAT Details from Powerink Ltd, tel: 01273 202920, website: www.power-ink.com

ET 2000

Environmental technology exhibition, 6-8 June, Birmingham Details from Reed Exhibitions, tel: 0181 910 7959, e-mail: sandie.mccaubrey@reedexpo co.uk

Energy solutions in action Conference, 6 June, Glasgow Details from ESTA, tel: 07041 492049, e-mail: *olan@esta.org.uk*

Energy management Institute of Energy course, 7 June, West Midlands, £99 + VAT Details from Beatriz Cano, tel: 020 7580 7124, e-mail: bcano@instenergy.org.uk

Energy solutions in action Conference, 8 June, London Details from ESTA, tel: 07041 492049, e-mail: alan@esta.org.uk

Energy trading in central and eastern Europe Conference, 8-9 June, Warsaw, Poland. Details from Synergy. tel: +31 346 590 901, fax: +31 346 590 601

World Petroleum Congress

Conference and exhibition, 11-15 June, Calgary, Canada Details from WPC, tel: +1 403 218 2000, e-mail: cdn.ossoc@wpc2000.com

Energy saver

Course, 13-15 June, Durham, £875 + VAT Details from NIFES, tel: 0115 984 4944, e-mail: training@nifes.co.uk

E-billing

Conference, 14-16 June, Frankfurt, Germany Details from IFMR, tel: +31 20 531 2856, e-mail: rebeccos@icmnl.com

Energy solutions in action Conference, 15 June, Bristol Details from ESTA, tel: 07041 492049, e-mail: alan@esta.org.uk

Mergers in European gas and electricity

Conference, 15-16 June, Berlin, £850 + VAT Details from the Petroleum Economist, tel: 020 7831 5588, e-mail: jackets@petroleumeconomist.com

Gas markets in transition

Conference, 18-23 June, Wiltshire, £2900 + VAT Details from Alphatania, fax: 020 7650 1405, e-mail: training@alphatania.com

World Engineers' Convention

Conference, 19-21 June, Hanover. Details from the Congress Organisation, tel: +49 211 6214 400, e-mail: togungen@vdi.de Energy solutions in action Conference, 20 June, Belfast Details from ESTA, tel: 07041 492049, e-mail: alan@esta.org.uk

Power-gen 2000

Conference and exhibition, 20-22 June, Helsinki Details from PennWell, tel: +1 918 831 9160, e-mail: powergeneurope@pennwell.com

Energy solutions in action Conference, 22 June, Teesside Details from ESTA, tel: 07041 492049, e-mail: alan@esta.org.uk

Wind power technology

Course, 26-30 June Loughborough Details from CREST, Loughborough University, tel: 01509 223 466, email: a.j.white I @boro.ac.uk

How to do an energy survey

Course, 27 June, London, £224 Details from Mid Career College, tel: 01223 880016, e-mail: courses@mid-careercollege.ac.uk

Introduction to NETA

Course, 27 June, London, £699 + VAT Details from IIR Ltd, tel: 020 7915 5055, e-mail: registration@iir-conferences.com

Electricity trading in the UK and Europe Conference, 29-30 June, London, £899 + VAT Details from IBC Conferences,

tel: 020 7453 5491.

e-mail: cust.serv@informa.com

Events

2000 European oil refining Conference, 29-30 June, Berlin, £975 Details from Primark WEFA, tel: 020 7566 1970, e-mail: karen.buckingham@primark.com

July 2000

World renewable energy congress Conference and exhibition, 1-7 July, Brighton Details from WREN, tel: 0118 961 1364, e-mail: asayigh@netcom.co.uk

Energy research – helping the UK compete IMechE seminar and exhibition, 4 July, London Details from Fiona Fulton, tel: 020 7304 6815, e-mail: f_fulton@imeche.org.uk

Renewable energy for developing infrastructure Conference, 3-7 July, Loughborough Details from CREST, Loughborough University, tel: 01509 223 466, email: a.j.whitel @iboro.ac.uk

The Utilities Bill 2000

Conference, 6-7 July, London, £899 + VAT Details from Euroforum, tel: 020 7878 6886, fax: 020 7878 6885

UK electricity outlook

Course, 10-12 July, Brighton, £1195 + VAT. Details from Powerink Ltd, tel: 01273 202920, website: www.power-ink.com effers

Climate change, renewables

Two articles – on whether nuclear power is a key to sustainability or a dangerous industry which should be phased out - published in last November/December's issue of Energy World continue to attract comment. Here Paul Spare and

Sir

The article by John Bond and myself in the February issue of *Energy World* has generated more comment than expected and we would like to attempt to answer the technical points raised.

The availability and constancy of electricity supply is of vital importance to an industrial economy and I feel that David Olivier has missed the point in concentrating on interruptions of only a few minutes.

Maintaining voltage and frequency will become an increasing problem as fluctuating renewables replace established fuels. This was explained in an article in the February issue by Jenkins and Strbac, which described some very interesting ideas for ameliorating the problem.

According to the last statistics that I remember seeing, supply interruptions across the UK are typically about 0.02% pa ie loss of supply for about 1.5 hours per year. This may be annoying, but rarely ruinous. Much longer interruptions will occur frequently if renewables reach 10-15% of installed generation. Supplies could be lost for days or weeks with credible probability, even if energy storage is introduced.

The National Grid Company made the same point last year in their submission to the House of Lords, that there would have to be more investment in reserve plant if wind power grew to above 1500 MW of capacity. The implications become more serious as our dependence on sensitive electronic equipment increases. Some of these problems can be seen already. The Stock Exchange computer problems of 5th April gave an indication of our vulnerability.

Two examples serve to illustrate recent trends. Fuel collection for the 10 MW wood-powered plant in Yorkshire was disabled on April 4 by heavy rain. Similarly, in January this year, I was travelling to a meeting at UKAEA Windscale. At 8 am, there was freezing fog with a hard frost as the weather was dominated by a stable anticyclone. All the wind generators at the wind farm on the A590 near Haverthwaite were immobile – producing nothing. Fortunately, for all the green protesters, BNFL Calder Hall was maintaining its 150 MW output, as it has for the last 45 years, so that they could use their computers to complain about the foolishness of nuclear power.

Secondly, the calculations about the numbers of wind generators needed are correct. The numbers are consistent with OECD and the International Energy Agency estimates. Lord Williams quoted a figure of 45000 turbines to supply 5% of UK demand on November 5 in the House of Lords debate.

In calculating their numbers, it is reasonable to use an average turbine size. Generators as large as 1.2 MW may be available (Mr McGregor), but not all sites can accept the largest machines. If the 'polluter pays' principle is applied by the rural population, more of the machines will be installed close to the people who use the power, for example in London or Glasgow. I cannot see the populations of Hampstead Heath or Paisley having 1.2 MW machines 250 ft tall behind their gardens, so that they can have their own 'green' electricity.

Thirdly, benefits from energy efficiency are illusory, unless they reduce consumption by a factor of two or more, which is very unlikely by developing existing technology. Energy efficiency has been increasing steadily since the oil shock of 1973. Electricity consumption in the UK has however been growing at 2-3% pa over the same period. The small improvements that can be achieved through technical developments simply

John Bond (both members of the Institute's nuclear power special interest group) respond to previous criticism of their arguments, while Leonard Brookes accuses the 'anti-science' movement. All three letters have been edited.

> reduce the real cost of a unit of energy, encouraging the use of larger equipment or disposable income being spent on additional equipment. That is human nature. Over the period 1985-96 in the EC, GDP increased 27% with a 10% improvement in energy efficiency, but total energy consumption increased by about 15%.

> In the same way, improving the fuel economy of small cars has encouraged purchasers to buy cars with larger engines and better performance.

> Consider the energy-saving example cited, for the power consumption of a laptop versus a desktop PC. A difference of 150 W means a saving of one kWh per day. This reduced electricity consumption for 220 working days sums to £4.40 per annum. This it is proposed be achieved by a £500 subsidy per machine, requiring 100 years to recover the investment.

Paul Spare

Sir

Professor Thring (Energy World April 2000) dismisses nuclear energy rather casually in my view, but he is not alone as a large number of people have, sadly, been deceived by many decades of poorly informed commentary resulting in its 'demonisation'. The most damaging element in this 'under-information' is the assumption that radiation is harmful at any level – this degree of caution is fair, even perhaps commendable, for regulatory purposes, but there is increasing evidence that it does not represent reality.

We need a 'joined up' and broadened out understanding of nuclear energy, from its fundamentals down to the role of the derived energy from the decay of radioactive isotopes in the earth, without which we would not

and nuclear power

now have had the shaping of the continents, and might well be fish in a sea covering the whole earth. We have evolved through aeons of radioactivity in our environment, subjected to radiation of all types, eg alpha, beta and gamma from the materials of the earth as well as cosmic radiation from space. The three main sources of radioactivity in the earth are uranium, thorium and the radioactive potassium isotope (k-40), which we ingest in food from natural sources. It would be an interesting question as to what would happen to our health if natural radiation could, hypothetically, be switched off. Studies of radiation hormesis indicating the benefits of enhanced radiation at levels close to those to which we are accustomed would suggest that our immune systems would take a nose-dive.

As for the perceived problems of active waste disposal - packaging methods are highly developed; a suitable deep repository having the required geology and low ground water flow conditions can be found, given the national will to do so, and the waste quantities are manageable. For example, the total quantity of high level waste residues conditioned in glass blocks arising from the reprocessing of discharged fuel for the whole of the UK civil nuclear programme from Berkeley and Bradwell to completion of reprocessing from Sizewell B is no more than 1890 m³ - which could be placed in the tower of my parish church with room to spare. There are other, less active, wastes arising from nuclear power operations and decommissioning but these are not totally disproportionate, so that there is a generally quite unrecognised nonsensational perspective on nuclear wastes.

Further, it is perhaps of interest that the really seriously radioactive residues from spent nuclear fuel, such as strontium-90, caesium-137 and neptunium-237 total 89 kilograms per annum per 1000 MW electrical output, which, theoretically (though lethal) a strong man could carry. This is not much compared with the national production of chemically toxic waste, whose toxicity is everlasting. The total of radioactive waste as a percentage of chemically toxic waste is about 0.4% (four parts in a thousand). These quite small waste quantities are not inconceivable when related to the throughput of fuel, which, in terms of weight, normalised to unity for Sizewell B, is 96,000 for a coal fired power station, and 47,000 for a combined cycle gas fired station, each of the same output.

John P Bond, MInsteE

Sir

Professor Meredrith Thring (Energy World April) expresses his concern that his great grandson is at risk of finding himself in a world made uninhabitable by excessive global warming and asks for all the stops to be pulled out to avoid this. Well, almost all the stops – he still rejects nuclear energy although it offers farm more practical scope than almost anything one could think of for making major reductions in manmade greenhouse gas emissions.

Before this letter could possibly appear in print one of my granddaughters will have added a great grandchild to our family score but my fears for this new generation are very different from Professor Thring's. Past President Neville Potter's letter in *Energy* World, for July/August 1999, encapsulates the case for scepticism about the risks of global warming and he is by no means the only writer to point out that the emperor seems to have no clothes. I believe that the real threat to our future lies in the insidious infiltration of an anti-science element into the corridors of power and the success the preachers of this gospel seem to be having in converting the younger members of society in particular to their point of view.

Anti-science has a very disreputable history – the burning to death of Pythagoras and his followers in 510 BC; the unspeakably cruel execution of woman mathematician Hypatia in the fourth century AD; the persecution of Galileo for his wholly accurate views on the movement of the planets and the hounding of the mid western school teacher for telling his pupils about Darwin's theory of evolution – all for the best, mainly religious, motives.

The present state of the anti-science movement is none the less dangerous for being anti new and big science rather than anti-science in general. There is no way the present world population could exist on the basis of the technology of 500 years ago and yet there is a strong well-organised movement that would have us revert to the sources of inanimate energy - wind and water power - that the world depended on at the time when Pythagoras and his followers were being murdered. There is equally no way a world population making its way up to ten billion during this century could be fed on the output of organic farming. We need a second agricultural revolution like the one that saved millions of people from extinction during the last century but the environmental pressure groups would deny it to the world, not shrinking from lawlessness in the process.

In short, I fear far more the risks to my descendants from interference with food and energy options and supplies (whatever the motives) than I do from the highly questionable risk that man's activities will cause damaging climate change and I believe that the greatest single source of these risks is the resurgence of an insidious but influential anti-science movement.

Dr L G Brookes, Fellow

The editor welcomes letters for publication, particularly short contributions, on anything that has appeared in Energy World, and on wider energy issues.



New Members

LONDON & HOME COUNTIES

Mr N Starmer AMInstE **CGU** Insurance Plc Group Member Miss LA Evans MInstE The Institute of Energy

MIDLAND

Mr NF Peacock FinstE (transf) Energy International (UK) Ltd Group Member

BRANCH EVENTS

JUNE 2000

TEESSIDE

Tuesday 6 June

Branch AGM at Enron Power Station. Contact CR Howarth, North East branch tel: 0191 222 7303 Email: c.r.howarth@ncl.ac.uk

BIRMINGHAM

Wednesday 7 June One-day Energy Management course at the Government Office for the West Midlands. Contact Ms B Cano, The Institute of Energy tel: 020 7580 0008. Email: bcono@instenergy.org.uk

NORTHERN IRELAND

Mr J Watson MInstE The Caldwell Partnership

SCOTTISH

Mr L Denniel, Student Heriot Watt University

SOUTH WALES & WEST OF ENGLAND Mr MD Williams, Student

University of Wales, Cardiff

CHELTENHAM

11.00am

Friday 16 June, 10.30 for

Annual CRE Lunchtime Lecture

"Economics of Energy use to

2010" presented by Prof John

the Institute of Energy at CRE

Chesshire, Past President of

Group, Stoke Orchard.

Contact A Boulton, South

Wales & West of England

branch, tel: 0117 932 3322

Email: a.boulton@talk21.com

NORTHERN

Date to be confirmed

Scheme presentation, NIE

IRELAND

Newforge Lane.

Miss SCY Liang, Student University of Portsmouth

YORKSHIRE

Mr TL Taylor, Graduate (transfer) Dale Gas Power **Department of Chemical** & Process Engineering University of Sheffield Academic Affiliate Mrs T Sawaiz, Associate Bradford Energy Management Agency

All members are welcome to attend these events regardless of the branch they are organised by

Contact Dr D McIlveen-Wright, Northern Ireland branch, tel: 01265 324477Email: dr.mcilveen-wright@ulst.ac.uk

LONDON

Thursday 22 June, 12.30pm Institute of Energy AGM Contact Ms S Milligan, tel: 020 7580 7124 Email: smilligan@instenergy.org.uk

LONDON

Thursday 22 June, 6.30pm Melchett Lecture 2000 at the London Planetarium 'Energy Visions' by W Patterson. Contact Ms S Milligan. tel: 020 7580 7124 Email: smilligan@instenergy.org.uk

CPD CALENDAR

JUNE 2000

BRIGHTON

5 -7 June **UK** Generation Markets Power Ink Workshops approved by InstE. Contact Power Ink Ltd. tel: 01273 202920 fax: 01273 203720, register online: www.power-ink.com

UK ENVIRONMENT WEEK

5 - 11 June Tel: 0870 7511552, www.ukenvironmentweek.org

CRICKLADE, WILTSHIRE

18 - 23 June Gas Markets in Transition: Challenges & Opportunities. Contact Margaret Coen tel: +44 (0) 20 7650 1402 email: training@alphatania.com

IULY 2000

CRANFIELD

3 - 7 July Gas Turbine Combustion. Contact Mrs Mary Howard, School of Mechanical Engineering, Cranfield University, tel: 01234 754644. fax: 01234 750728 email: m.howard@cranfield.ac.uk

RIBA exhibits sustainability in London

Energy Efficiency Accreditation

The Royal Institute of British Architects (RIBA) is staging a major exhibition under the banner of London Living City. It questions how we can sustain urban lifestyles in an increasingly urbanising world without irreparably damaging the ecosystems that support us. Solar panels have been fixed to the sides of RIBA HQ to provide the power for the exhibition, setting an example for those who will design the urban spaces of the future.

Themes explored inside the building include transport systems, power supplies and the demands placed upon infrastructure by

twenty-four hour urban culture. Exhibits and information drawn from architecture, engineering, science and technology aim to demonstrate how these areas must be integrated to sustain our urban environment without damaging other environments.

Visitors can see how London has developed from its Roman roots two millennia ago and can track flows of energy, information and materials around the city.

London Living City is at RIBA, Portland Place, London WI until July 9th 2000

Are job opportunities likely as a result of the Government's sustainable development plans? The Labour Party's Environment Campaign SERA recently ran an event entitiled A New Deal for the Environment, Working for a Better Future to ask this of keynote speakers including David Blunkett, Secretary of State, Department for Education and Employment.

The Institute of Energy exhibited at the event, promoting its involvement in the Partnership for Best Practice initiative which aims to create partnerships through better environmental performance between the workforce and management. The Institute has worked with a variety of organisations to promote the initiative, including the The Royal Borough of Kensington and Chelsea and Allied Distillers, these activities were supported by the Best Practice Programme. Partnerships for Best Practice reports to the Trade Union Sustainable Development Advisory Committee. The Institute of Energy has developed education and training materials and products to encourage workforce participation in energy and environmental activities for TUSDAC.

Breakout workshops in the afternoon at the SERA event included discussions about Regional Development Agencies as a catalyst for sustainable job creation, and how trade unions can encourage development of sustainable development workplaces and practices. For more information about SERA contact their office on email: serooffice@aol.com or tel: 020 7263 7389.

If you would like to know more about Partnerships for Best Practice contact Beatriz Cano on tel: 020 7580 7124, email: *bcano@instenergy.org.uk* for a brochure.

CORPORATE SERVICES DIRECTORATE

Finance Division

Energy Officer

PO1 £21,585 - £23,259 pa plus essential user car allowance (Ref. 3384)

Energy Auditor

SO1 £19,101 - £20,364 pa plus essential user car allowance (Ref. 3385)

Required due to a restructure, two highly motivated and enthusiastic individuals to build on the already well-established reputation of the energy management function within Salford. The unit has had tremendous success, most eccently winning the Mersey Basin Business & the Environment 1999 Awards. As a member of the team, you will share in our ongoing success and help to take our energy management activities to the next level.

Both posts will assist the Energy Manager in the implementation of the Corporate Energy Management Strategy by carrying out detailed energy audits involving analysis and appraisal techniques. With considerable experience of energy management gained within a local authority or other large organisation, you will have knowledge of the latest developments in this area.

You are likely to have an electrical/mechanical engineering and/or energy development management qualification. In addition, you will have well-developed written and verbal communication skills and be able to work effectively with internal and external service providers.

Closing date: 16th June 2000.

Application forms may be obtained from the Director of Personnel Services, Salford Clvic Centre, Chorley Road, Swinton, Salford, M27 5BN. Tel 0161 793 3507 (answerphone service after office hours). Minicom 0161 793 2544 (hearing impaired applications only).

Please quote post reference in all communications. Salford City Council is striving to be an Equal Opportunities Employer and positively encourages applications from all sections of the

community. The Authority operates a Job Share Scheme, details of which are available on request.



Student Services Getting Ahead

If you are completing your studies this summer and beginning to think about possible careers and getting a job, why not let the membership of The Institute of Energy know you are out there? Take this opportunity to place an ad in *Energy World*, entirely free of charge, to search out potential employers. Tell us in no more than 30 words who you are, what you have been doing and what you are looking for. Send your ad to Beatriz Cano by fax, post or email by 15 June 2000.

> For more details contact Beatriz Cano on tel: 0207 580 7124, fax: 0207 580 4420, Email: bcano@instenergy.org.uk

Science related work experience Student at University of the West of England (BA(Hons) Science, Society and the Media) seeks work experience in PR, Journalism or Exhibitions within a science environment. Contact Alastair Mumford, Tel: 020 7937 1182 or email: *almumford@hotmail.com*

> BEng Environmental Energy Engineering Graduate (First Class with Honours) Now studying for a Masters in Combustion and Energy Studies at Leeds requires work from 15/09/2000. Contact Steven Paul Mills on e-mail: Fue6spm@Leeds.ac.uk or telephone: 07931 344234

Please note: This space will be dedicated each month to individuals and organisations wishing to advertise situations vocant or situations wanted. Please note that this service is FREE

For more details contact Maria Adams or Beatriz Cano on tel: 020 7580 7124, fax: 020 7580 4420 or e-mail: eworld@instanergy.org.uk



In the sensational domed theatre of the London Planetarium Walt Patterson, Companion of the Institute of Energy, will be awarded the Melchett Medal 2000 by the President, Richard Coldwell for his significant contribution to the energy debate.

His Melchett Lecture will attempt to reassess the link between energy and human purpose what we humans want from energy, whether we can get it and how.

Walt says "We need urgently not only to reassess but also to realign the link between energy and human purpose, to make the world work better for all of us."

To reserve your place at a Melchett Lecture photocopy and fax back this registration form

l/we	will be attending the Me	lchett Lecture o	on 22 June 2000
Name(s)			
Job Title(s)			
Organisatio	n(s)		
Address			
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Tel:	Fax:	Email:	
Are you a m Membership	ember of The Institute o Number:	of Energy?	YES/NO
Attendanc	e is FREE but priority will be §	given to members of	The Institute of Energy
All	delegates will receive a FREE visitors pass Fax back to The Institute of Energy 18 Dev Tel: 020 7580 7124 Eav: 020 7580	for the London Planetarium Beatriz Cano conshire Street London 4420 email: brono@in	to use at a later date