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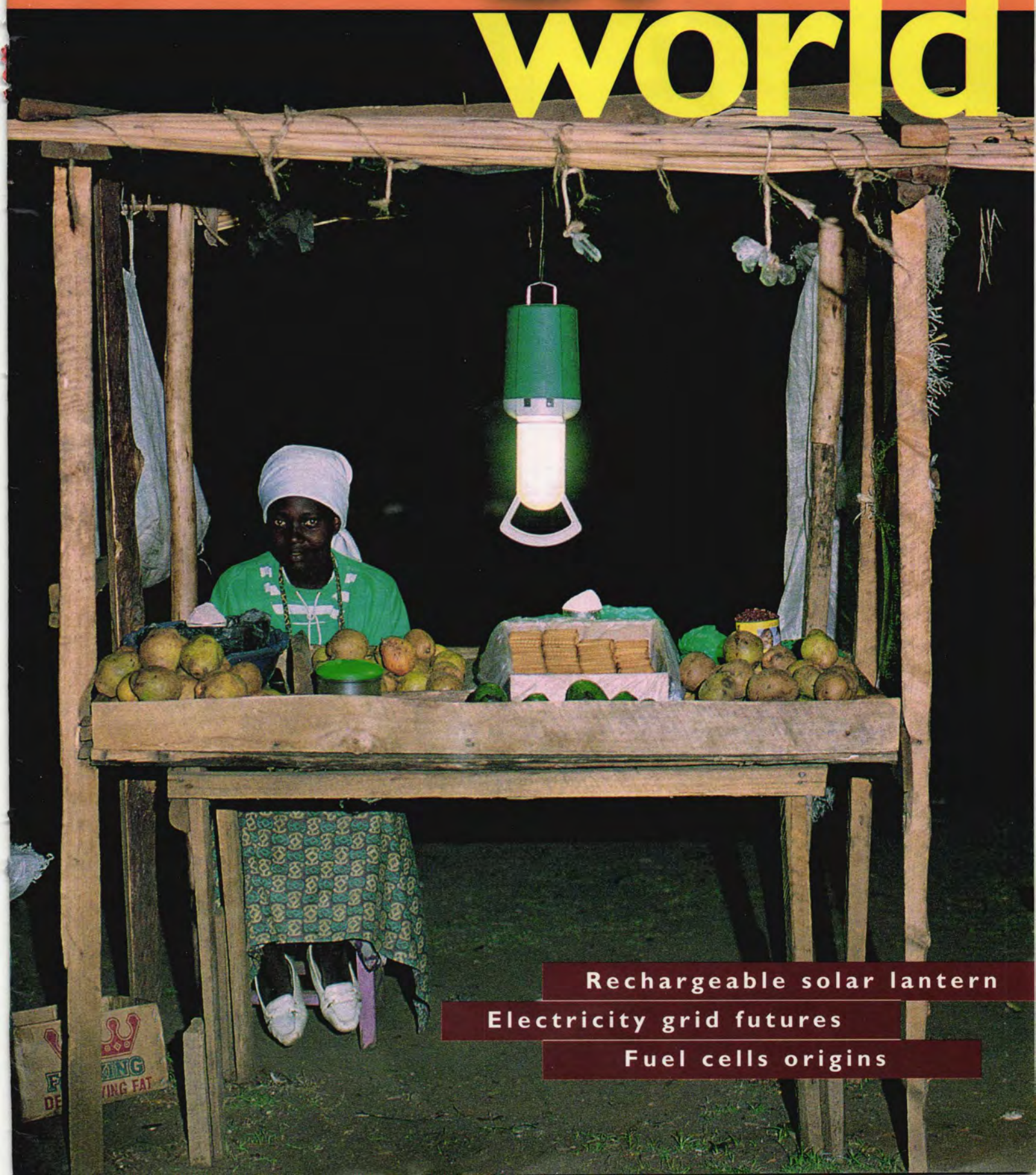

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Electricity grid futures

Fuel cells origins

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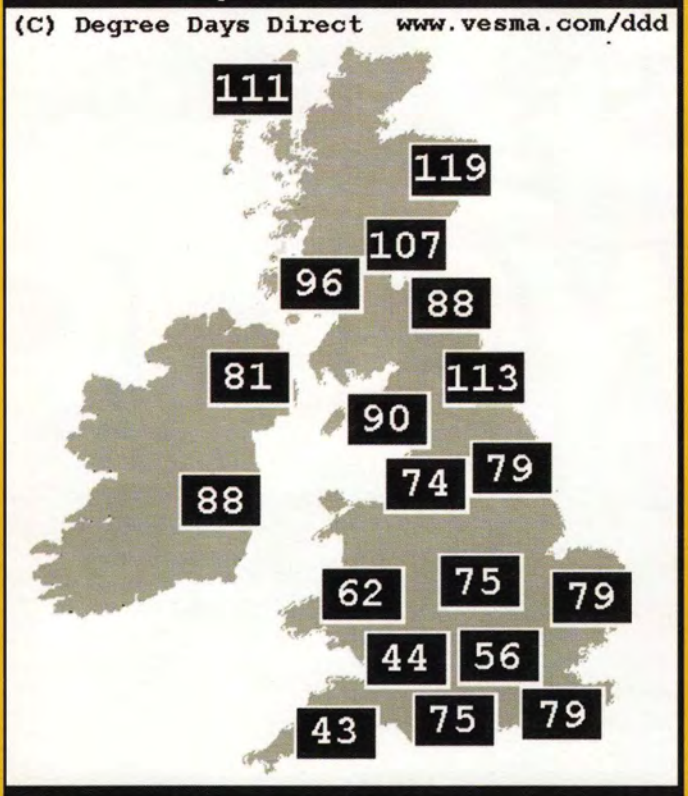

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THE MAGAZINE OF THE INSTITUTE OF ENERGY

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COVER

Developed by Intermediate Technology Consultants of Rugby and pictured here in use in Kenya is the new 'Glowstar' solar rechargeable lantern, which has just won the Engineering Council's prestigious Environment Award for Engineers 2001. Incorporating a 7 W compact fluorescent lamp and with a light duration of four hours, the lamp is designed as a low-cost alternative to solar home systems. It should repay its cost in savings on kerosene and batteries, in about one year.

Orders have been placed for the lantern from some 25 countries so far, illustrating how business can produce an appropriate product for dispersed rural mass markets. The lantern could transform millions of lives.

See page 18 for more details, and for other winners.

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Putting CHP back on track

David Green, Director, CHP Association.

The development of new CHP schemes in Britain may stop – indeed some existing schemes may be closed down – if we don't stop putting new barriers to CHP in place, and fail to act with sufficient urgency to remove existing obstructions. The development of new schemes, particularly in the industrial sector, has already slowed to a trickle in the last year and the CHP industry is in the most depressed state I have seen for a decade.

Yet, it is well-known that CHP has the potential to deliver the single largest contribution to cutting UK carbon dioxide emissions in the short to medium term, at a net *benefit* to the economy, according to DEFRA and CHP delivers significant economic and competitiveness benefits to its users, be they from hard-pressed industry, commerce or the public sector. CHP is a win-win technology which ought to be racing ahead towards its expansion target.

Despite much vocal support from the Government, its actions are letting the industry down. The New Electricity Trading Arrangements (NETA) which have been in place since March have led to considerable difficulties for operators of CHP and other distributed generation projects. NETA requires suppliers to forecast the amount of energy they will supply 3.5 hours ahead of delivery and penalises them for any shortfall in what was actually delivered.

These arrangements effectively handicap smaller, distributed generators, particularly where plant is designed to respond directly to its customer's demand for energy, rather than the wider electricity market. The CHPA has received several reports of considerable falls in the price paid by electricity companies for power exported from CHP schemes. In some cases, reasonable contracts are not available at all.

At the same time, and despite considerable lobbying from the CHPA and others, the Government's Climate Change Levy, also launched this spring, contains only a partial exemption for CHP. While heat and power used on-site and by neighbouring companies are exempt from the Levy, excess power exported to the distribution network and sold on the open market, *does* attract charges. This denies consumers the option to buy levy-free green power.

The lack of a full Levy exemption has been a serious blow to the economics of plants designed to export power, and we have already seen the development of several new CHP schemes cancelled for this reason.

CHP has also been hit by higher gas prices. Added together, these barriers have led researchers from Cambridge Econometrics and Forum for the Future to conclude that, under today's market conditions, the Government's policy framework will deliver less than 6,600 MWe of CHP. This figure undershoots the Government's 10 GWe target, is barely a third of the national economic potential for CHP and would mean a loss of eleven million tonnes of carbon dioxide savings annually.

A possible glimmer of hope on the horizon is action promised by Ofgem in response to a report from a joint industry-government body, the Embedded Generation Working Group. The Group's February report suggested that even now, a decade after privatisation, electricity distribution network operators have yet to take embedded generation seriously and are failing to recognise or reward operators for the contribution that distributed generation makes to networks. Nearly all CHP (and renewables schemes) are 'embedded' within the electricity distribution system.

Ofgem has responded with a "preliminary consultation document" aimed at reducing connection charges to embedded generators. However, timescales involved are uncertain and, meanwhile, CHP operators are suffering.

The electricity industry still has some considerable way to go before it can be said to be playing its part in encouraging new, green generation. Last year's major report on climate change by the Royal Commission for Environmental Pollution emphasised the need to transform the national electricity network so that it can accommodate large contributions from CHP and renewables.

Despite all these barriers, CHP's fundamentally high efficiency means that it has made considerable progress in the last ten years – we now have double the capacity in place compared to 1990. And some new schemes continue to be commissioned, particularly in new niche areas such as computer installations which require both high quality power and constant cooling, and glass houses. Micro-turbines and even domestic-scale CHP also point to a potential way forward.

But the challenge of climate change demands considerably more progress for green energy than that currently being achieved.

The CHP industry is increasingly tired of fighting uphill and having to climb the barriers erected by a market fundamentally at odds with the Government's environmental goals.

Two immediate steps which would start to move the industry forward again are:

- ensuring that NETA is changed early on so that distributed generators get a fair deal; and
- that the Climate Change Levy exemption is extended so that all CHP-produced energy is truly exempt.

Any less will deprive Britain of some £3 billion of new investment and deny consumers the benefits which CHP can deliver.

Contact David Green on tel: 0207 828 4077 or at e-mail: info@chpa.co.uk

New pipeline will double Ecuador's oil production

Work has started on a new 500 km oil pipeline across the Andes in Ecuador, to run for most of its length parallel to the existing Transecuadorian Pipeline, SOTE, that was built by Texaco in the 70's. The new OCP pipeline begins near Lago Agrio, in the oil rich Amazonas region of Ecuador, climbs to 4062 m above sea level on its route across the Andes and ends at the Marine Terminal near to Esmeraldas on the Pacific coast.

Four pumping stations will operate in series on the uphill part of the line, providing the dynamic pressure head for the flow and the static head for the altitude increase.

In the pumping stations heavy crude oil blend is heated to 65-75°C in order to reduce its viscosity.

Equipment for the pumping stations will be provided by the Finnish power and marine engineering group Wartsila, which will supply 22 pumping units with outputs varying from 3.1 to 3.4 MW.

Brazil improves its electricity system

Power company ALSTOM is to supply equipment for the combined-cycle power plant of TermoRio, located on the outskirts of Rio de Janeiro in Brazil. When operational, the plant will produce an electrical power output of more than 1000 MW and 400 t/hr of steam to be supplied to the Reduc refinery of Petrobras and to the grid. It will be the largest combined-cycle and cogeneration power plant in South America.

The plant will be constructed in phases, starting commercial operation in simple-cycle mode in 2002, less than a year from order. The whole plant is scheduled for completion at the beginning of 2004.

ALSTOM will supply the six gas turbines, steam turbines, heat recovery steam generators, electrical generators and control systems. In addition, ALSTOM in Brazil will be responsible for the design, procurement and contracting for the civil works and balance of plant, including a high-voltage substation as well as installation of all the equipment at site.

Meanwhile, global technology group ABB has supplied two large power transformers to the Brazilian utility Furnas, to allow the additional transmission of 1,500 MW of electricity from the world's largest hydro power plant, Itaipu, to the Sao Paulo region of the country. The 280 tonne transformers each have capacities of 550 MVA and 765 kV.

Restoring power in NY

One of the impacts of September's terrorist attack on the World Trade Center was the loss of electrical service to lower Manhattan. Two electrical substations next to the Trade Center were totally destroyed and a third knocked out of service. Major electrical transmission cables were also lost. The city's electric utility, Con Edison, managed to restore power to all of lower Manhattan within a week, after installing more than 33 miles of new high-voltage cable.

Security was heightened throughout the US energy infrastructure in response to the attacks. Shipments of nuclear material were halted and security was heightened at nuclear plants, refineries, pipelines, and along the electricity transmission grid. The Federal Energy Regulatory Commission (FERC) noted that the electric, gas, and oil companies that it regulates may need to adopt new procedures and install facilities to further safeguard their systems.

CO2e.com

The world headquarters of CO2e.com, which supplied an article on emissions trading for the September issue of *Energy World*, were on the 101st floor of the World Trade Center. Three people from the company died in the event. The company has since relocated its HQ to London.

Logica takes Europe to market

The Dutch, Czech and Danish energy markets are to be opened up for competition with the assistance of Logica, which has won contracts to provide solutions to all three countries to add to its experience gained through projects at the heart of competitive markets in the UK, USA and Australia.

In the Netherlands, Logica has been chosen by the Energie Clearing House, a foundation formed by the three leading Dutch utilities companies: ENECO Energie, Essent and NUON, to design, build, host and operate an IT service to allow eligible customers to switch to their energy supplier of choice. This solution is intended to facilitate the next phase of electricity and gas market opening, due to come into effect from January 2002.

Logica has also won a contract worth several hundred million CZK from the Czech electricity market operator, to provide a solution for the liberalisation of the Czech electricity market. Under the eight year contract, Logica will develop, implement and operate the IT infrastructure required to enable electricity trading.

In Denmark, the company is to implement its 'Prodis' solution to enable third party access to the Danish gas transmission operator's gas system.

Promoting the hydrogen economy

What has been described as the world's largest solar hydrogen energy project, designed to power totally green buses, is to go ahead following news that an application to the European Commission for a Euro 2.2 million grant has been recommended for support.

The project, called USHER, will combine three technologies - photovoltaics, electrolysers and fuel cells so as to provide 100% renewable fuel for buses.

A partnership between the University of Cambridge, consulting engineers Whitby Bird & Partners and the Municipality of Gotland, is proposing to develop USHER in Cambridge and Sweden as an EU demonstration project.

The principle behind the project is to convert sunlight into electricity, which is then used to split water into hydrogen and oxygen. The hydrogen is then stored and used to power vehicles.

Some 3500 m^2 of photovoltaic cells will be installed above a covered colonnade on the Cambridge site. The electricity produced will be used to generate hydrogen, via an electrolyser. The hydrogen will be compressed, stored and used to power a bus service between the site and the city centre.

Colin Saunders, USHER's Project Manager said: "This project presents a totally green alternative to oil, it is transport from sunshine. The scheme is an operational demonstration of areas of technology that are under research within the University, namely photovoltaic cells, gas storage, fuel cells and the technology to control the emerging systems". A similar project will also be carried out on the island of Gotland in Sweden, where an array of photovoltaic cells will replace the roofs of a number of municipal buildings. The project will be carried out in Visby, a world heritage city, where there is demand for totally clean transport to protect the city's medieval wall.

All change at the Engineering Council

The Senate of the Engineering Council has voted by a majority of 33 to 5 in favour of proposals to replace the Council with a new Engineering and Technology Board (ETB) and a new regulatory body (NRB). A further meeting on 6 December will formally give effect to the new bodies.

Proposals for the new ETB follow extensive criticism of the Engineering Council, in particular its perceived failure to keep up with developments in engineering and education. The new ETB will widen the focus from the needs of the 200,000 Engineering Council-registered engineers in the UK to those of the 2 million people highly skilled working in the "wider engineering and technology community" estimated by the Hawley Group earlier this year (see *Energy World* July/August 2001 for more background).

The smaller community of registered engineers will be at the heart of the new ETB, rather than defining it, says the Council, adding that the wider focus is more appropriate to today's world of work. Meanwhile, part of the functions involved in registering engineers will be devolved by the NRB to the professional institutions. Registrants and non-registered members of the institutions will both benefit, says the Council, from a modern, better targeted central body.

Formation of the new organisations is said to have widespread support among the business and industry communities, government and academia; the Senate vote confirmed similar support among the engineering profession, says the Engineering Council's David Worskett. However, this was only achieved after the Council gave concessions to registered engineers in terms of their influence in the running of the new bodies.

The ETB is scheduled to be up and running by the start of next year while the NRB, which will take over the registration of and continue to set the standards for registered engineers, will follow, perhaps in April.

The Institute of Energy is among a small number of institutions praised by the Council as examples of how institutions should themselves be modernising in a similar way.

Budge returns to coal at Hatfield

Ex-chief of RJB Mining Richard Budge is back in the coal business by agreeing to take over and restart mining operations at Hatfield colliery south of Doncaster, south Yorkshire. Budge surprisingly left Britain's biggest coal producer, RJB Mining earlier this year, after which the company was renamed UK Coal plc

Budge's takeover of Hatfield followed intervention by Energy Minister Brian Wilson to keep the mine open on a care and maintenance basis for four weeks, enabling potential new bidders for the tender to come forward. Its previous operator, Hatfield Coal Company had ceased trading in August after experiencing persistent operational difficulties.

Care and maintenance costs totalled around £50,000 per week. If these had not been paid the mine would have closed and the cost of reopening it would have increased significantly, says the DTI.

Welcoming the move Mr Wilson said: "Keeping the mine open on a care and maintenance basis for these extra weeks has allowed the pit to be saved. Extensive resources remain untapped and I recognise the importance of Hatfield colliery to the local community. Over 200 jobs can now be restored".

The mine also received Goverment help under the UK Coal Operating Aid Scheme.

Renewables and CHP targets 'at risk due to NETA'

The new Renewable Power Association (RPA) has strongly criticised a report from Ofgem which suggests that green generators are faring no worse than other electricity producers following the introduction of New Electricity Trading Arrangements (NETA) in March this year.

The RPA says that Ofgem's report confirms their own findings that both prices paid for green power and generation volumes have both fallen, leading to a decline in revenues of over a third.

"In practice the implementation of NETA has shown itself to be directly contrary to Government policy," says David Byers, Chief Executive of the RPA. The Association says despite being asked by the Government three years ago to reform the electricity industry, with explicit instructions to promote renewable electricity, NETA is resulting in higher risks, greater costs and much lower revenues in the UK renewable sector.

To the embarrassment of Government and the amazement of the industry, Ofgem now proclaims that it is not authorised to address the issues, adds the RPA. A letter from Ofgem chief Callum McCarthy to Energy Minister Brian Wilson advises that costs involved in achieving renewable targets will be higher than estimated.

The CHP Association has made similar points, saying simply that the review shows that NETA is damaging both CHP and renewables and that the Government will fail to meet its targets for either sector unless it takes action to counter the effects of the new arrangements. Ofgem itself says that "Electricity generated from green sources is likely to require additional Government support if current environmental targets and wider environmental objectives are to be met".

- Launched in October, the RPA aims to represent the whole range of renewable technologies under the same roof for the same time, and can only strengthen the voice of the previously divided green producers to Government and others. It claims to have more than 50% of the UK's current renewables capacity as members already.

See also Viewpoint on page 2.

New hydro-electric scheme for Scotland

Innogy Hydro, part of electricity giant Innogy plc, has stared work to build an 800 kW hydro-electric scheme in Scotland. Located at the western end of Glen Garry on the Garry Gualach Burn, near Invergarry, the site is being developed in partnership with Forest Enterprise and a local trust.

Scottish firm R J McLeods, which was responsible for the construction of Innogy's similar hydro project at Glen Tarbert, has been awarded the contract for this new site.

The station has been carefully designed to blend in with the surrounding landscape. Other environmentally sensitive features include a buried pipeline, a low intake weir with fish friendly screens and the transmission line which will also be buried for some of the route.

The station is expected to be operational by July next year. The project will bring the number of Innogy Hydro projects operating in Scotland to four.

Waste-to-energy facility planned for Isle of Man

A proposed energy from waste facility serving the 75,000 residents of the Isle of Man has received planning approval. With the final stage of a lengthy planning process successfully completed, the way is clear for United Waste (Isle of Man) Limited, a part of the SITA group of companies in the UK, to begin preparations for the construction of the £42 million project.

The plant is being built for the Island's Department of Local Government and the Environment as part of its integrated waste management strategy which also embraces measures to minimise the production of waste, to recycle and to reuse goods and materials.

Located close to Douglas, the Island's capital and major source of waste arisings, the plant has been designed to process up to 8.25 tonnes of municipal solid waste per hour with an annual operating capacity ranging from 45,000 to 60,000 tonnes. Unlike other facilities in the UK and Europe, the plant will also feature a second incineration line for the treatment of clinical waste and animal wastes. It will have the flexibility to allow energy created by the incineration process to be used either to generate electricity which will be sold to the Manx Electricity Authority or used in future district heating schemes.

Waste-to-energy plant from SITA – a similar scheme is planned for the Isle of Man

Green groups in legal bid to stop MOX nuclear plant

The Government is being taken to court by green groups Friends of the Earth and Greenpeace in a bid to prevent the controversial mixed oxide (MOX) plant at Sellafield from opening.

The application for judicial review follows a decision by the Government to give state-owned British Nuclear Fuels Plc (BNFL) the go-ahead to begin operations at the plant. Friends of the Earth and Greenpeace say the decision is unlawful because:

- the economic benefits of the scheme have been distorted as the £472 million of taxpayers' money spent so far, mostly on constructing the plant, have been disregarded;
- there is insufficient evidence that potential customers, such as the Japanese, will materialise.

The MOX plant, completed in 1996, was intended to turn 'spent' plutonium and uranium into usable fuel. However, following financial concerns, and in the wake of an incident involving data falsification, the commercial go-ahead for the plant was withheld. Under EU law, the Government is required to show that the economic benefits of the plant outweigh the health and environmental detriments.

The Department for the Environment, Food and Rural Affairs (DEFRA) announced in October that the manufacture of MOX fuel is justified in accordance with European safety standards. After five public consultation exercises, the last one being completed in July this year, ministers concluded that the operation of the plant would result in a lifetime financial benefit with a net present value of over £150 million.

Welcoming the decision, BNFL said that the plant "already has contracted/reserved business for the 40% 'break even' sales".

The economic case has long been challenged by the environmental groups, but the perceived risk of terrorist attacks on fuel in transit following the events of 11 September have added a new global security line of objection. Charles Secrett, Director of Friends of the Earth said: "The Government's decision ..... is dangerous, uneconomic and perverse. [It] makes the world an even more dangerous place. The plant will struggle to find clients and may well never make any money"

Part of BNFL's MOX fuel plant at Sellafield

Join the emissions trading game

Thinking of getting into emissions trading, ie the buying and selling of carbon dioxide reduction credits, but don't know where to start? A new course from AEA Technology Environment and ILEX Energy Consulting might help.

The new course is aimed at business and financial directors or energy managers and will give participants a chance to experiment using a computer-based 'virtual' emissions trading game – the Carbon Trader. The course which runs over one evening and the following day will also explain the incentives for companies to join the UK Government's Emissions Trading Scheme, launched in August.

Climate Change Policy Manager at AEA, Will Blyth, says: "Few people have had the time to study all the information that has come out on emissions trading. In one evening and a day we will give delegates all the experience they need to make the decision for their own company about whether to trade or not and when to start. The opportunity to try out the emissions trading game will also allow them to make mistakes and learn to trade at no risk to their company!"

The course will run in November, December and the new year.

Contact Janet Hutchings at AEA Technology Environment for more details, e-mail: janet.hutchings@aeat.co.uk , tel: 01235 433942.

R&D should focus on 'distributed power, non-oil fuels and the nuclear question'

UK research and development priorities for the next forty years should be based around moves:

- towards smaller, distributed electricity generation plants,
- away from oil-based transport fuels and towards as yet unclear alternatives, and
- to clarify the future of nuclear power.

These are the conclusions of a new report from the Government's Foresight Energy Futures Task Force. The three priority areas emerge whichever of the future environmental scenarios is studied.

Long-term R&D must begin now to determine how best the UK can move from an infrastructure based on relatively few, large electricity generating plants to one with many, smaller generators that are geographically dispersed, says the report. Whatever the mix of energy sources it seems certain that more, smaller generation stations will be used in the future.

These will be sited either at the point of supply, as for wind, wave and biomass power, or at the point of demand, as for CHP stations and embedded generation.

R&D also needs to be started and co-ordinated to ensure that the UK is able to manage the change from oil-based transport fuels, although it is not yet clear what energy sources will replace these. However it is certain that changes to the supply infrastructure will be required, ultimately greater than those needed when the UK changed from town gas to natural gas in the 1970s, according to the Foresight team.

A full re-examination must also be undertaken of the nuclear power issue. If a nuclear power component is required over the long term, then the UK must maintain and develop its expertise, to keep the option of designing, building, running, and eventually decommissioning, new plant. Much of this activity will take place through international co-operation and will focus on cheaper, more efficient and easier to decommission power stations.

The issues of waste disposal and public confidence in safety must be addressed with further research, adds the Task Force, which also says that this is essential if the UK is, at a minimum, in a position to be an intelligent customer should it prove necessary to buy nuclear plant in the future.

The pump house for the Pimlico District Heating Undertaking (PDHU) is controlled by a building management system from York Controls Group. Owned and operated by the Housing Department of Westminster City Council, the PDHU supplies heating and hot water to 3,000 residential flats together with schools, shops and other commercial buildings.

The pump house was erected in the early 1950s when waste heat from the nearby Battersea Power Station provided CHP supplies to the residential estates. When the power station was mothballed in 1982, the CHP system was replaced with three 7.25 MW coal-fired boilers, which were later upgraded to three 10 MW gas-fired boilers.

The Pump House forms the hub of the system where hot water from the boilerhouse is received, metered, distributed, and controlled to the various residential premises. To improve energy efficiency and effectively control and monitor PDHU, the City Council Engineers in co-operation with York designed and installed an Integrated Systems Network (ISN) Building Management System (BMS).

All pumps installed on the main distribution network are inverter controlled, enabling the BMS to match pump speed with system demand. The system also monitors the operation of the boilers, the heat supply to the accumulator and is connected to some 30 buildings monitoring temperatures and controlling the heating and hot water supply.

Limits to renewables – may constrain the growth of

by Professor Michael Laughton, BSc, PhD, DSc (Eng), FREng, CEng, FIEE and Paul Spare, MSc, CEng, FInstE, MIMechE

To meet Kyoto commitments and to preserve a degree of diversity of electricity supply, the UK Government has a target of 10% of electrical energy to be generated by renewable sources by 2010. This target is ambitious; nevertheless grid system control will have to cope with an increasing proportion of small, embedded power stations, most of which will be connected to the distribution networks. These developments will generate significant challenges for the control of the grid system and need to be understood more widely, argue Michael Laughton and Paul Spare.

The UK Government has a target of 10% of electricity to be generated by renewable sources by 2010 - note that this is a target for energy not power. More ambitious targets have been recommended by a parliamentary committee of 20% by 2010 and 50% by 2030. In addition the Government has simultaneous ambitions of increasing the electrical contribution of combined heat and power (CHP) plant to at least 10,000 MW by 2010, more than twice the 2000 capacity of 4,300 MW.

The proportion of new forms of plant, both renewable and CHP, within the UK's overall generating capacity is estimated to rise from 8.6% in 2001 to 20% in 2010 and likely to increase further in subsequent years, according to the National Grid Company. Over the same period to 2010, some twenty Magnox nuclear reactors are scheduled for closure, followed in the decade 2010-2020 by most of the AGR stations and many large coal-fired plants. These provide most of the current base-load on the grid.

Energy sources in electricity supply

There are important differences between our current major power sources and renewables. Conventional large stations, eg coal, gas and nuclear plant, each with an output of at least 100 MW, generate the bulk of electricity in the UK. In England and Wales in mid-2001 there is 67,000 MW of such plant, 94% of which is connected directly to the high voltage transmission network and supplying 92% of approximately 375 TWh of the electricity produced in the UK.

This integrated system, which operates under co-ordinated central control, allows responsive generation capability and standby reserves to be shared across the system, whilst allowing demand at each moment to be met by the most economic generation, largely irrespective of where it is located.

Renewable sources of electricity, on the other hand, take many forms, eg the marine sources - tidal barrages, tidal streams and waves; wind both on and off-shore; biomass - combustible waste, landfill gas and energy crops; hydro - both large and small-scale; and solar - both active (PV) and passive.

With most outputs being much less than 100 MW, it is uneconomic for them to connect directly to the transmission system and so they are generally connected directly to their local distribution network. Individually, most of such small stations will not be subject to central control as exercised by the system operators, partly because the high cost of conventional telemetry means that system control and data acquisition (SCADA) has only low penetration at voltages below 132kV. At these levels, therefore, distribution networks operate largely with incomplete and uncertain information.

The Government's renewable target

Using the electricity growth rates forecast last year by the DTI in Energy Paper 68 as a guide, the Government's 10% target for renewable generation is 39-41 TWh, four times the present level. The likelihood of achieving the 10% target is a matter of speculation. Major uncertainties surround the necessary planning permissions to be obtained for various schemes because of growing environmental opposition. Last year only 60 MW of onshore wind powered capacity was installed and this year the figure is likely to be about 100 MW. However the DTI intends that offshore wind alone will supply 1.8% of total UK electricity supply by 2010, ie from approximately 3000 MW of installed offshore capacity. (Taking an average wind farm load factor to be about 28%, then one TWh would be produced from some 400-420 MW of turbine capacity).

Simple arithmetic shows that the rates of build necessary for wind turbine and small biomass fuelled plants, plus the associated electrical substation and network connection changes, impose severe practical limits on the capacity that might be in place by 2010. Perhaps 6-7% might be possible in total, but no matter, the 10% target serves as a useful spur to the development of a young industry.

Implications for security and diversity

Many publications claim that one benefit of policies geared to the development of renewable energy sources will be increased diversity and hence improved security of supply. This does not coincide with the view advanced by the NGC in its latest Seven Year Statement, viz: "It may seem at first that security of supply is potentially at its greatest value when the source of power is close to the demand it supplies. However, transmission circuits tend to be far more reliable than individual generating units. Accordingly,

how electricity grid issues distributed generation

enhanced security is delivered by providing sufficient transmission capacity between customers and the national stock of generation. The transmission system is able to exploit the diversity between individual generating sources and demand."

Power supply quality

The following three points with regard to electrical power are paramount:

- it has to be generated at the same time as it is used,
- it has to be delivered to strict standards governing voltage levels and frequency, and
- security of supply is extremely important.

Power is required at the rated frequency and voltage, free from harmonics, voltage surges and interruptions. A modern industrialised society depends heavily on high quality power supplies for computerised control processes and information technology. Even a millisecond interruption is sufficient to cause many millions of pounds of damage to continuous processes.

The estimated cost to European businesses of periods of poor power quality amounts to some 13-20 billion Euros per year. Even higher amounts are quoted for the US.

A large number of small, embedded generators make control more difficult. Small, dispersed renewable generation plant with, in some cases, randomly intermittent output cannot provide the whole capacity needed to meet the national demand for electrical energy for technical reasons. There is room for renewables in the UK power supply, but only to a limit determined by the ability of the rest of the conventional generating plant to guarantee the integrity of operation and power supply quality.

Variable and unpredictable output/quality

Voltage

Consumer loads can be sensitive to both frequency and voltage. The significance of voltage dips has been seen in Singapore, where an unprecedented five voltage dips occurred in the last few months of 1999, with large outcries from the high technology consumers. The cost to one chip manufacturer was claimed to be $1 million per event. The cost of voltage dips to US industry is estimated to be $10 billion/year.

This issue is further illustrated by the problems created for the network voltage by the pulsation or random fluctuation of power generated by large wind farms. Voltage control and quality problems arise when generators embedded within the distribution network start and stop generating. This can cause other network users to suffer voltage fluctuation, dips and steps outside of the statutory limits and inject unwanted harmonics into the voltage waveform. The problem would be exacerbated if the wind farm were to be connected to the high voltage grid, despite certain technical fixes.

Frequency

Frequency is controlled to a certain degree by generators responding automatically to changes in power output; however many new forms of generation, renewable and CCGT plant included, do not provide the necessary response to low frequency drift.

The frequency of the electricity supplied has to be controlled to within 1% of the rated 50 Hz specified. Outside of these limits, automatic load shedding occurs and in practice frequencies are maintained within much closer limits to avoid other, less serious system problems. This requirement is achieved by continuous balancing of load demand with generation on a minute-by-minute basis.

Added to this technical picture are the economic constraints imposed by privatisation. Now, the frequency depends on the price offered to ensure sufficient generation is made available to match demand, ie, market price is made by market equilibrium. The system frequency effectively represents the market equilibrium. Frequency above 50 Hz would mean surplus generation, under which condition, all costlier generation should be backed down; frequency below 50 Hz would mean a generation deficit, calling for even costlier generation to be brought in. The New Electricity Trading Arrangements (NETA) place greater responsibility on companies to balance actual production with last-minute customer demands, which may cause short-term price volatility.

Today, there are many non-utility players in the electric power industry and the potential levels of their power generation depend on factors such as the associated heat output or renewable resource availability, which are mostly uncertain. They are not in the business of maintaining good engineering practices on the generation and transmission systems. Since there is generally a profit built into each kWh sold (however small), there is no incentive for independent generators to reduce generation during periods of high frequency (and possibly to increase generation during periods of low frequency). Increasing levels of renewable and CHP plant could thus amplify frequency and also voltage instability.

System stability

System stability problems will arise when intermittent generators, especially at light load, supply a significant proportion of system demand. Informed electricity supply industry opinion asserts that when the power presented to the grid by randomly intermittent sources rises above 15-20% of total system demand, then grid stability becomes an increasing risk.

It is not widely appreciated that this

operational constraint relates to *power* and not to *energy*. The annual load factors of wind turbines are between 25% and 30%. There would be times, however, when most turbines would be operating at full load and delivering 100% of power. It is this maximum power output, not the energy output, which causes stability problems. Furthermore, the system endures a daily load demand cycle as shown in Figure1, so it follows that the system can only accommodate lower levels of wind turbine-generator output power at night or in the summer. With a 20% limit, the embedded wind generation would have to stay between 10 GW maximum (at a peak winter load 50 GW) to about 3.8 GW (at the minimum summer load of 19 GW).

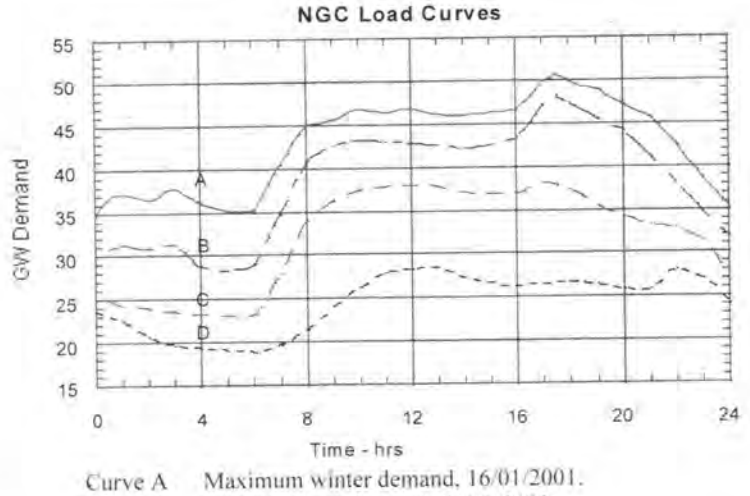
In Denmark in 2000, wind power production comprised 13-14% of the total electricity consumption and was growing. The energy sector and individuals have complained about the problem of stability in the electrical network for quite some time, and the Danish energy minister has admitted that there is a problem and that it should be solved through discussion and openness.

Uncertainties in plant scheduling

Many factors set operating limits on the flexibility of power system operation and there must be operating reserves of various kinds to ensure that the system can meet all likely immediate dynamic and longer term steady-state conditions. Normally within a time-scale of:

- 10 seconds to 2-3 minutes, the reserve requirement is met from the inherent inertia of rotating plant and conventional thermal plant boiler steam pressure;
- from 2-3 minutes to 10-15 minutes from ramping the power output of 'hot stand-by' spinning reserve, ie plant connected to the network busbars but only partly loaded, plus hydro storage and gas turbines and beyond that over; and
- 8-10 hours by plant start-up from various standby levels.

In all of these situations, operator decisions are an integral part of the control process and negotiation of such reserve requirements is an ongoing dynamic process.



Curve A Maximum winter demand, 16/01/2001.
Curve B Typical winter demand, 04/12/2000.
Curve C Typical summer demand, 04/07/2000.
Curve D Minimum summer demand, 30/07/2000.

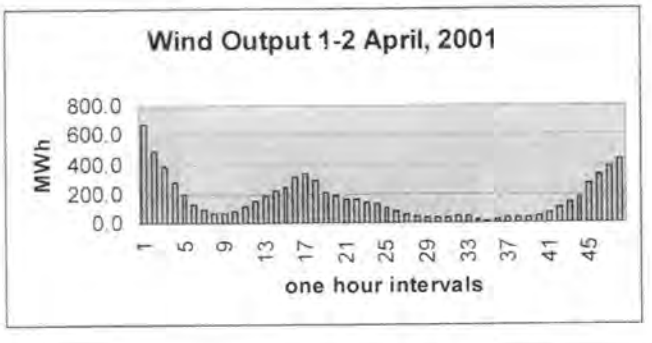
Figure 1: Daily load demand on the England and Wales power supply system

The problems caused by large amounts of randomly intermittent generation are well illustrated by the situation faced by the transmission company Eltra in West Denmark. The Eltra Magazine had a front-page story on the subject, which read: "We have between 0 and 2000 MWe of wind power tomorrow". The wind power is 0 MW if the wind is below force 3, around 800 MW if the wind force is 4/5, or 2000 MW if the wind force is 5/6.

Figure 2 illustrates the aggregated output from the wind farms in the region feeding the Eltra system selected arbitrarily from four days in April 2001. There are large errors in almost a third of wind forecasts from the Danish Meteorological Institute. It is thus impossible to plan production, and therefore, both an over-production of power or, in certain wind-deficient cases, a shortage of power can occur. In the latter case, Eltra is forced to buy power at maximum prices on the open market.

Eltra's problems arise because in the Danish system, it is impossible to control the production of 'environmentally friendly' electricity. Eltra is forced to accept all the power not only from wind turbines but also from decentralised heating and power plants, irrespective of the need for electricity.

Denmark has a small electricity system with an annual demand less than 10% that



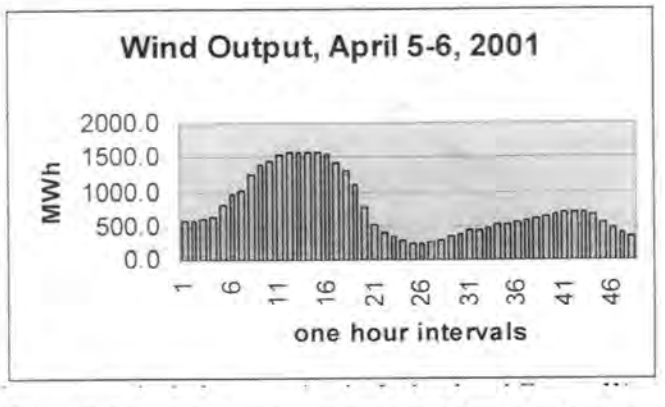


Figure 2: Aggregated wind generation in Jutland and Furen, western Denmark

of the UK. Having to balance supply and demand when there is a very substantial wind power capacity (1600 MWe in west Denmark alone) requires that conventional thermal power stations continually follow customer demand, less wind input - a task for which they were never designed. Norway, Sweden and Germany provide the added flexibility needed in operation, through inter-connectors, allowing power imports, or surplus power to be exported.

This situation results in the highly efficient thermal power stations running below their optimal efficiency and requiring a certain amount of the thermal capacity to be kept in 'spinning reserve' where they consume energy but deliver no useful power. Further plant must be 'kept hot' ready to start up on short notice; again a highly inefficient process. The cost of operating stand-by plant is never attached to the costs quoted for plant with intermittent generation, but might explain why the Danes have the highest domestic electricity costs in Europe at 12.21 p/kWh (cf UK cost of 7.97 p/kWh).

In the case of the UK, the level of generation contributed by randomly intermittent sources has been relatively small and has caused little difficulty. It is sufficient to note, that at some level of supply the Danish problems would appear in the UK and the cost of operating stand-by plant would become prohibitive. Such plant would be needed to power essential services about four or five times in the winter when the country is covered by a large, cold high-pressure system with little or no wind.

This practical conclusion runs counter to that of a three-year study by the Forum for the Future, an environmental charity, where researchers investigated the possibility of sourcing 30% of electricity from renewable sources by 2020 and of increasing CHP schemes. If half of the contribution came from wind, about 24 GW of turbine capacity would be needed, plus a correspondingly large capacity of conventional plant for stand by purposes. Clearly such enthusiastic claims have ignored the practical and economic limits.

Network considerations

The UK power system is characterised by a 400 kV grid transmission system that delivers the large flows of power through bulk supply points to the low voltage distributors. The arrival of renewable and other embedded generation may not alter the need for bulk transfers of power along the transmission network and could even lead to their increase.

The various forms of embedded generation are connected to distribution networks that are designed and operated in radial configurations and are not designed to accommodate active sources of energy. This historic practice is based on the aim of minimising infrastructure costs. Embedded generation adds to local fault levels and hence, sooner or later leads to the need for larger switchgear as well as the restructuring of the protective systems.

In addition, and as a consequence of this design practice, the distribution networks are often tapered in power flow capacity from the bulk supply point down to the customer in much the same way as a road or water network. Much renewable generation, eg wind, is sited nearer to the ends of the network and away from the bulk supply points. It is often difficult to find suitable connection points on the joint grounds of limited power flow and switchgear capacity.

There are frequent claims that the wind and wave resources in north west Scotland are very large. However, transmission capabilities southwards to the Scottish markets for electrical energy are inadequate or non-existent and those from Scotland to the larger English markets are already being used to capacity. The Scotland/England interconnector has a capacity of only 1,600 MW, although this is being enhanced to 2,200 MW. To remove these limitations will require major investment in reinforcing and expanding the transmission grid. Gaining rights of way to build such new circuits will face determined and prolonged opposition from environmental groups. Tapping this resource therefore faces many severe challenges.

Conclusions

The present high quality power supply in the UK is the result of immense capital and intellectual investment over many years. The importance of maintaining high-quality power supplies is perhaps not appreciated by those who debate the future of the electricity supply industry in political, economic and environmental circles, yet without high-quality power supply, the operation of a modern industrialised society is not possible.

Several issues need to be addressed with regard to the future mix of generating capacity if a significant proportion of renewable generating plant is to be included.

- System security and power supply quality will be much more difficult with a high proportion of renewables. New structures for information gathering, decision support for generators and control actions on distribution networks will be required.
- Without further major investment in low voltage networks the offshore wind and wave resources in England and Wales will be limited.
- Without further major investment in high voltage 400 kV transmission links between Scotland and England, the large wind and wave resources in north west Scotland will never be exploited.
- Finally, in view of these technical constraints and others imposed on the extent of renewable energy exploitation by the electricity supply system, the question has to be asked as to whether direct connection to the electricity system is the most appropriate way forward in the longer term, or whether there are other outlets for the electricity generated, perhaps in the form of energy storage schemes or in alternative chemical fuel manufacture.

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The making of the Baltic Ring

The 230 km, 600 MW cable between Sweden and Poland recently completed by global electricity company ABB brought the dream of linking the power grids of all the states bordering the Baltic Sea into a gargantuan 'Baltic Ring' one step closer to reality. This overview, an edited version of an article which first appeared in the ABB Review, looks at the origins of this undertaking and at how ABB are providing much of the know-how and hardware.

The Baltic Ring will unite all private and public power resources of the states around the Baltic Sea. Financing by the World Bank, Scandinavia and other interested parties will accelerate the construction of this common and open power resource. A specially instituted body, BALTREL, will oversee the entire apparatus and a control centre will direct energy distribution and trade. Agreed tariffs and environmental policies will maximise the benefit for the consumer and for the environment, not least because the newest, most efficient and loss-free equipment and computer-based management and trade systems are being used.

The first proposals, for a Danish-Swedish link, date back more than a century. But ambition had to wait for technology to catch up, in 1915, when a submarine cable was laid between the Danish island of Zealand and Scania, in the south-western tip of Sweden. Patiently, over years, further links in this power ring have been inserted, the latest in 1999 when a 600 MW link between Sweden and Poland was installed. A 200 MW link from Estonia to the Nordic net is now planned.

But work on the Ring did not start from scratch; valuable experience was gained by the creation of the 'Nord Pool', a supranational smaller-scale version of the Baltic Ring built by the Scandinavian countries.

ABB has provided much of the knowledge and advanced equipment required for the Baltic Ring.

Why a Baltic Ring?

Even a brief examination of power resources in the Baltic countries reveals a country-wise energy monoculture (with the exception of Finland). Norway is dependent on hydropower (99%); Denmark gets its power from coal; nuclear power delivers 50% of power in Sweden (the rest is mostly hydropower); Estonia uses mainly shale oil; Latvia has hydropower; and Lithuania relies on the 2x1500 MW Ignalina Chernobyl-type nuclear station, scheduled to close, by arrangement with the EU.

Opposition to new nuclear and hydro-plants and other environmental concerns will bring other sources, such as wind, wave and gas, to the fore in the effort to satisfy society's increasing hunger for energy.

Obviously, a pooling of these diverse resources is to the advantage of all. Energy gaps which arise when less environmentally friendly sources are phased out can be covered by newer, cleaner sources; in times when one resource is expensive, more power can be generated and shared from the cheaper resources; peak demands in different regions at different times can be covered by shifting power through the Ring.

East meets west...

There is, however, another dimension to the Baltic Ring. After many decades of reliance on power from Soviet Russia, the Baltic states (Estonia, Lithuania and Latvia) are looking to the West for power expansion possibilities. At the moment, however, the lines stop at Kaliningrad, with no connection to the Polish grid and points further west.

The link between the two systems, revitalising the ancient trade links, but this time with a commodity the ancients would not recognise, forms a power gateway to the East. It would seem a simple matter to build, but it's not quite that easy.

... or rather doesn't

When the Iron Curtain divided Europe, east-west energy exchange fell to practically nil. Both blocs operated their grids at 50 Hz, but not in synchronism, so no power lines could link the two systems. Iron, though usually a good conductor, was in this case an almost perfect electrical insulator!

In the decades of isolation, the operating standards in the two systems drifted apart, especially those regulating frequency. Synchronising the frequency throughout a grid is absolutely critical; the smallest uncorrected deviations can quickly lead to equipment shutdown. In the west, some of the most advanced technology available is utilised in meeting this challenge.

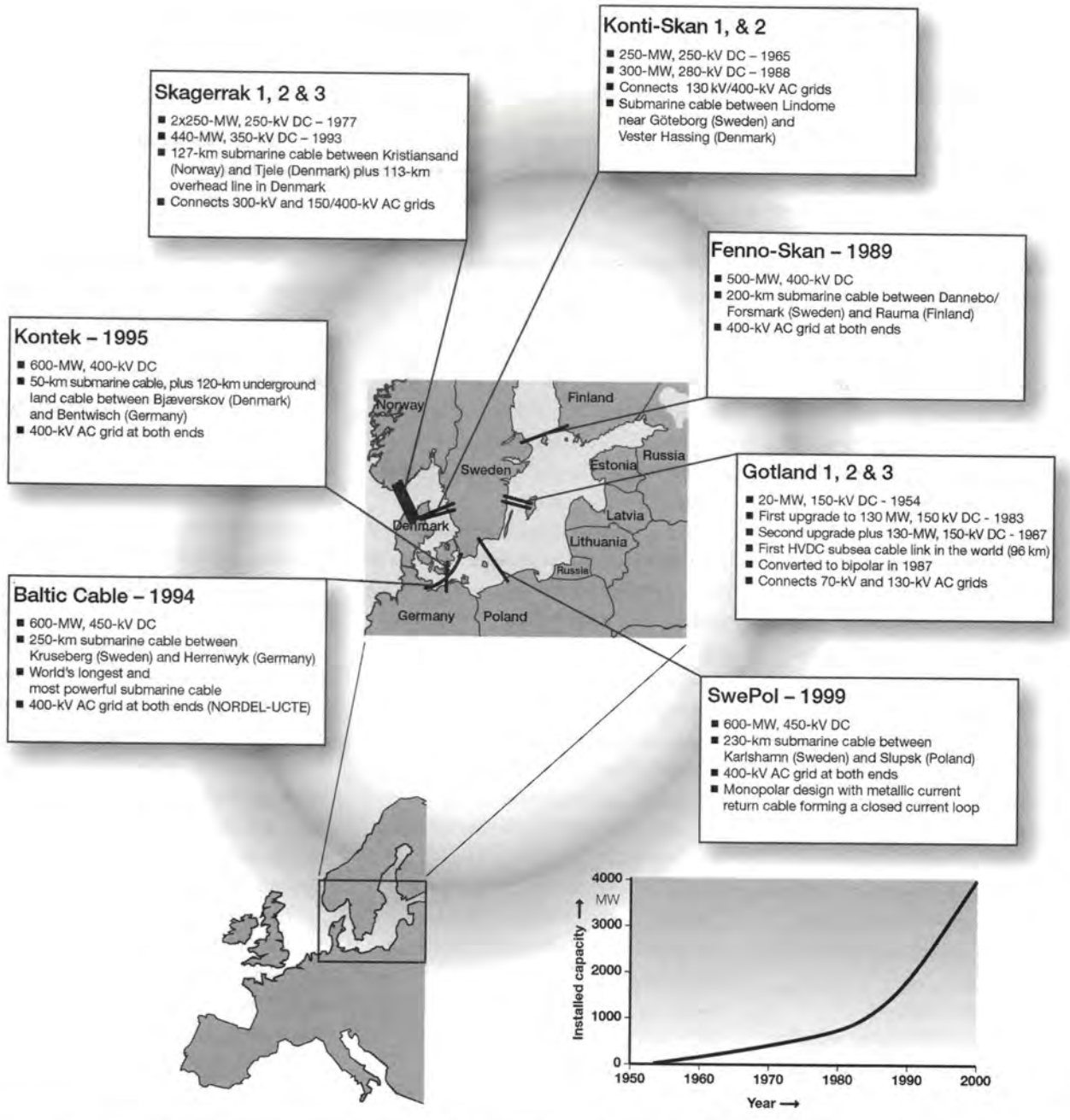
Other aspects of a power grid, such as transients and control of power flow from region to region, provide other areas of divergence that must be overcome. Thus, the intention of the three Baltic states to disengage from the CIS grid and take up with the West involves substantial investment in equipment.

Modernising Baltic state substations

In order to improve the capacity and the reliability of the power networks in the Baltic states, the power authorities of the three countries are busy reinforcing and modernising their transmission and distribution networks. These investments are partly financed by proprietary funds and partly by foreign credit, mainly from the World Bank and its European counterpart, the EBRD, as well as by the EU-TEN (Trans European Network) program. Through these investments, the three countries are improving their infrastructure and building up know-how in the field of power management.

ABB is making a significant contribution to these efforts by supplying, installing and commissioning both primary high-voltage equipment and substation automation equipment. Vertical integration of control, protection and monitoring functions can significantly reduce investment requirements.

The capability of these substation automation systems to contribute to better performance of the entire network



will become even more important when the power networks around the Baltic Sea become fully connected to the Baltic Ring. ABB is already a major contributor to the Baltic Ring and technology and know-how the company has to offer can help bring the Baltic Ring to a triumphant conclusion.

Contact ABB's publisher's office for more details of the ABB Review, tel: +41 1 319 22 75, e-mail: abbreview.abbzh@ch.abb.com

The missing link in the Ring

The planned Estonia-Finland link will bring Estonia into the Nordic grid. This 200 MW of transmission capacity significantly strengthens the eastern part of the Baltic Ring. Likewise, the 'Viking Cable' a system of extremely long cables planned as links from south Norway to north-west Germany and the Netherlands, will upgrade the western section. The missing link in the Ring is, as described here, the gap between the non-compatible electrical systems of the old East and West blocs. But the Ring involves more than just connecting grids together; to be fully functional it must be capable of transferring huge amounts of energy in a stable and synchronised manner, and so needs advanced control and protection equipment and sophisticated energy management systems.

An attractive alternative means of coupling non-synchronised grids together is provided by HVDC technology – the current links in the Ring are all ABB HVDC. The changeover to multi-terminal DC (MTDC) transmission elegantly sidesteps many of the problems raised by different frequencies and standards, short-circuit current transmission and overload handling.

Nuclear renaissance in USA and UK?

by Terry Shane, Energy Research Manager, Frost & Sullivan

It's the biggest question in global energy right now – will a new generation of (low carbon emitting) nuclear power stations emerge to 'fill the capacity gap' caused by retiring coal and first generation nuclear power stations in the west. Frost & Sullivan's Terry Shane says the answer is likely to be yes – and points to recent moves by the nuclear industry as evidence.

Nuclear power is increasingly being touted as a technology with a future in markets that only a short while ago remained hostile. In particular, the US National Energy Plan proposes up to 3,000 MW of nuclear facility installations per year over the coming years to plug its medium and longer term capacity problems. It appears the UK could follow suit.

BNFL, owner of Westinghouse Electric's nuclear business since March 1999 and ABB Atom since April 2000 will be the likely recipient of any plant development in both countries. It was just 18 months ago the company received its license to operate for its new AP600 design units. According to BNFL, these units represent the safest, most economical option with lead times of just a few years between order and completion.

Indeed, BNFL is to put forward plans to the Government to build at least four, preferably six, new AP600 nuclear stations on the same sites as its existing ageing Magnox power plants that are closing after 40 years of service.

According to its developer, Westinghouse, the AP600 design simplifies plant systems and significant operation, inspections, maintenance, and quality assurance requirements by greatly reducing valves, pumps, piping, HVAC ducting, and other complex components. Safety systems are predominantly passive, depending on the reliable natural forces of gravity, circulation, convection, evaporation, and condensation, instead of AC power supplies and motor-driven components.

The effectiveness of the technology has also been demonstrated through years of operations and testing. The passive safety systems are an extension of the technology used previously, since Westinghouse supplied PWRs have had accumulators for injection of core cooling water without the use of pumps for many years. 'The AP600 is the result of a logical progression in plant design'.

There is certainly demand for new power capacity in the USA and in the UK, the main driving force is that of ensuring security of supply in the face of increasing reliance on natural gas (domestic supplies are in decline). Of course the other main argument in favour of deploying new nuclear facilities concern its zero carbon dioxide emission status.

On a global level, the capacity gap continues to widen as capacity additions fail to meet the combined impact of increasing global power demand (estimated at 2.5% per annum by the IEA) and decaying installed capacity. Based on our analysis, this is falling by 1.5% per year giving rise to a total capacity addition requirement of about 4%. This equates to a global annual demand for capacity additions that are in the region of 141 GW per year between now and 2010.

Filling the capacity gap

The proportion of this global capacity gap that is filled by each of the primary technologies is a matter of hot debate. At the moment of course, it is gas fired combined cycle plants that are taking the lion's share. But there is strong competition from coal fired plants too, with programmes that sponsor the development of cleaner coal technologies helping its cause. The debate surrounding distributed generation technologies such as microturbines and fuel cells remains furious, although no-one really knows how much these technologies will end up contributing.

Adding to the uncertainty are developments in renewable technologies such as wind turbines, biomass and photovoltaics. One of the most important features in this market are price subsidies which seem to fluctuate from year to year at the whim of the extant political climate.

The extent to which nuclear power will play in adding to the global capacity gap is as unknown today as it was yesterday. However, one thing is for sure, there is a recognisable and distinguishable feeling amongst the power equipment supply community that nuclear power will make some form of resurgence.

Consolidation

One can see this also in the competitive market where consolidation has been rife. In March 1999 BNFL completed its acquisition of Westinghouse Electric Company's commercial nuclear power business. In December 1999, BNFL and ABB announced that BNFL would purchase ABB Atom's commercial nuclear power business, completion of which took place in April 2000. Also during December 1999, Framatome and Siemens announced plans to merge their nuclear businesses in the form of a joint venture, and in July 2000, the parties executed the final agreement resulting in the creation of Framatome ANP.

Finally, GE, Hitachi, and Toshiba agreed to jointly establish Global Nuclear Fuel, an international nuclear fuel joint venture. Spanish company INITEC based in Madrid was a government owned organisation until its four divisions were sold off last year. A consortium of Westinghouse Nuclear Services, Técnicas Reunidas and Dragados Industrial acquired the Nuclear Division, which employed around 150 people, earlier this year to add to BNFL's global business portfolio.

Such consolidation was apparent in the gas turbine OEM segment just a few years ago. This clever piece of corporate manoeuvring meant that for the first time in a decade, this business became profitable as it coincided with a boom in demand whilst clamping down on supply to ensure strong prices and delivery conditions.

Perhaps this is the driving force behind the latest round of consolidation in the nuclear industry. If so, we should be preparing for the renaissance of nuclear power.

Cutting energy costs for East Cambridgeshire

by Nick Towers, Centre for Sustainable Energy

While local authorities are relatively large energy users, East Cambridgeshire District Council (ECDC) understands the implications of unnecessary energy and water consumption and has included actions for their reduction within its Local Agenda 21 strategy. The Council's buildings are located in the historic city of Ely.

Aware that it does not have the capacity to undertake an energy review internally, ECDC consequently, contracted the Bristol-based Centre for Sustainable Energy (CSE) to provide a thorough review of fuel and water consumption and produce a five year action plan to direct the Council towards cost-effective savings.

Here, the CSE's Nick Towers runs through some of the options recommended to the Council.

The twin aims of the review were to identify current fuel and water use and suggest methods of reducing that consumption. CSE has investigated several possibilities for reducing both consumption and carbon dioxide emissions, specifically:

- staff training with regard to fuel and water consumption,
- changes to existing building fabric and services,
- installation of embedded generation technology including water recovery, and
- purchasing electricity from accredited renewable generation plant.

The delivery of staff awareness training is an established technique and needs little further explanation. Similarly, the virtue of good housekeeping measures and the need for quality data collection have been described elsewhere.

The total energy consumption from buildings for the most recent year is almost four million kWh. Carbon dioxide emissions associated with this and vehicle fuel consumption is 1,250 tonnes per annum.

Building fabric and services

Recommended changes to the building fabric were limited to areas where overheating has been reported. Overheating appears to be mainly due to solar gain during the summer months, although increased dependence on electronic equipment also adds to this burden. In order to address this problem, without resorting to mechanical ventilation, the use of solar films and solar shading was recommended as a starting point. In the longer term, however, it may be necessary to increase ventilation rates and CSE recommended passive techniques.

Elsewhere, the opening hours of the public conveniences lend themselves to the installation of sun pipes to provide natural daylighting and reduce dependency on artificial lighting.

Many of the services, including boiler plant, are relatively new. Consequently, although improvements can be made it is not possible to justify them within the short term of the action plan. CSE was disappointed that the recently refitted leisure pool does not feature a combined heat and power (CHP) plant. There did, however, appear to be the opportunity for installing small scale CHP plant in two buildings when replacement of boiler plant is required.

Locally, presence detection and daylighting needed to be linked to artificial lighting. Heating needs to be more carefully controlled and water use should be regulated through spray taps and water dams where possible.

Embedded generation and water recovery

The climate of East Cambridgeshire is remarkably consistent throughout the year, with the variance within average monthly rainfall totals very low. Annual sunshine hours are relatively high and wind speeds fall within a relatively narrow band. This allows for optimal sizing of new technology easier, and reduces the payback periods.

Although recommendations for the embedded generation of electrical power were not confined only to the main office building, it is here where its use is most likely to be witnessed by the general public. Consequently, CSE recommended installing a small wind turbine and a solar thermal water system. While the potential for installing a photovoltaic array exists, it was difficult on economic terms to justify its installation without some form of external financial and technical support.

Recommendations for installing solar thermal water systems at the public conveniences were also made, owing to the requirements for large quantities of hot water during the warmer summer months. Rainwater harvesting systems were also considered.

The large roof area of the leisure centre lends itself to solar heat collection and rainwater harvesting. These could both contribute to meeting the annual hot water load.

Purchasing renewable electricity

Purchasing green electricity does not necessarily lead to a reduction in energy consumption or spend. It can, however, be used to support a Local Agenda 21 commitment to reducing carbon dioxide emissions and support the development of renewable energy nationally.

Initial discussions between CSE and the electricity suppliers indicated that the premium for green electricity is not likely to be any higher than the additional costs attributable to the Climate Change Levy (CCL). CSE therefore recommended that ECDC consider procuring green electricity for those sites where a negotiated contract is not currently in place and the CCL is payable.

Conclusion

The review indicated that carbon dioxide emissions for all buildings could be reduced by over 40% a year by the end of the fifth year. However, the calculated capital expenditure for the series of works suggested is likely to require 12 years, based on current equipment and utility costs, to break even.

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The birth of the fuel cell

by Don Prohaska

Everyone knows that Thomas Alva Edison invented the light bulb, Alexander Graham Bell the telephone and that the Otto and Diesel engines were invented by two Germans bearing those names.

But who invented the fuel cell? Fuel cells generate electricity with virtually zero pollution by combining gaseous fuels and air. There are different types generally described as high temperature or low temperature fuel cells.

Here, Don Prohaska delves into a recently published book: The Birth of the Fuel Cell, by a descendant of one of the fathers of the fuel cell, and sheds new light on the early days of this technology.

As it turns out, the fuel cell effect was discovered in 1838 by the Swiss professor Christian Friedrich Schoenbein (1799-1868) from the University of Basel. After some initial experiments in 1839 Sir William Robert Grove (1811-1896), a London lawyer with a strong engineering bent, in 1845 finally demonstrated an apparatus for the replacement of batteries. He suggested its use as a continuous power source for "experiments of slow crystallisation (galvanic deposition of materials) and possibly the telegraph", ie the internet of those days. By all standards, Schoenbein discovered the effect, while Grove must be credited for the invention of what he called the 'gas battery', now better known as the fuel cell.

Since fuel cells are not yet a mass-market commodity, Schoenbein and Grove have not yet become household names. But just wait five years or so when these phenomenal devices start showing up in everything from vacuum cleaners to mobile phones, automobiles and homes (for grid-independent power generation). By then the recently published *The Birth of the Fuel Cell* will undoubtedly have been adapted by Hollywood into a fascinating motion picture starring Johnny Depp as Bill Grove and Tom Cruise as the irascible C F Schoenbein (who most likely inspired Alfred Nobel to invent dynamite - but more on that later).

New evidence from archives

Schoenbein's great, great grandson, Dr Ulf Bossel, is the author of *The Birth of the Fuel Cell*. The text not only portrays the exciting evolution of science between 1835 and 1845, but is also presents the yet unpublished almost thirty years of correspondence (about 26 sets of letters) between Schoenbein and Grove. Both scientists were the hailed speakers at the 1839 meeting of the British Association for the Advancement of Science at Birmingham. They became good friends and exchanged science as well as familial visits.

Bossel today organises one of Europe's most prestigious annual fuel cell conferences in Lucerne, Switzerland (www.efcf.com), and he holds more than twenty fuel cell patents.

"At the time Schoenbein made his discovery, the science of electricity itself was in its infancy. The concept of discrete molecules, atoms, electrons, ions or electric charges had not yet been proposed," explains Bossel, adding: "Also there was no general understanding of electricity. Voltage, current and power had not yet been sorted out conceptionally. Electricity's strength was measured by the length of an arc, the amount of gas liberated by electrolysis or by the number of persons feeling the sensation of an electric shock when holding hands."

Schoenbein's description of the fuel cell effect first appeared in the English language in the January 1839 edition of *The London, Edinburgh, and Dublin Philosophical Magazine*, in short, *Philosophical Magazine*. And, shortly thereafter, Schoenbein also set a precedent for fuel cell research funding when he received in 1839 a grant of 40 pounds sterling from the British Association for the Advancement of Science "for defraying the expenses of certain experiments on the connection between chemical and electrical phenomena: the results to be reported to the Association at their next meeting". Today, US, European and Asian companies receive government funding for fuel cell research measured in the hundreds of millions.

Paradoxically, Schoenbein also discovered ozone during his early fuel cell experiments. Whenever the generated electricity was dissipated by electric arcs, a strange "electric smell" became noticeable. With his new powerful source of electricity, Schoenbein was able to generate enough ozone to identify the substance and announce its discovery in October of 1839. The new power source was the "alpha unit" of Grove's latest invention, a platinum zinc battery, which Schoenbein had purchased from his friend during his visit to England.

It is an irony of history that the fuel cell effect and ozone were both discovered within one year by Christian Friedrich Schoenbein in his humble laboratory, a laundry room in the basement of a medieval building in Basel, Switzerland. Today, fuel cells are needed to reduce air pollution that leads to the formation of toxic ozone in the lower atmosphere, or that causes the destruction of the earth's delicate ozone shield in the higher regions.

Whereas fuel cells are finally taking off, Schoenbein's invention of gun cotton (nitro cellulose) was basically a dud. Although the smokeless and odourless explosive is still used today, the replacement of conventional gunpowder by gun cotton became a difficult task. Schoenbein applied for patent protection in England. His patent attorney was, believe it or not, Sir William Grove. He also licensed his gun cotton technology to an English entrepreneur whose operations ended with a factory explosion that took the lives of two dozen or so employees. After the mishap in 1847 Schoenbein discontinued all work on gun cotton and never mentioned the word again in any of his publications. But the headline generating activities came to the attention of Alfred Nobel who supposedly used Schoenbein's work on gun cotton and other forms of nitro cellulose for his own developments of nitroglycerin and, subsequently, of dynamite.

GROVE THE INVENTOR

While Schoenbein was content in his role as discoverer of effects, as well as professor of chemistry and physics in Basel, William Grove was much more the practical tinkerer. Grove must have read Schoenbein's original publication in January 1839, because he added a one-page postscript to an unrelated paper that appeared in February of 1839. Grove claims to have seen similar effects in his laboratory, but no further details were provided for the following three years. In the meantime, Schoenbein had published the results of his detailed studies on the fuel cell effect. Finally, in 1842 Grove returned to the subject and developed a practical fuel cell power source, which he called a "gas battery", from concept to reality (1845), although never to a commercial success.

According to Bossel, "after six years of work on the subject, Grove finally realised the practical potential of his gas battery to become a continuous source of electric power and to replace batteries of conventional design," he says. Grove himself states that his invention "appears to me to offer some advantages over any form of battery hitherto constructed, and which, independently of any practical result, is, from circumstances peculiar to the gas battery, not without interest".

In fact, Grove was hell-bent on finding practical applications for his batteries and fuel cells. On August 20, 1842 he wrote to Schoenbein: "A friend of mine in the neighbourhood has with me been getting up a boat which goes at about three miles an hour by electro magnetism with only eight pairs of six inch plates of my battery and carries several hundred weights". This was, perhaps, the first electric boat. Although battery-powered, theoretically, Grove could have powered the vessel with a fuel cell. Nevertheless, this seems to be the first known report on a battery-powered electric boat.

No doubt Grove's wife was less than enthusiastic at spotting an electric boat in the carriage house, much as Schoenbein's wife probably frowned on his experiments with gun cotton. And, the fuel cell of the 1840s was simply too expensive because of its reliance on expensive platinum as a key component (a barrier to success even today for some types of fuel cells). At the turn of the century, along came the low-cost (relatively speaking) internal combustion engine, and the fate of fuel cells was sealed for another century.

Only now are fuel cells starting to catch up to internal combustion engines in cost per kilowatt although they are about twice as efficient in converting hydrocarbon fuels to electricity, which greatly adds to their economic viability, in addition to being considered environmentally friendly.

The paperback version of The Birth of the Fuel Cell (about $25 plus postage) and the proceedings of recent fuel cell conferences can be ordered from the European Fuel Cell Forum in Switzerland, fax +41 56 496 4412, e-mail: www.efcf.com

Fuel cell vehicles on parade in London

Several fuel cell powered vehicles were present at the latest annual Grove Fuel Cell Symposium held at the QEII Centre, London in September.

A GM Chevrolet S10 pick-up powered by a gasoline-fed fuel cell was joined by fuel cell vehicles developed by ZeTek, Ballard and ENEA.

General Motors claims that its latest fuel cell stack sets a new world standard for power density, packing 60% more power than any competitor. The GM stack generates 1.75 kW per litre in volumetric efficiency - the measurement of the stack's power output in kilowatts against its volume. The highest power density announced by any other fuel cell manufacturer is 1.1 kW per litre by Ballard Power Systems, says GM.

"Reducing the size and weight of the fuel cell stack while maintaining or improving its power output is important for packaging, design and affordability," said Matthew Fronk, Chief Engineer of fuel cell systems for GM's Global Alternative Propulsion Center. Smaller stacks create more space for other components and allow their use in smaller vehicles and stationary units. They require less material, providing an opportunity for further cost savings. Stack volume can be tailored to the power needs of the vehicle in which it is installed.

The new stack has 640 cells with a continuous power output of 102 kW and a peak power output of 129 kW.

Ballard's fuel cell powered go-kart was taken for a spin in Parliament Square, Westminster by London's Deputy Mayor, Nicky Gavron, who also spoke at the event about the importance of the city as a centre for research into and manufacture of fuel cells. London will take delivery of three fuel cell powered buses next year as part of the European 'EvoBus' trials.

London's Deputy Mayor Nicky Gavron takes the wheel of a fuel cell powered go-kart from Ballard

Glowstar lantern wins Environment Award

The Glowstar solar rechargeable lantern, which could transform the lives of millions of people, is the overall winner of the Engineering Council's prestigious *Environment Award for Engineers 2001*.

Featured on the front cover, the Glowstar Solar Lantern has been developed by Intermediate Technology Consultants of Rugby for use in countries where access to power and other forms of commercial energy mean that light after dark continues to be a luxury. Most rural families in large parts of Africa and Asia still rely on candles and kerosene to provide basic lighting.

Once charged, the lantern is capable of producing at least four hours of light. It has been designed to have a minimum life of six years with affordable and accessible spares. The key component is its battery (cyclic valve regulated lead acid) that can withstand the wear and tear of daily use, has zero maintenance, low cost and a low environmental impact.

In Kenya, for example, some 96% of householders use kerosene for lighting, while 70% also spend significant amounts of hard earned cash on dry-cell batteries for torches and radios (cost typically £3-5 per month). Each lantern is expected to cost around £50 or less and to date orders have already been placed in 25 countries.

Meanwhile, the *British Energy Trophy for Sustainable Engineering* went to Manchester's PB Power Limited for the efficiency improvements it has developed for thermal desalination plants.

PB Power's system incorporates a drains cooler for installation at any thermal desalination plant to make the production of fresh water more energy efficient. This modification cools the hot brine concentrate with a small-recirculated stream of product water from the lower temperature, lower pressure stage of the process. This does not involve any significant design changes and the cost of installation can be recouped in less than 12 months.

Runners-up in the same category were the Arable Biomass Renewable Energy (ARBRE) plant which turns locally-grown wood into energy in Yorkshire, and the 'Rooftop Power Stations' concept from photovoltaics company Solar Century (see below).

The winner of the *Engineering Council Trophy for Engineering Alternatives* was Ove Arup & Partners, of Harare, Zimbabwe, for its work at Harare International School to develop a unique passive cooling and heating system.

The system works by taking fresh air and drawing it through filters via low-energy fans into underground rock compartments. These act as storage batteries that are charged with 'coolth' energy every night. During the following day, warm air is blown through the rock compartments with changeover to a fresh bank occurring in the afternoon as the morning store begins to warm up. The system is 30% cheaper than traditional cooling systems.

Contact ITC on tel: 01926 634400, website: www.itcltd.com

Rooftop power stations

Through an innovative partnership between Laing Homes and Solar Century, nine terraced homes in north London have been fitted with photovoltaic 'Sunslates' as part of the DTI Domestic PV field trial.

The Sunslate is a fully building integrated product, which consists of a small photovoltaic module bonded to a standard fibre-cement slate. It is easy to adapt to different roof shapes, can be installed by normal contractors and is silent, automatic and basically maintenance-free in operation. The power produced is 100% emission free and studies show that the energy used in the production of the slate will be paid back up to five times over in the lifetime of the system. These roofs will provide between a quarter and two-thirds of the households' annual electricity and each roof will displace between 30 and 40 tonnes of carbon dioxide emissions before the slates need replacing.

Solar powered homes in London

The systems on the Laing development are all grid-connected. A small inverter installed in the attic feeds grid-quality power straight into the household circuits. Any excess power produced by the system is fed back to the electricity network and at night and times of especially high demand the standard network supply is used. Crucially, a 'net metering' agreement has been set up between the householders and Eastern Energy, which means that the householder gets paid the same amount for the electricity that they export, as they pay for the electricity that they import.

Contact Solar Century on tel: 0870 735 8100, website: www.solarcentury.co.uk

Professional development update

by Rob Wall, Education Services Officer, Institute of Energy

One of the primary functions of any professional body is to support its members in their professional development (PD). This is often an ad hoc process, with each member doing their own thing and perhaps only occasionally contacting the InstE about it. Similarly, the InstE only occasionally contacts members about PD, unless it receives a specific enquiry. There have recently been some significant changes in PD policy and practice, however, so this piece is intended to bring you up to date – and hopefully to motivate you!

Professional develoment is the enhancement of personal qualities and skills to maintain employability. It can help to define goals and ambitions, track progress and achieve recognition. Continuing professional development (CPD) has traditionally been separated from initial professional development (IPD), but it is now recognised that they involve the same activities and processes, just at different career stages.

The InstE defines PD as "the systematic maintenance, improvement and broadening of technical and commercial knowledge and competencies to carry out a member's professional job, together with the development and broadening of personal and professional competencies". This might sound onerous, but it needn't be. For those who are doing their jobs well, it could be that the only extra activity required is record keeping. You should find that you are already undertaking PD activities. In this case, the important factor is to approach them so as to gain maximum benefit.

Recording and structuring PD

The current trend across professional bodies is to cease counting hours of PD. Instead, members should consider the outcomes of activities, rather than simply time spent on them. The InstE believes that much more is gained when members take their goals and aspirations into account.

PD is not mandatory for InstE members, but it is recommended that they should keep records of relevant activity. The Institute produces a *CPD Planner* (available for £12.50), which can help with this process. Energy managers can also use the *CPD Manual in Managing Energy*. Based upon the *National Standards for Managing Energy*, it helps to assess performance against this benchmark. To bring its service right up to date – and to make the best use of the new web site – an on-line facility is also being developed which will eventually replace the paper *Planner*. Members will be able to record and rate activities and seek guidance from InstE staff, as well as retrieving their information from a secure electronic store.

The InstE recommends that members follow the continuous cycle shown here to plan and structure PD. Each review will lead to the identification of new goals.

What constitutes PD?

The idea that you must attend a formal course or receive certification for an activity to count as PD is false. That's not to say that courses are not one form of PD, but there are many others. *You* decide what can aid your development, but you might like to consider:

- conferences, meetings, or seminars,
- writing or presenting papers,
- participation in your local community,
- participation in the life of your professional body,
- private study or distance learning, and
- workplace learning, either formally or informally.

The Qualifications and Curriculum Authority identifies five goals for PD:

- improving and maintaining quality of practice,
- career development,
- expanding one's domain of competence,
- facilitating changes in practice, and
- quality assurance for users and the public.

It's worth bearing these in mind when planning PD. It helps to decide on your priorities before deciding on particular actions. Do you need to facilitate change in your workplace? Or are you more concerned with preparing for your next career move? Clarifying these issues will help you to put specifics into your development cycle.

Personal development plans

Given that there is a general move away from simply clocking up a certain number of hours of PD each year, what alternatives are there? One is the use of a personal development plan (PDP).

Two important points about PDPs need noting at the outset. Firstly, a PDP should account for the needs of the professional, their employer and a wider set of stakeholders. This set includes users of professionals' services, training providers and even Government in some instances. It is obviously a challenge to incorporate the needs of so many individuals and groups into one plan and also to realise that they will be accorded different weightings at different times. The main point is that all these stakeholders require some consideration.

Secondly, planning and taking a structured approach to PD can mean that opportunities for spontaneous learning are missed. It is important to be aware that such opportunities arise all the time. Your plan must be flexible enough to accommodate them.

A PDP emphasises the need to think about *why* you undertake any activity. Under a quota of hours system, there is not necessarily any better reason for performing a PD task than to gain the required hours, but the PDP requires more thought. Consider where you want to get to and then decide upon an appropriate path. This can be done in conjunction with managers (eg through your appraisal system) or individually, through the use of a tool such as the InstE *Planner*. Of course, InstE staff will be happy to advise on developing your plan.

For more information about any aspect of PD, please e-mail Rob Wall at education@instenergy.org.uk or tel: 020 7580 7124.

Events

November 2001

Towards sustainable housing refurbishment
5 November, Garston, Watford
Details from BRECSU
Free seminar by ticket only.
tel: 01923 664532
fax: 01923 664602
e-mail: brecsueve@bre.co.uk

Green convention 2001: commercialising green energy
5-6 November, Brussels
tel: 020 7375 7575
e-mail:
hmundy@eyeforenergy.com

Micropower: small-scale electricity generation
Conference, 6 November
Watford
Details from Kate Perry
tel: 01923 664542
e-mail: perryk@bre.co.uk
Co-sponsored by the Institute of Energy

InstE Branch Event
Visit to Magor Brewery
6 November
Details from the South Wales & West of England Branch
- Tony Boulton
tel: 0117 932 3322
e-mail: a.boulton@talk21.com

European autumn gas
Conference, 6-7 November,
The Netherlands
Details from Lynne Evans,
tel: 0207 650 1430,
e-mail:
confs@economatters.com

InstE Branch Event
Energy market de-regulation
Seminar jointly organised by the Hong Kong Branch, IGasE far east section and HKIE energy division
7 November, 6pm, HKIE HQ
Details from the Hong Kong Branch - Danny Lai
tel: 2966 8837
fax: 2966 7087
e-mail: mtlai@netvigator.com

InstE Branch Event
Energy and resources in the 21st century
Conference, 7 November,
University of Hertfordshire,
free admission by ticket only
Details from the London & Home Counties Branch
- Julie Huckle
tel: 01707 284004
fax: 01707 286040
e-mail: j.a.huckle@herts.ac.uk

UK waste: going forward - dialogue and decisions
British Nuclear Energy Society
Conference, 7 November
London
Details from Sue Frye at the ICE,
tel: 020 7665 2315,
e-mail: sue.fry@ice.org.uk

NEMEX 2001
Conference & exhibition
7-8 November, Birmingham
tel: 020 7772 8450
fax: 0800 496 4154,
www.nemex-energy.co.uk

Towards sustainable housing refurbishment
8 November, Cardiff
Details from BRECSU
Free seminar by ticket only.
tel: 01923 664532
fax: 01923 664602
e-mail: brecsueve@bre.co.uk

European young engineers
Conference: education and mobility in Europe
9-11 November, Paris
Organised by the French association of engineering students (BNEI).
Details from
Dr Jasper Graham-Jones
tel: 023 9284 2113
fax: 023 9284 2351
e-mail: jasper.graham-jones@port.ac.uk

Win market share in Italy's liberalising power market
Conference, 12 November,
Milan, £1299
Details from WBR Ltd,
tel: 020 7759 9000

Towards sustainable housing refurbishment
13 November, Glasgow
Details from BRECSU
Free seminar by ticket only.
tel: 01923 664532
fax: 01923 664602
e-mail: brecsueve@bre.co.uk

Engineering for profit from waste
International conference
13-14 November, London
Details from Alison Payton at the IMechE,
tel: 020 7304 6829,
e-mail:
a_payton@imeche.org.uk
Co-sponsored by the Institute of Energy

InstE Branch Event
Energy & environmental management
13-15 November, Kings Hall
Details from the Northern Ireland Branch
- Ciaran McGrath
tel: 028 9024 0588

InstE Branch Event
Visit to Newell glass works
14 November, Sunderland
Joint event with Society of Glass Technology and The Institute of Materials
Details from the North East Branch - Andrew Cox
tel/fax: 0191 261 5274
e-mail:
awcox@eimr.demon.co.uk

InstE Branch Event
CHP case studies
15 November, Risley
Details from the North West Branch - Brian Doran
tel: 0161 817 4036
fax: 0161 817 4001
e-mail:
brian.doran@burohappold.com

Transport in a renewable era
Seminar, 19 November
IMechE HQ, London
Details from Laura Feinberg
tel: 020 7304 6829, e-mail:
l_feinberg@imeche.org.uk
Co-sponsored by the Institute of Energy

EMART energy 2001
20-21 November, Milan, Italy
Details from
www.emart-energy.com

Gas forum europe
20-21 November, Milan, Italy
Details from
www.gasforumeurope.com
fax: +31 346 590 601

2nd annual European renewables summit
20-21 November, Brussels
tel: 020 7704 6161
e-mail:
bookings@thecwcgroup.com

Events

Lazing on a sunny afternoon – the business response to climate change
Seminar, 22 November, London
Details from James Hanaway,
tel: 020 7632 0103
Co-sponsored by the Institute of Energy

National engineering recruitment
Exhibition, 23-24 November, NEC, Birmingham
tel: 0870 870 7411

Spark ignition engine emissions
Course, Leeds, 26-30 November
Details from Alison Whiteley, University of Leeds,
tel: 0113 233 2494,
e-mail: cpd.speme@leeds.ac.uk

Fuel cells for stationary applications
Conference, 27-28 November, Brussels
Details from eyeforfuelcells,
tel: 0207 375 7575,
e-mail: jburnham@eyeforfuelcells.com

Towards sustainable housing refurbishment
28 November, Belfast
Details from BRECSU
Free seminar by ticket only.
tel: 01923 664532
fax: 01923 664602
e-mail: brecsueve@bre.co.uk

InstE Branch Event
Fuel Cells
28 November, Newcastle
Joint event with the Institution of Chemical Engineers and Newcastle City Council
Details from the North East Branch - Andrew Cox
tel/fax: 0191 261 5274
e-mail: awcox@eimr.demon.co.uk

The energy forum
IEA conference, 28-29 November, London, £995 + VAT
Details from Marketforce Communications,
tel: 020 7608 0541,
www.marketforce-communications.co.uk
Co-sponsored by the Institute of Energy

Seventh international conference on AC-DC power transmission
28-30 November, IEE, Savoy Place, London
Details from IEE
tel: 020 7344 5732
e-mail: events@iee.org.uk

December 2001

Special presentations by Britain's young engineers at the House of Commons
3 December, London
Details from Dr Eric Watson
tel: 01235 832335
fax: 01235 820 688
e-mail: eric@eric-watson.freeserve.co.uk

Pollutec 2001
Exhibition and meetings on environment equipment,
4-7 December, Paris
Details from website:
www.pollutec.com

InstE Branch Event
Harry Ramsden's Cardiff Bay
5 December
Quiz between InstE and IGE
Details from the South Wales & West of England Branch - Tony Boulton
tel: 0117 932 3322
e-mail: a.boulton@talk21.com

InstE Branch Event
Hydrogen economy
5 December, Warrington,
Details from the North West Branch - Brian Doran
tel: 0161 817 4036
fax: 0161 817 4001
e-mail: brian.doran@burohappold.com

High performance heat pump applications
Course, 5 December, London
Details from Mid career College, tel: 01223 880016

Energy choices
BNIF/BNES conference, 6 December, London, £188
Details from the conference desk, tel: 0208 542 8223

InstE Branch Event
Weekend technical visit
Guangzhou pumped storage power station in Conghua, China, 8 December
Details from the Hong Kong Branch - Danny Lai.
tel: 2966 8837
fax: 2966 7087
e-mail: mtlai@netvigator.com

Power Europe 2002: examining the European revival of nuclear power
10-12 December, Amsterdam
Details from IBC global conferences
tel: 01932 893851

Offshore wind energy
10-12 December, Belgium
Details from EWEA
tel: +32 2 546 1940
fax: +32 2 546 1944
e-mail: ewea@ewea.org

InstE Branch Event
Presidents evening
13 December, Birmingham
Details from the Midlands Branch - Vian Davys
tel: 01332 666296
e-mail: vian.davys@eme.co.uk

January 2002

InstE Branch Event
Energy efficiency the key to world class manufacturing
10 January, Birmingham
Details from the Midlands Branch - Vian Davys
tel: 01332 666296
e-mail: vian.davys@eme.co.uk

Registering on an event seen here?
If you are registering on an event which you have seen listed here, please don't forget to mention to the organisers that you saw it listed in the *Energy World* Events Diary.
For further information about events, and to view the Institute of Energy's events calender please click on to our website at: www.instenergy.org.uk/community
InstE Branch events are open to everyone regardless of the branch they are organised by.

The 11th hour for prospective chartered engineers

The June 2001 issue of *Energy World* (page 22) informed individuals seeking Chartered Engineer status of the impact of the Engineering Council's Standards and Routes to Registration 3rd Edition (SARTOR 3). That article outlined the timetable for the implementation of SARTOR 3.

This article outlines in greater depth the impact of SARTOR 3 to individuals who do not possess an accredited BEng (Hons) qualification.

From 1st January 2002, individuals who do not possess an accredited BEng (Hons) will be required to complete a Matching Section to satisfy the academic requirements for Chartered Engineer status as stipulated by SARTOR 3. Applicants required to complete a Matching Section pursue a non-standard route to membership and registration with the Engineering Council. A Matching Section can be either obtained either through:

- Further academic study that expands an individual's existing academic attainment through depth, breadth, specialism and engineering applications, or
- extended career direction, and the initial professional development and competence needed to achieve it.

An applicant pursuing either of these routes must demonstrate how the Matching Section has contributed to the educational base requirement for Chartered Engineer status.

Please contact the Membership Office as soon as possible if you are unsure of your eligibility for Chartered Engineer. Please note that the Institute of Energy's deadline for the receipt of applications for non-standard pathways to Chartered Engineer status is 1st November 2001. Non-standard applications viewed after this date will be assessed against the criteria stipulated in SARTOR 3.

The Institute urges you to forward this information to colleagues or friends to whom this might apply and request that they consult the Membership Office for advice and guidance on their pathway to Chartered Engineer status as soon as possible.

The Membership Office can be contacted by e-mail at membership@instenergy.org.uk or telephone 020 7580 0077

Council Elections

Presidential officers and honorary officers 2002/2003

The undermentioned have been elected by Council to take office following the Annual General Meeting on 7 June 2002

Mr J Blackhall CEng FInstE
EUR ING RI WILKIE FInstE -Honorary secretary
Mr D BARBER CEng FInstE -Honorary treasurer

Election to Council 2002/2003

Following the AGM, the undermentioned will retire and are not eligible for re-election: Mr J MOSLEY CEng MInstE, Mr RI Taylor CEng MInstE, MR S WILCE CEng MInstE

Notice of Council Nominations

Any ten Corporate Members may nominate in writing any duly qualified person to serve on Council. Any three Corporate or Associate Members may also nominate in writing an Incorporated Engineer to serve on Council. A vote for associate members would be by Associate Members only. All nominations, together with the written consent of the nominee to serve, should reach the Secretary & Chief Executive of the Institute not later than eight weeks before the AGM but preferably earlier. (Members are not, however, permitted to join in the nomination of more than three persons in any one year).

Carbon dioxide separation and storage seminar

September 26th saw over 80 delegates attend the Carbon Dioxide Separation and Storage Seminar, which was organised by the Institute of Energy in partnership with Trade Partners UK.

International efforts to reduce the effects of climate change have so far centred on improvements in energy efficiency and renewable energy sources. The Kyoto Protocol calls for a 5% reduction in global emissions based on 1990 levels to be achieved during the years 2008 to 2012. In practice, this is proving to be a very onerous target because of increased economic growth over the period. The seminar examined the utilisation of carbon dioxide separation and storage to reduce greenhouse gas emissions, particularly evaluating the existing technology and how it can be improved and applied to reduce emissions over the next few decades and beyond.

Venue, the DTI Conference Centre


Delgates discuess the conference over lunch

The Seminar provided detailed information on the technologies, which enabled a sound platform for debate of the key issues surrounding the separation and storage of carbon dioxide. The day was very lively and identified the need for further development, debate and communication of the technology.

the institute of energy

Subscription Notices

You will soon be receiving your subscription notice for 2002.

Your subscription notice contains space to change your contact details. If your details have changed, including your e-mail address, it would be appreciated if you could amend the notice and return this to the Institute of Energy.

Please contact Sam Cobbina on 020 7580 7124 or e-mail: finance@instenergy.org.uk if you have any finance queries regarding your subscription.

If you require assistance regarding concessionary subscription rates, please contact Holly Naisbitt on 020 7580 0077 or e-mail: membership@instenergy.org.uk

Thank you in advance, for prompt payment of your subscription notice.

NEW MEMBERS

NORTH EASTERN

Ms J Park MInstE
Blyth Valley Borough Council

LONDON & HOME COUNTIES

Dr R Moreea-Taha Graduate
IEA Coal Research
Mr D Rajasingam Student
Kingston University
Dr G Lowry MInstE
Brunel University

SCOTLAND

Mr J E Simmons MInstE
Babtie Group
Mr G Sanderson MInstE
Babcock Engineering Services
Mr G Buchanan Graduate
BP Energy

EAST MIDLANDS

Mr S D Kirk Graduate
Monodraught Ltd
Mr D Waite Affiliate
Redbank Manufacturing Co Ltd

SOUTH WALES AND WEST

Mr . Ross MInstE
Collinson Grant Ltd
Mr D Cooper Graduate
Clifford Talbot Partnership

YORKSHIRE

Mr M J Edwards Graduate

SOUTH COAST

Mr M E Currid Graduate
Hoare Lea

HONG KONG

Mr D H L Yau MInstE
Hong Kong SAR Government
Mr S F Chow MInstE
CLP Power Hong Kong Ltd.
Mr W L Choi MInstE
Wellux Consultants Ltd
Mr R W M Cheung MInstE
Mobil Oil Hong Kong Ltd

Deceased Members
Mr Donald R Fair FinstE
Mr Ronald H Shttleworth MInstE

Energy Review Conference & Workshop and NETA

On 19 October, the Institute held an Energy Review Stakeholder Conference and Workshop in conjunction with the Cabinet Office's Performance & Innovation Unit. The event was being held to discuss the key themes that have already arisen from the submissions to the Energy Review. The four workshops looked at Networks and Security, 2050 Low Carbon Technologies, Institutions and Policy Instruments. The event attracted some of the key figures in the energy industry.

The Institute's NETA Conference was held on 31 October and exposed the divided opinions on the key issues. With speakers from the National Grid Company, CHPA, OFGEM and the DTI, the event gave delegates an opportunity to address the issues and focus on the ongoing development of electricity trading in the UK.

OBITUARY - DAVID C GUNN MSc SFInstE CEng

Born in Cardiff on 20th February 1912, David first appeared on the energy scene when he graduated with a BSc in Engineering from Cardiff Tech in 1933.

His early professional years were spent in the gas industry, during which time he was awarded MSc with distinction in Gas Engineering at Leeds University in 1943.

In 1947, David embarked on a very long and distinguished career in the boiler industry, starting in the Boiler Department at BCURA and rising to Technical and then Research Director at Thompson Cochran Ltd (latterly NEI) from which he retired in 1977.

Such was the energy of the man that, at the age of 63, he embarked on a new career as a consultant. Working closely with the Leeds based engineering consultancy, White Young Prentice Royle, he became their Director of Energy Projects in 1986. Who knows how long he would have gone on working had it not been for the co-incident events of the illness of his wife and the application of BS 5750 at the consultancy which definitely did not suit David's free thinking approach to engineering design.

David's association with the Institute of Fuel started in 1947 and he became a Senior Fellow in 1959. He was a regular member of the Committee of the Yorkshire Branch right up to his final retirement at the age of 81 in 1993.

He wrote and presented innumerable papers for professional bodies including the Institute and the Combustion Engineering Association (of which he was a Vice President) and was co-author of the book 'Industrial Boilers' published in January 1989.

David will long be remembered for his seemingly boundless energy, enthusiasm for his subject and eagerness to share his knowledge with those around him which made it a pleasure to those who had the good fortune to work with him. His endearing mannerism of always ceremoniously removing his coat before delivering a talk is a particularly fond memory of colleagues and contemporaries alike.

He died after a short illness on April 5th 2001 and was cremated at Lawnswood Crematorium in Leeds on April 12th.

Andrew Mallalieu
Hon Secretary, of the Yorkshire Branch BCURA and the Combustion Engineering Association, in conjunction with the Institute of Energy presented the 1st David Gunn Memorial Lecture on the evening of 15th October 2001 at the Painters' Hall, City of London.

HIGHER PROFESSIONAL & TECHNICAL OFFICER OR HIGHER EXECUTIVE OFFICER

Property Services Department, Vauxhall, London

£19,297 to £22,511 plus a location allowance of £2,556 per annum
(salaries are currently subject to review)

The Metropolitan Police, Property Services Department, Energy Section, provides an energy management service for the Metropolitan Police Estate.

As a member of the section you will work with and support a senior engineer in a small team responsible for the energy management of the estate.

The key responsibilities of the post will be to manage the utilities invoice processing contract and ensure that the TEAM energy management database is accurate and up to date. The work will include monitoring the performance of the invoice processing contractor and the reconciliation of any invoicing disputes with either the contractor or the utility supplier. The work also includes the collation of tender documentation for the utility contracts, the production of cost and consumption reports and the line management of the TEAM database technician.

To be appointed at HPTO level you must have a minimum HNC/HND/BTEC level in building services engineering or an energy related discipline and at least two years' post qualification experience in a relevant field of work.

For an appointment at HEO level you must have extensive experience of administrative management, invoice processing or finance/accounting, contract management and a good working knowledge of word, excel and access. An interest in energy and the environment with a background in a relevant discipline is desirable.

For an information pack and application form, call our Senior Civil Staff Selection Centre on 020 7321 8981, Mon-Fri 8am-5pm. Completed application forms should be returned by 23 November 2001.

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the institute of energy

The staff at the Institute would like to wish all readers a very Happy Christmas and best wishes for the New Year

The office at Devonshire Street will be closed for the Chrismas break from 5pm on the 24th December 2001 and will reopen on the 2nd of January 2002.