THE MAGAZINE OF THE INSTITUTE OF ENERGY

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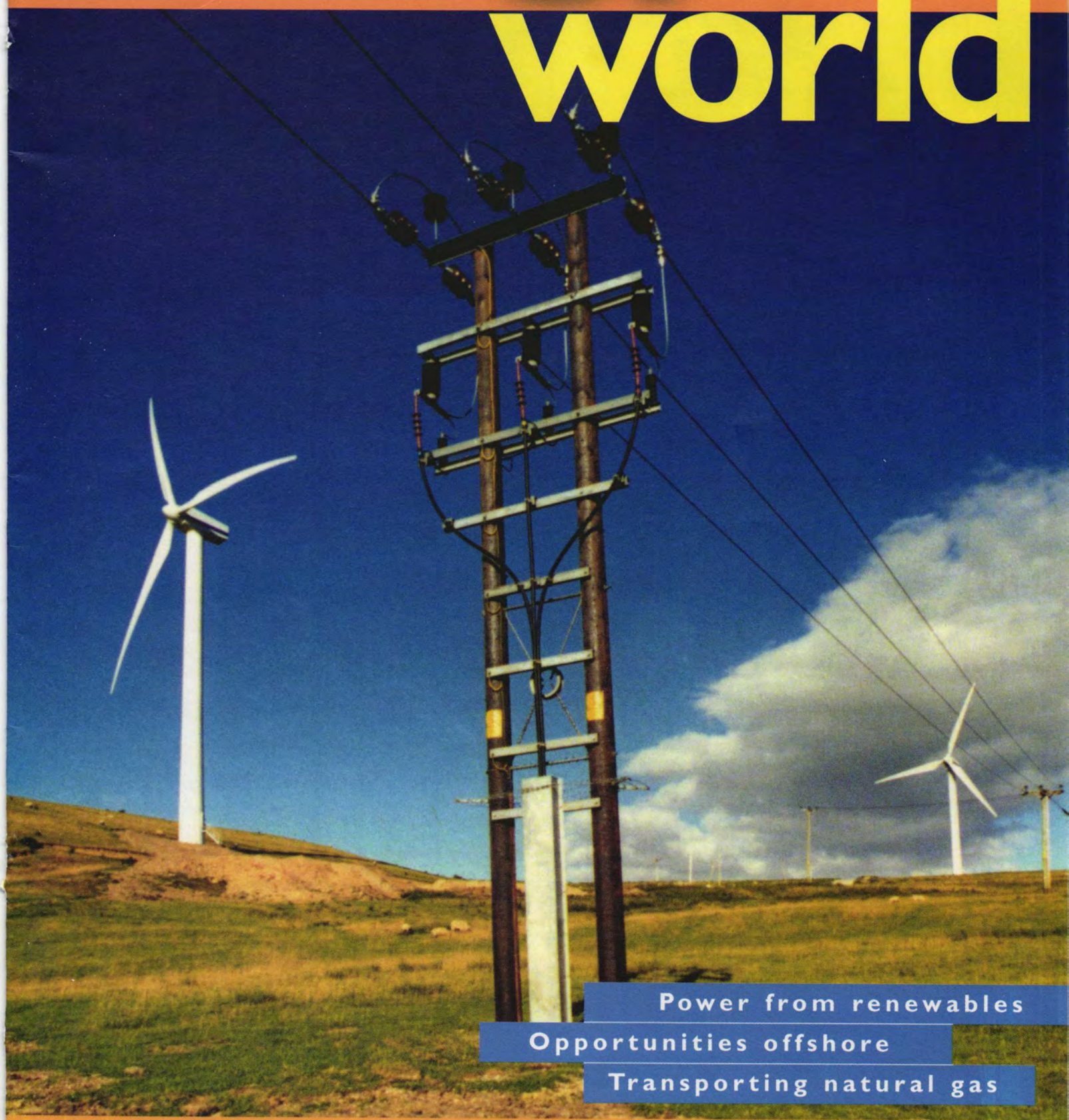

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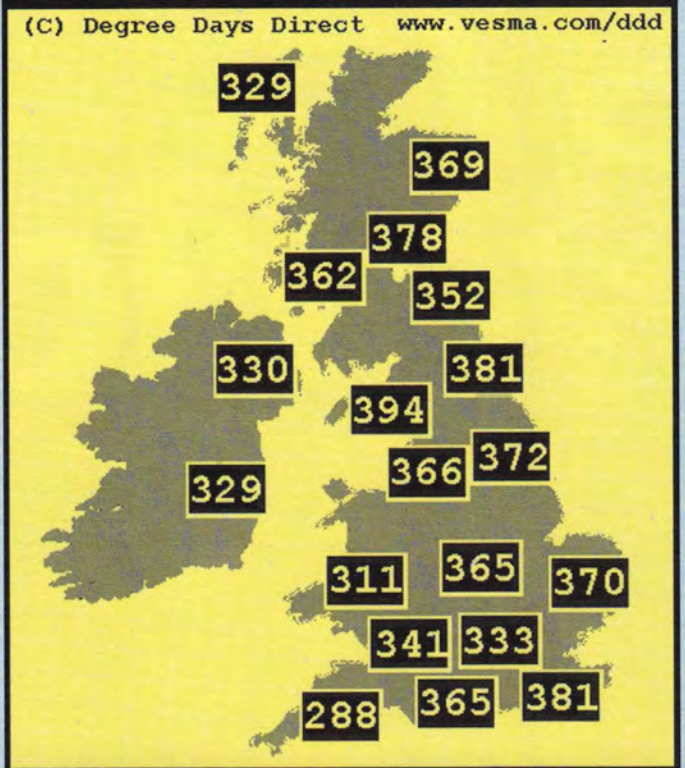

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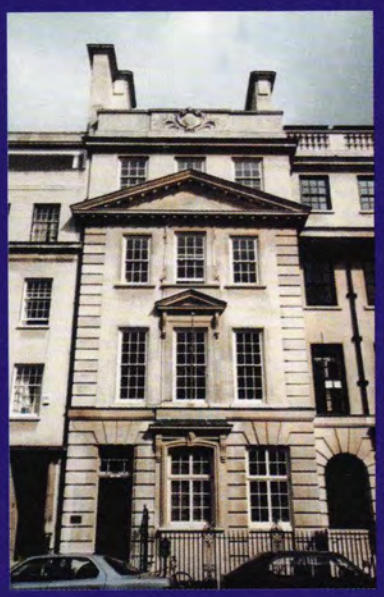

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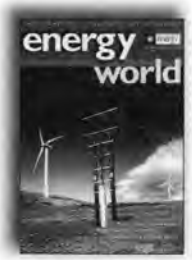

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COVER

The 33 kV network connection to Askam windfarm in Cumbria. The ability or otherwise of Britain's electricity transmission and distribution system to accommodate large increases in renewable electricity generation has been much debated. Recently announced plans for several giant new wind farms in Scotland has sharpened this debate. On page 8, Econnect's Rob Driver takes a positive view – suggesting that both grid operators and developers of renewable projects will need to adapt.
Further articles look at how some of Britain's more traditional industries can benefit from the growth of renewables, and at one man's efforts to green the planet.

Building a high productivity, low carbon economy

Extracted from a speech delivered by Ms Hewitt to a conference on low carbon futures organised by the Institute for Public Policy Research last December

Patricia Hewitt, Secretary of State for Trade and Industry

The role of my Department, Trade and Industry, is to help drive up UK productivity and narrow the productivity gap between the UK and our major competitors.

In simple terms that means getting the most out of what we put in - working smarter not harder, drawing on people's skills in the labour force; getting the most out of capital investment; getting more out of the natural and finite resources we have, cutting waste and pollution.

Environmental productivity is a central part of our mission to raise UK productivity.

All of Government has a part to play. The DTI's priorities are:

- promoting innovation,
- spurring enterprise, and
- creating competitive frameworks which deliver open and dynamic markets.

Raising resource productivity is an essential element of all three areas. Above all, our role is to create the competitive framework that helps the market develop low carbon solutions.

First, Government must provide the right fiscal framework. One that internalises externalities. Where the full social and environmental costs of an activity are not incorporated in prices, the Government can allow the market to adjust to efficient levels of production by levying appropriately set taxation.

The climate change levy is part of a long-term change in the fiscal framework to give businesses an incentive to cut energy use and switch to low carbon alternatives - shifting the tax burden away from beneficial things like employment and towards undesirable things like pollution.

My next point is that we need to look at the broader design of energy markets. Energy markets have a crucial role to play in achieving a low carbon economy.

Our aim is to promote dynamic, competitive wholesale and consumer energy markets, with the right incentives and regulatory requirements to promote low carbon energy sources. So we need to act on both sides of the equation: reducing demand on one side and making supply cleaner and less wasteful on the other.

Finally, I want to look at the broader issue of innovation. We have excellent examples of businesses responding, through innovation, to the challenge of climate change.

There is a growing realisation amongst businesses that the need to cut greenhouse gas emissions - once thought to be costly and a threat - is, in reality a huge business opportunity. Businesses can save money by reducing their energy costs, making themselves more competitive and safeguarding profits and jobs.

At the same time, businesses can grow by developing products using low carbon technologies. With 180 countries signed up to the Kyoto Protocol there is a huge potential market, a very real prize for companies and countries that get ahead of the game.

The global market for environmental goods and services is projected to rise to £440 billion by 2010, and renewable sources of energy could take a large part of that market.

But it is still a minority of businesses that are spotting the market opportunities. Innovation is key to achieving a low carbon, sustainable economy.

A central part of the review I have been leading of DTI has been how we can make the most of the work we have been doing over the last four years in strengthening our science and technology base - to ensure that UK science, engineering and technology expertise is exploited by new and existing businesses.

Within DTI, as part of our reorganisation, there will be a new division for Science, Technology and Innovation - and part of its core purpose will be to promote the take up of environmental technology throughout UK business.

Innovation is about developing and applying new ideas and technology - in products, services and processes. So, in providing a competitive framework, we must ensure that market regulation encourages and does not hinder innovation. We must work with the regulators and with business to ensure that the commercial environment is right for bringing existing and new low carbon technologies to market.

We must also encourage new developments in industry, creating more environmentally friendly products.

For example, the UK car industry is already leading major technological developments towards low carbon transport.

Yesterday, my colleague Brian Wilson - together with colleagues in DTLR, DEFRA and the Treasury - launched the Government's draft strategy: *Powering Future Vehicles*, setting out how we aim to lead the global shift to a low-carbon automotive economy (see also page 3). Setting ourselves challenging targets. And on this, we're looking at the possibility that the proportion of low-carbon vehicles, including hybrid and fuel cell vehicles, could make up 8-12% of new car sales, within a decade.

We can only set and achieve the right goals if we work with business, and the not for profit sector.

That's why we have set up the Carbon Trust, Government backed but business led. It has a remit directly from the Prime Minister to: "take the lead on low carbon technology and innovation in this country and put Britain in the lead internationally".

We know we have a lot to do.

Draft PIU report suggests 'death knell' for nuclear

"Death knell sounds for nuclear energy" – so said New Scientist magazine just before Christmas, having seen a copy of the draft report of the Government's energy policy review produced by the Cabinet Office's Performance and Innovation Unit. The Financial Times' take was: "Business likely to bear the costs of 'green' energy.

Both publications reported that the *draft* report – the final version was due to be published roughly as these words are being written in January – suggests that the best way to tackle climate change is to replace coal and oil-fired electricity generating capacity with new renewables - to the tune of 20% of the UK total by 2020. Household power bills will rise by around 6%, commercial bills by perhaps 12%, to finance the growth in renewables.

The report was widely expected to endorse plans by the nuclear industry to build up to 15 new atomic power stations to replace ageing nuclear and coal stations.

There is "no current case for public support for the existing generation of nuclear technology" reports the FT, while there are, however, "good grounds for .... keeping the nuclear option open".

Energy World will carry a full report on the Energy Policy Review once the final report is published.

Powering future vehicles

The Government's new draft strategy: *Powering Future Vehicles* proposes how to make the UK a world leader in the move to a low-carbon road transport system, minimising the environmental impacts and maximising the benefit to UK industry.

Devised jointly by the Department for Transport, Local Government and The Regions, the Department of Trade and Industry, the Department of Environment, Food and Rural Affairs, and the Treasury, the strategy sets out clear objectives and how to meet them, principally by identifying and removing market barriers and addressing market failures.

The document suggests delivery of this strategy through an 11-point plan, which includes:

- promotion of research and development,
- sensible regulation,
- facilitating infrastructure development,
- setting the right fiscal regime,
- laying the foundations for transport to play a part in the UK emissions trading scheme, and
- working with international partners and better integration of UK funding programmes.

The document suggests that a feasible but challenging target for the proportion of low-carbon vehicles sold within a decade, including hybrid and fuel cell vehicles, might be eight to 12%.

A final Powering Future Vehicles Strategy will be published in the spring.

High street stores combine energy purchasing

Marks and Spencer and the John Lewis Partnership have combined forces to purchase energy on-line by using Utilyx, which claims to be the UK's leading energy e-market. The move follows a demonstration of very significant cost savings by purchasing together.

The two retailers each ran individual auctions, followed by one joint auction, which resulted in a six figure saving over the best prices obtained in the separate auctions, says Utilyx.

The Utilyx team suggested operating three simultaneous on-line auctions to resolve the issue of how to measure and allocate any savings made by a joint auction. Each company conducted its on-line auction over two weeks through Utilyx and Utilyx ran an auction of the contracts for the 347 Marks & Spencer and 154 John Lewis sites together.

In the end eight suppliers participated, making a total of 40 bids. As well as the joint auction making a six figure saving, the two companies spent less time and effort in the process, says Utilyx. The savings were shared in proportion to the companies' electricity spend.

Meanwhile, Ofgem has blocked proposals by electricity suppliers to object to industrial and commercial consumers transferring to alternative suppliers. Power companies had wanted the I&C market to be the same as in gas, where suppliers can object to transfer on the grounds of breach of contract.

Big Brother's power – half of the TV programme's 137 m² solar panelled wall has been installed into five different schools in Leicester by Solar Century, each school gaining a 1.9 kW array to help teach students about renewable energy and sustainability. The project won the commercial section of Eurosolar's 2001 awards.

Halton Borough Council won the local authorities section for its installation of a solar tracker and solar thermal system on an eight storey council building. Ove Arup and partners won the solar architecture section for its installation of the UK's largest PV installation, to power the 'assisted' ventilation system at the new Jubilee campus of the University of Nottingham.

A BETTA deal for Scottish electricity

Planned reforms to the wholesale electricity market in Scotland will bring the same benefits to Scottish electricity customers as those enjoyed by their counterparts in England and Wales.

Ofgem's proposals to introduce British-wide electricity trading and transmission arrangements (BETTA), will create, for the first time, fully competitive market arrangements in Scotland. Based on NETA, which came into force in England and Wales last spring, the new arrangements will not only bring the benefits of competition to Scottish customers, but will also give Scottish generators greater access to markets in England and Wales, says Ofgem.

Wholesale prices make up half of domestic customers' bills. Following the introduction of new electricity trading arrangements (NETA), these prices fell by 20-25% in England and Wales, a fall which will feed through to domestic bills.

Ofgem's GB-wide proposals will address a number of issues which are hindering the development of the electricity industry in Scotland. These include:

- giving greater access to a GB market for Scottish electricity which exceeds national demand by about 70%,
- creating a market to cope with the end of the Nuclear Energy Agreement (NEA) in 2005 at the latest. The NEA was set up at privatisation and means that British Energy's Scottish output has to be sold to the two Scottish energy companies - Scottish Power and Scottish & Southern Energy, and
- creating a wider British market for renewable generation which is receiving major Scottish investment.

The proposals will bring:

- a single operator of the British electricity transmission system,
- a right of access on fair and competitive terms to the Scottish transmission network for companies throughout Great Britain, and
- a single set of arrangements for the real time balancing of the transmission system and for settling the cost of balancing.

However, because of the need for legislation, it will not be possible to introduce BETTA until 2004 at the earliest, according to Ofgem.

New authority picks up old waste

Secretary of State for Trade and Industry Patricia Hewitt has announced a new approach to the clean-up of the legacy created by the early years of Britain's military and civil nuclear programmes. A Liabilities Management Authority (LMA) will be established to take on responsibility for most of the UK's public sector civil nuclear liabilities on behalf of the Government.

The LMA will take on responsibility for most of BNFL's liabilities and assets as well as those of the UK Atomic Energy Authority (UKAEA). The LMA will work in partnership with the UKAEA and BNFL, and the safety, security and environment regulators to achieve the most effective and safe means of discharging the liabilities.

Mrs Hewitt said: "Nuclear decommissioning and clean up needs to be recognised for what it is - an environmental programme which requires the same focus, intensity and technological innovation as the original nuclear development programme. We have to face up to our responsibilities and not leave them to future generations".

As part of its legacy management activities over the past 18 months, BNFL has been reviewing its approach to tackling its historic nuclear wastes. The company announced a new strategy for dealing with these, which has led to an increase in the estimated cost to BNFL of discharging its liabilities of £1.9 billion. As a result of this increase, BNFL's long term liabilities are estimated to exceed its assets. The proposals outlined for restructuring the industry more broadly will address this. HM Chief Inspector of Nuclear Installations has assured Government that BNFL's financial position will have no impact on the safety of BNFL's operations.

Existing fields could produce more oil

A new report has confirmed that the UK's producing oil and gas fields could be holding a further 3.7 billion barrels of oil equivalent (boe) in unexploited reserves, and that sharing best practice in mature field management will be the key to unlocking the prize.

Commissioned by PILOT and co-ordinated by LOGIC, the industry-funded body focused on oil and gas industry competitiveness. The study: *Brownfield Benchmarking Project* says that the UK's 200 producing offshore oil and gas fields could yield up to 3.7 billion boe more than the 6.3 billion boe reserves currently known to be economically and technically viable.

This gives the UK's producing (or brown) fields a total ultimate recovery potential of 10 billion barrels of oil equivalent (boe) which, in comparison with the 3 billion boe estimated to lie in new undeveloped fields, underlines the significance of the industry's current initiatives to maximise recovery of oil and gas reserves from existing fields.

- Meanwhile, Energy Minister Brian Wilson has approved development of the first phase of the west of Scotland Clair oil field, located 75 km west of the Shetland Isles. The field is said to be the largest undeveloped UKCS resource, but lies in water up to 150 m deep.

Europe's largest wind farm planned for Scotland; UK windpower is ten years old

Unconfirmed reports (see *Energy World* January 2002) of plans for Europe's largest wind farm to be built in Scotland have now been confirmed by construction company AMEC and nuclear generator British Energy. The two companies plan to build a 300 turbine, 600 MW farm on the Isle of Lewis, off the west coast of Scotland. The 2 MW turbines would be among the world's largest.

If brought to fruition, the £600 million project will feed electricity directly into the UK national grid. AMEC is undertaking a year long detailed feasibility study into cost, location and environmental impact as the first stage of the project. The plan is linked to a parallel project to investigate the building of a major sub-sea cable off the west coast of Wales, England and Scotland.

Announcing the wind farm scheme, Energy Minister Brian Wilson pointed out the scale of the proposed development, which: "has the potential to provide around 1% of the UK's electricity needs. It has long been recognised that the Western Isles offer outstanding potential for the development of renewable energy. I am delighted that a project of such significance has emerged and that it would not only contribute to our energy needs but also create manufacturing employment on Lewis.

It is particularly gratifying that the companies' plans are based on the reopening of the former oil fabrication yard at Arnish Point, as a turbine and tower manufacturing plant. This emphasises the fact that manufacturing for renewables can become a very substantial sector of our economy. Initially 150 jobs will be created for turbine and tower manufacture but more will follow in operation and maintenance of the windfarm."

Meanwhile, Welsh wind power has started to take off again with the first new farm to be opened for two years and Government consent being granted to what will be (until Lewis) the UK's single largest wind farm. Brian Wilson has opened a five turbine, 3.5 MW wind farm at Parc Cynog and has given consent for a 58 MW farm to be built in Cefn Croes.

After a lengthy lull in the commissioning of new wind farms, the launch of these two projects seem to signal a new period of expansion for UK wind energy.

Not to be left out, B9 Energy Services Ltd has received planning permission for Northern Ireland's biggest wind farm, a 22 MW scheme to be built at Altahullion in Co Londonderry.

Looking back, Britain's first commercial wind farm, at Delabole in north Cornwall, passed its tenth birthday and generated its 100 million kWh of electricity last December. The ten turbines have avoided the burning of an estimated half a million tonnes of coal over the decade.

A 30 kW Comp-AC drive from ABB is helping a wooden toy company reduce the noise in its workshops, as well as save over £700 a year in energy costs.

Community Playthings, run by the Beechgrove Community near Sandwich in Kent, has for the past five years produced items such as workbenches, blocks and toys for sale to schools. It approached ABB Drives Alliance member MKE Engineering Group in Sittingbourne as it was experiencing problems with the dust extraction equipment in the workshop. The workshop has an extractor fan for removing wood dust from the air though ducting, previously based on a 30 kW motor driving a fan. It ran at a constant speed, regardless of the number of machines working or the amount of dust in the air.

MKE Drive Systems recommended the 30 kW drive from ABB. Each woodworking machine in the workshop now has its own vent, connected to the air extraction ducting. When the machine is switched on, the operator opens the vent, causing the pressure in the ducting to drop – when the machine is switched off, the vent is closed and the pressure rises. The drive uses a pressure differential sensor, ensuring that the correct air pressure and volume is maintained in the ducting, to avoid damaging the ducting and wood dust settling in the ducts.

The noise in the workshop has now been substantially reduced, and with the energy savings, the system will pay for itself in 14 months.

Enron Direct goes to British Gas Trading

Administrators called in to Enron Direct Ltd, part of the US-based energy giant Enron which collapsed last December, have sold the major supply business assets of Enron Direct in the UK to British Gas Trading for £96 million.

The arrangements offer the 148,000 electricity and 12,000 gas customers a continuing supply. Domestic and business customers can continue for the time being under the same terms and conditions as with Enron Direct. Enron Direct also supplies customers of North Wales Energy, Cambridge Gas, Northern Energy, Telecom Plus and Countrywide.

Iowa farmers grow switchgrass for power production

Farm machinery manufacturer John Deere is to support a groundbreaking project in central Iowa to generate electricity from switchgrass, a common prairie grass grown on marginal farmland throughout many parts of North America. Its high energy output per acre of harvested crop makes it an attractive crop for energy production.

The Chariton Valley Biomass Project involves more than 80 farmers managing 7,000 acres of switchgrass. The project is managed by Chariton Valley Resource Conservation & Development, Inc, a non-profit corporation helping southern Iowa farmers. John Deere provided equipment to harvest and bale the switchgrass, and the company provided expertise on when to harvest and how to store the crop. Iowa State University is testing the impact of harvests on the environment, including water runoff, wildlife, and soil stress. Alliant Energy is testing small portions of the switchgrass at its coal-fired Ottumwa Generating Station in Chillicothe, Iowa.

If the project reaches its goal, 5% of the fuel burned at the generating station will be switchgrass, eventually adding up to 200,000 tons burned annually at the site.

John Deere has also announced that the use of soy-based biodiesel is approved for all of its diesel-powered products. However, the company cautions against possible fuel degradation and water absorption if the fuel is stored improperly.

Office and telecoms power 'will not rise above 4%'

The annual electricity consumption of commercial office and telecommunications equipment is unlikely to significantly impact the US's power supply throughout the next decade, according to a study by Arthur D Little. The study forecasts that the equipment, which currently accounts for less than 3% of national electricity use, should increase to no more than 4% by 2010.

The study is the first comprehensive analysis of present and future electricity consumption of all office and telecoms equipment, including personal and server computers, monitors, telephone network equipment, computer network equipment, copy machines and printers. Among its findings are the first published estimates of telephone network and uninterruptible power supply (UPS) electricity usage.

The study concludes that by 2010, office and telecoms equipment will demand, at most, 4% of the national electricity supply, with desktop PCs and their monitors utilising the most electricity. Furthermore, the study also forecasts that electricity consumption by office electronics could potentially decrease to less than 2% of national electricity supply if green practices become commonplace in the sector.

"Based on recent electricity shortages and rising corporate equipment needs over the past few years, there has been a great deal of concern about whether we will be able to provide the level of electricity this equipment will continue to demand," said Dr Kurt Roth, Project Leader at Arthur D Little. "Our analysis clearly demonstrates that, despite earlier concerns, the amount of electricity required by office and telecoms equipment has been largely overestimated and will not dominate electricity consumption."

The study was commissioned by the US Department of Energy, which has since commissioned ADL to perform a follow-on study to investigate the impact of energy-savings opportunities for office and telecoms equipment.

Collaborative engineering from ABB operations in France and the UK has provided the French national power authority, Electricité de France (EDF), with an automatic early warning system for hydrogen leakage prevention in the alternators of its nuclear power stations.

Inside the power generator's alternator the rotating windings are cooled by pure hydrogen while the stationary elements – the stators – are water cooled. Should the internal stator circuit become defective, hydrogen is likely to leak into the cooling waters and will need to be replaced in order to maintain pressure in the system. Quick detection of such leakage is vital to preserving the plant's operational efficiency and cost-effectiveness.

The solution – currently being applied to more than 50 alternators in nuclear power stations throughout France – has combined ABB's industrial product and applications engineering expertise to provide continuous on-line hydrogen monitoring and leakage detection. The system integrates advanced katharometers – purity analysers based on gas thermal conductivity – mass flowmeters, computing controllers, regulation valves and operator displays.

IEA commends Czech Republic for market reform

The first review of energy policies of the Czech Republic by the International Energy Agency - the Republic became its 25th member last February - praises the country for its impressive achievements in energy market reform.

IEA Executive Director, Robert Priddle commended the country, "for improving oil and gas security of supply and reducing air pollution. However, an effective regulatory framework is needed to open its electricity and gas markets". Mr Priddle also noted that "energy efficiency should be a high priority, in order to alleviate the effect of price increases as cross-subsidisation is phased out".

The Czech Republic has greatly diversified its oil and gas supplies and routes. Commissioned in 1996, the oil pipeline from Ingolstadt (Germany) to Litvinov provides Czech refineries with an alternative to Russian supplies. Norway now supplies 15% of the country's natural gas. Strategic oil stocks and emergency preparations meet with IEA standards.

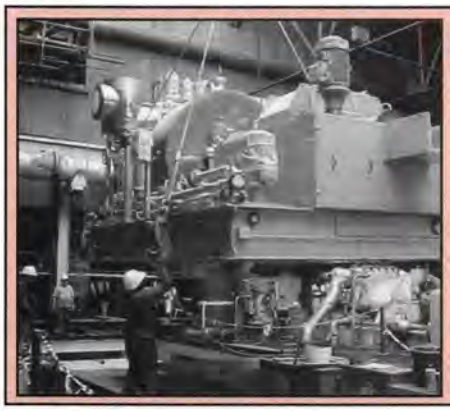
Coal still dominates the Czech fuel mix and generates 70% of total electricity. The commissioning of a second nuclear power plant in Temelin next year will increase the share of nuclear in total power generation to 40%. As a result, the use of brown coal is expected to be cut by 25% and several power plants are likely to be closed.

While Mr Priddle noted "remarkable progress in energy market reform during the last decade," he added that "the momentum must be maintained to achieve real competition". From 2002, Czech consumers will be given the right to choose their electricity suppliers. Full liberalisation of the market is scheduled for 2006. The introduction of competition in the natural gas market will start in 2005.

The Energy Regulatory Office's planned removal of cross-subsidisation in the electricity and natural gas sectors is important not only for effective competition, but also for energy efficiency improvement in households. Electricity and gas tariffs, which truly reflect cost, will enable energy companies to finance the development and modernisation of the energy sector, says the IEA.

Energy intensity in the Czech Republic fell dramatically during the last decade but is still 1.6 times the average of IEA Europe and 25% higher than Hungary. "Further efficiency improvement and, consequently, reducing carbon dioxide emissions is possible" said Mr Priddle. The Czech Republic will have no major difficulties in meeting its Kyoto target but emissions per unit of GDP are still higher than the average for IEA Europe.

The report commends the Czech Republic for having dramatically reduced its emissions of pollutants, thanks to an effective mix of policy measures and investments. These efforts should continue, notably in transport, a major emitter.



A sugar mill in Hippo Valley near Chirezdi, Zimbabwe receives its new 20 MW turbo-alternator set designed and manufactured by UK-based Peter Brotherhood. Thought to be the largest steam turbine ever installed in an African sugar mill, the 50 tonne machine was lowered into place within the mill through a hole created for the purpose in the roof of the power house.

The back-pressure turbine will use steam raised from burning bagasse - the waste material left after the processing of sugar cane - to generate the mill's electrical power and the exhaust steam will be used in the sugar refining process. Peter Brotherhood has more than 500 steam turbines operating in sugar mills around the world, including more than 100 in Africa.

Multiple gas turbine order for Algerian pipeline

ALSTOM has won an order worth 40 million Euro to supply 15 gas turbines for pipelines in Algeria, with an option for a further 15 gas turbines expected to be confirmed later in the year. The order was won by ALSTOM's gas turbine business in Lincoln, UK, taking its September order intake for small industrial gas turbines to 80 million Euro.

Awarded by the French-Italian main contractor on-site, the order is for Tornado industrial gas turbines for the OZ 1 and OZ 2 pipelines in Northern Algeria. The project is in two phases. ALSTOM will supply 15 Tornado gas turbine pump drivers in Phase 1 for installation at three pumping stations on the existing OZ 1 pipeline and the new OZ 2 pipeline. The gas turbines will be operated by Sonatrach TRC.

In Phase Two, yet to be implemented, ALSTOM will supply a further 15 Tornado gas turbine pump drivers for six pumping stations on the OZ 2 pipeline. OZ 2 is an 86cm diameter, 800 km long pipeline which will expand the capacity of the crude oil corridor between Haoud El-Hamra and the Arzew terminal on the Mediterranean coast of Algeria.

Riding the wave

by Rob Driver, Econnect Ltd

To date, renewable generation has only provided a small fraction of the UK's electricity requirements and an article in last November/December's Energy World suggested that electricity grid issues may constrain the growth of distributed renewable generation plant.

Now, with plans for major new wind farms in Scotland and in coastal waters around the whole of Britain, the prospect of large scale growth in renewables is looking more likely. Here, Rob Driver of electrical engineering consultancy Econnect Ltd, strikes an altogether more positive view of how this growth is likely to affect the operation and development of the UK's electricity system.

Something strange is happening in the UK's renewable energy industry. After spending years stuck in first gear, watching countries such as Denmark, Germany and Spain forging ahead in terms of installed renewable capacity, the UK's sector now seems to be moving straight into overdrive. The power for this acceleration is being provided by the Government's proposed Renewables Obligation. Under the Obligation, electricity suppliers will be obliged to purchase an increasing percentage of their requirements from renewable generators, reaching 10% by 2010.

Of the various technologies that qualify as 'renewable' under this scheme, wind energy is the one whose immediate prospects have changed the most markedly. This can be seen by the sheer scale of the projects that are currently being planned. Developers are working on plans to build offshore windfarms at thirteen sites around the UK coastline, with upwards of 30 turbines at each site. These projects will use very large turbines, so a 30-turbine project could have an installed capacity in excess of 100 MW. To cap all of this, a leading wind developer has recently announced plans to build a 250-turbine, 500 MW windfarm on Lewis, the largest of the Hebridean islands (see also page 5).

With projects of this size on the drawing board, it is clear that wind energy is destined to deliver a sizeable component of the UK's energy mix. Looking to the longer term, other renewable energy sources have similar potential. Biofuels, wave energy and tidal stream energy could all make significant contributions to the UK's electricity requirements, and several companies are working to develop and demonstrate cost-effective technologies for harnessing these energy sources.

This is all good news for those of us who want more of the UK's energy requirements to be met using carbon-neutral technologies, without leaving a legacy of radioactive waste for future generations to deal with. However, there are concerns about the expected growth in renewable electricity generation, regarding its effect on the operation of the UK's electricity system. Network operators such as the National Grid Company have been foremost in raising these concerns. As these companies are responsible for maintaining the safety, security and reliability of the system, it is right that they should analyse and address the impact of new generation technologies. While caution is appropriate, the key task for the industry is to ensure that the system evolves to accommodate new forms of generation, without jeopardising system safety and reliability.

Above all, it must be appreciated that the electricity system itself is not 'technology-neutral'. For the last fifty years, the system has been designed and operated on the assumption that energy is generated in large, transmission-connected power stations, and that these stations can usually be relied on to generate when needed. Inevitably, some changes to the system will be necessary in order to achieve the large-scale integration of renewable generation. A positive and flexible approach is required for this. There is nothing to gain – and much to lose – by casting renewable generation technologies as the scapegoat for complex and multi-faceted technical problems.

Diversity and complementarity

The operation of the electricity system has always depended on the co-ordinated and concerted actions of users with different capabilities and requirements. Some generation technologies, such as nuclear reactors, are well suited to base-load operation, and tend to operate at more or less the same power output throughout the daily demand cycle. The system depends on other generators, whose variable cost of generation is usually higher, to deliver the additional power required during the shoulder and peak demand periods. Short-term flexibility is provided by generators such as aeroderivative gas turbines, whose output level can be changed rapidly, at short notice.

Like conventional forms of generation, renewable generation technologies will find their own operational niches where they can provide the most value to the system. These niches will depend on the economic and technical characteristics of the technologies in question, and will depend on the complementary operation of other generators and demand users. The existence of efficient markets and price signals is an essential factor in this process. If flexibility is at a premium, generators who are able to change their level of output at short notice will try to capitalise on this capability, thus increasing the pool of flexible generation available to the system. This price signal will also act as a driver for technical developments, designed to increase the value of generation technologies that were previously regarded as inflexible.

In short, the essence of the integrated electricity system is its ability to combine the complementary strengths of a variety of different forms of generation, to meet

– how Britain's electricity system is gearing up for renewables

the pooled requirements of millions of electricity users. Diversity really is strength, and renewable generation will increase the diversity of generation on the system. Of course other forms of generation will be needed to complement the particular characteristics of certain renewables, such as intermittency. There is nothing new or strange about this, and it should not prevent renewable generators from contributing to the UK's energy requirements.

Hagshaw Hill – Scotland's oldest windfarm

INTERMITTENT GENERATION

Yes, it's true – the wind doesn't always blow at the same strength. As a result, the power output of a windfarm varies from one minute to the next, and sometimes there is no power at all. This is a significant problem if you are trying to use wind energy to provide an electricity supply for an isolated building or a small island. However, if the windfarm is connected to a large interconnected electricity system with enough complementary, flexible generation also available, the two forms of generation can be made to work together.

The fact is that electricity systems have always had to cope with intermittency. The vast majority of demand loads on the system are autonomous. People (and control systems) switch loads on and off at will, without any form of central control and co-ordination. In order to compensate for the resulting minute-by-minute variations in system demand, some generators are required to operate in 'load-following' mode, or to flex their output at short notice. This is costly, as it involves uncertainty regarding fuel requirements, and greater wear and tear on the generating plant itself.

Fortunately, the UK's daily, weekly and annual demand cycles are well-mapped, and a lot of effort has gone into understanding how demand levels are affected by factors such as the weather, and the all-important television schedules. As a result, only a small fraction of total demand is met by generators operating in load-following mode.

Demand forecasts are not 100% accurate, however. At present, the RMS error in the system demand forecast (in megawatts) exceeds the peak output of the UK's installed wind generation. However, as more wind generation is connected to the system, the uncertainty over the power output of this generation will start to exceed the demand forecast error. At this point, it is likely that more load-following generation will be needed. This will impact on system costs – but more of this next.

Since their introduction in March 2001, the new electricity trading arrangements (NETA) have been criticised for their effect on small generators. However, it can be argued that NETA is a vital step to allow the large-scale integration of renewable energy. NETA penalises generators and demand users who fail to deliver (or take) the amount of energy they contracted for in advance. The costs of providing flexible generation to cover unpredictability is borne by those system users who give rise to the unpredictability in the first place.

This means that generators who generate as and when they like will get paid less per unit (for energy) than generators who deliver to an agreed forecast. For wind generators, this will provide a real incentive to develop and use better wind forecasting techniques, as this will improve the accuracy with which the power output of windfarms can be predicted and traded in advance.

As well as penalising unpredictability, NETA is also designed to reward flexibility. This incentive will encourage forms of generation that are complementary to wind generation and other intermittent technologies. Even with sophisticated weather modelling, site-specific wind forecasts are unlikely to prove very accurate beyond a timescale of a few hours. In order to provide a

complementary output profile to the predicted profile for the wind generation, other generators will be required to flex their output within this timescale.

Fortunately, not all forms of renewable generation are inherently intermittent. Thermal generation systems using renewable fuels such as landfill gas and bio-fuels can be designed to provide steady power output, or even flexible operation. Hydro-electric generation can also provide very good short-term flexibility. Given appropriate access to markets for flexible generation, these technologies could help to complement the intermittency of wind energy.

Inside the nacelle of a wind turbine

Distributed generation

Many people associate renewable energy with concepts like self-sufficiency and 'small is beautiful'. To date, grid-connected renewable generation schemes have tended to be fairly small-scale, ranging from a few kilowatts up to twenty or thirty megawatts. As a rule, these generators are geographically dispersed, and are connected to the grid via the local electricity distribution network. Because of this, their operation tends to reduce the amount of power that has to be imported from the transmission system to meet the local demand for electricity. Effectively, these generation projects help to meet local energy requirements.

However, this 'distributed' model of renewable energy development is no longer the only game in town. As we have seen, developers are now planning some very large renewable generation projects, with installed capacities of up to several hundred megawatts. In terms of how they interface with the electricity grid, these projects will have a lot in common with large fossil-fuelled power stations. They will have to connect to the grid via high-voltage networks with enough capacity to accommodate their power output – some may even connect directly to the transmission system. Moreover, the scale of these projects is likely to justify the cost of major new transmission infrastructure in areas where there are good energy resources.

Thus, rather than helping to meet energy requirements within the local distribution network, these large renewable generation projects will feed energy into the backbone of the grid. This will create new challenges, both for the operators of the projects themselves and for the operators of the networks to which they are connected. In some cases, the network codes – the 'rules of the road' for users and operators of the network – need to be revised to incorporate appropriate requirements relating to renewable forms of generation. Arrangements for network access also need to be reviewed, to ensure that network capacity can be allocated fairly and efficiently between different generators and other users. These issues are being actively addressed by the relevant bodies.

Although very large projects may become the predominant pattern for wind generation, this will not signal the end of distributed generation. Other renewable energy resources such as hydro-power and landfill gas are inherently better suited to smaller, dispersed projects. Energy from waste projects and CHP schemes also fit the distributed model. The integration of generation into distribution networks is not always straightforward, but there are no impassable technical obstacles. The key question is who should pay for changes to the network that are needed to accommodate new generation projects. Ofgem is consulting on this issue at the moment, as the present arrangements are stifling the development of new generation projects.

One key factor in this debate is the fact that the electricity distribution networks in many of the UK's urban areas are ageing and over-stretched. Generators seeking connection to these networks are often faced with very high connection charges, reflecting the cost of replacing worn-out network assets or upgrading major assets that are already close to being overloaded. New investment in distribution networks will be needed to enable the growth of small-scale generation projects in these areas. Such investment will also improve network reliability and reduce distribution losses, so it will benefit demand customers as well as generators.

GB-wide transmission and trading

Geographically, the electricity system on the UK mainland is characterised by an excess of generation capacity in Scotland and the north of England, and by major demand centres in the Midlands and the South. As a result, the normal pattern of power flow across the transmission system is from North to South.

There are bottlenecks – known technically as *constraints* – at a number of points – or *boundaries* – in the transmission system. The respective system operators (National Grid Company, SP Power Systems and S+S) manage these constraints in a variety of ways, but in all cases the

solution results in geographical segmentation of the generation market. This reduces the effectiveness of price competition between generators, resulting in additional generation costs which must be borne by system users.

Advocates of renewable generation – myself included – often argue that it reduces transmission congestion. As I have already said, small-scale grid-connected generators tend to reduce the amount of power that has to be imported from the transmission system to meet the local demand for electricity. As a result, the amount of power that has to be transported across the transmission system is reduced. This reduces transmission congestion, which in turn, reduces the costs and inefficiencies caused by constraints.

Looking to the future, the anticipated growth in renewable generation will trigger a wave of change in the industry

Unfortunately, this is not the whole story. It really depends on what else happens when a renewable generation scheme starts to operate. Somewhere on the system, there must be either a corresponding increase in demand or a compensatory reduction in generation. The critical issue is not which of these two possibilities actually occurs, but where this action takes place. If it happens at a point close to the renewable generator, the effect of the change on wider system power flows will be negligible. If the compensation happens to the north of the generator, there will be a reduction in congestion. If it happens to the south of the generator, congestion will increase.

Most of the UK's existing generation capacity lies in a band extending from the Midlands up to Scotland's central belt. As the amount of installed renewable generation capacity increases, much of the corresponding reduction in non-renewable generation will occur in this band. Thus, renewable generators located in the south of England will tend to reduce transmission congestion, while renewable generators located in the north of Scotland will tend to increase congestion.

The north and west of Scotland is extremely rich in wind, wave and tidal stream energy, and there are already plans on the drawing board for very large generation projects in this region. However, the large-scale exploitation of the region's resources will require substantial investment in new transmission capacity to relieve existing constraints in Scotland and the north of England.

Ambitious plans have already been tabled to achieve this, involving a high-capacity sub-sea cable link running down the west coast of Britain (see *Energy World* January 2002). The proposed link extends from the Hebrides in the north to Cornwall in the south. As well as providing an alternative route for energy heading south, this proposed infrastructure could offer a very cost-effective connection route for nearby generation projects using offshore wind, wave and tidal stream energy.

As well as providing the necessary infrastructure to allow renewable energy generated in the north of Scotland to meet demand further south, action is also needed to ensure that renewable generators in Scotland can trade effectively with electricity suppliers and demand customers in England and Wales. At present, the electricity market in Scotland operates according to different rules from the NETA system in England and Wales. Although power can be transferred between the two markets using the Scotland-England interconnector, the rules for using the interconnector make this an impractical option for independent renewable generators in Scotland.

The industry regulator, Ofgem, has been aware of this issue for some time, and has recently set out a three-year plan to address the problem. Ofgem's key proposals include:

- setting up a single, GB-wide electricity market based on NETA;
- new arrangements for transmission access and allocation of losses; and
- the creation of an independent GB-wide system operator, responsible for maintaining the balance of supply and demand on the system.

This plan addresses the strategic importance of Scotland's renewable energy resources to the UK as a whole, and should give confidence to developers and investors planning new generation projects north of the border.

Conclusion

Renewable energy can make a significant contribution to meeting the UK's requirements for energy in the medium to long term. The integrated electricity system is the key to achieving this goal, as it enables demand for electricity to be met as a result of the complementary operation of various renewable and non-renewable generation technologies. In addition, the geographical reach of the electricity system allows renewable generation projects in remote and rural areas to be integrated into the system.

The electricity industry is responding positively to the challenge. On a number of fronts, changes to the system are being discussed and implemented with the aim of removing barriers to renewable generation. From technical codes to trading arrangements, the electricity system is adapting itself to accommodate new forms of generation.

Looking to the future, the anticipated growth in renewable generation will trigger a wave of change in the industry. The operation of new renewable generators will give rise to changes in the electricity market, forcing existing generation plants to re-asses their roles. Strategic investments in transmission and distribution networks may be required, to accommodate the new pattern of generation. Finally, renewable generation technologies will themselves evolve in order to increase their own value to the system.

Econnect Ltd is a consultancy specialising in network connections and electricity trading for renewable energy projects.
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Renewable opportunities for

by Dr Andrew W Cox, Energy Intelligence & Marketing Research

The UK's offshore oil and gas industry will continue to be a significant contributor to the nation's economy well into the 21st century. However, the number of new projects in the UK Continental Shelf (UKCS) area will continue to decline during this decade - leaving many of the associated companies anxiously searching for alternative markets in order that they can have a viable long-term future.

Many of the UK's former shipbuilding areas (including the North East and North West of England, plus Scotland) have also been searching for new markets and technologies that can utilise the skill-base of their local workforces. Here, Andrew Cox reviews the scene, particularly from the North East of England.

During the late 1990s and post-2000, offshore renewable energy (particularly wind power - together with wave and tidal energy) has been viewed by the offshore industry as a major potential source of employment and revenue. Following the 1997 Kyoto Protocol, the Government set the target of producing 10% of the UK's electricity from renewable sources and it soon became apparent that offshore wind energy offered major scope for development. Of all the renewable energy sources, it probably holds the greatest potential.

The initial offshore wind turbine development off Blyth harbour, Northumberland, as well as the considerable experience gained in other countries (notably Denmark) has shown that offshore turbines are a viable option for the future.

Locating wind turbines offshore will also overcome many environmental objections - particularly the visual intrusion of large turbines in attractive rural countryside. When turbines are located several kilometres offshore they can be readily increased in size, height and generating capacity - with turbines of 3-5 MW planned for next few years. These large structures need to be fabricated, transported to their sites and commissioned. Such activities offer considerable opportunities for UK-based companies.

In April 2001 the development of offshore wind power was given a boost when the Crown Estate, which controls the sea-bed around the UK, awarded 18 licences for sites (each approximately 10 square kilometres) with a total potential generating capacity of 1-1.5 GW.

The companies with the new licences are keen to take up the opportunities that the UK Government is creating and develop these new offshore wind sites. An example is AMEC Border Wind, which was allocated a site for a major offshore wind farm in the North Sea, off the Lincolnshire coast, near Skegness. The development will involve 30 turbines, between five and ten kilometres offshore - which will generate enough electricity annually for over 60,000 homes. Investment in this project will be around £90 million, with construction scheduled to start during 2004.

AMEC moved into the wind turbine business five years ago (acquiring the North East company Border Wind during 2000) - and has been developing several wind farm sites in the UK. Mike Straughan, Managing Director of AMEC Services on Tyneside, recently told an industry seminar that: "Renewable energy, and particularly offshore wind, wave and tidal energy, hold the greatest potential for diversification". He also warns that diversification into renewables is not an option – but a necessity.

Offshore renewable energy developments are not restricted to the UK. Throughout the rest of Europe the pace of development has been equally (if not more) rapid - with over 5 GW of new offshore wind generating capacity anticipated by 2010. A recent report: *Global Perspectives for Renewable Energy 2001-2011* from Douglas-Westwood Ltd indicates that the worldwide 'practicable exploitable resource' of offshore wind energy is some 330 TWh - with 45% of the total being located in European waters.

Market potential

Diversification into supplying the renewable energy industry alongside existing UK oil and industry business has also been identified as a key priority by the Department of Trade and Industry.

The Department, under the auspices of PILOT, commissioned a study in 2000 which highlighted considerable potential opportunities in renewable energy, as well as transport, infrastructure and logistics. Of the renewables, onshore wind, offshore wind and tidal stream turbines, with a global value of £4.5 billion, were identified as having the closest fit with the UK oil and gas suppliers' capabilities.

The UK is one of the windiest countries in Europe and has the theoretical capacity to supply three times its current electricity requirements. But while the German wind industry employs 20,000 workers and Denmark 12,200, a significant UK wind turbine manufacturing base has yet to take root.

New alliances

In the wake of the DTI reports, the Northern Offshore Federation (NOF - a federation of 300 companies, based at Washington, Tyne & Wear) and the European trade association SeaPower Europe announced a formal alliance during August 2001 to ensure that the North East of England becomes a key force in delivering commercially competitive marine renewable energies and to secure for the region, maximum commercial exploitation for the growing domestic and export markets.

The Alliance will act as a bridge to regional mainstream engineering companies and growing inward investors who see increasing business and investment opportunities in electrical power generation using nearshore and offshore wave energy converters and tidal stream turbine systems.

Marine renewable power generation and wind energy systems generating power offshore are closely allied and present almost identical sub-sea and engineering challenges and opportunities. The Alliance

Britain's offshore industry

hopes to ensure that its drive to maximise regional exploitation of the growth in international markets for marine renewable power will also enable local companies to better pursue sales opportunities within the offshore wind power sector.

Planned initiatives to be directed through regional offices include delivering training seminars and workshops aimed at linking regional businesses with marine renewable energy sales and job opportunities.

In addition, parallel developments of the NOF and SeaPower Europe internet portal sites will ensure e-commerce links exist between regional businesses and the world's primary electronic gateway for marine renewables.

Explaining the role of the new Alliance, the Director of NOF, Alastair Rodgers said: "Suppliers and subcontractors in our existing sector have developed a high level of capability in the production of offshore oil and gas from the North Sea over the last 30 years. They are ideally suited, individually and collectively, to form an efficient and competitive supply chain to address these new opportunities. SeaPower Europe will provide the market intelligence to focus our efforts".

The North East region has already much of the knowledge base to move quickly and take the lead, particularly in equipment installation work, which represents the primary cost driver within the sector. Key regional skill-sets include sub-sea engineering, hydraulic and electrical services, instrumentation and control and project management.

The Alliance between NOF and SeaPower Europe is an excellent example of recent developments, which hopefully will lead to UK-based industry taking a prominent role in the exploitation of offshore renewable energy.

Making the right connections

During November 2001, Brian Wilson, the Minister for Energy, announced that UK consultants are developing a plan for a subsea cable link down the west coast of Scotland, England, Wales and Northern Ireland to provide an offshore electricity grid using green energy sources - such as offshore wind farms, wave and tidal energy. In particular, Scotland's west coast has vast wave and wind resources (recently estimated at several times the UK's electricity requirements). However, the infrastructure to relay the power to the national grid is lacking.

The Government has commissioned PB Power, based in Newcastle upon Tyne, to produce a feasibility study on the possibility of the cable link. PB Power was awarded the initial contract because of its experience in power transmission and renewable generation, including previous studies for the UK Government into wind farm connections.

However, not everyone has been wildly enthusiastic about the proposals for an offshore grid system - mainly due to the high construction costs. Connecting an increasingly large number of offshore wind and wave generation sites to the onshore national grid will require a significant investment in the essential transmission infrastructure. It would appear to be logical to adopt a more long-term and strategic approach to this issue and develop a comprehensive system of offshore grid/connection systems rather than allowing the piecemeal (and potentially more expensive?) connection of new offshore wind and wave sites.

However, whichever option is eventually adopted, this work will inevitably create significant employment opportunities within the UK engineering, consultancy and offshore industries.

New renewable centre

An important development in the renewable energy sector could help the North East of England take centre stage in the renewable energy sector.

Plans for a new national renewable energy centre (with an initial budget of £20 million) are well advanced. The centre will be a joint venture involving all five of the North East region's universities plus other industrial partners - with funding expected from a range of sources. Several renewable energy sources will be promoted by the centre, which will also include large-scale testing facilities (up to 0.5 MW). Another element of the project is the creation of a major database by the major participants, including the British Wind Energy Association (BWEA). A new dedicated web site for the project is also planned, which should be launched during early 2002.

OPET-Scotland Marine Energies Review

Of course there is also a considerable concentration of offshore renewables ability in Scotland too.

Renewable Energy in Scotland – marine energies is a new booklet produced by NIFES Consulting Group as part of its role as OPET-Scotland. Part of the European Commission's OPET network, OPET-Scotland has produced the free booklet to explain the current state of developments in Scotland.

The recent announcement of detailed studies for a proposed new Scottish marine energy test centre in Orkney reinforces the importance being attached to the development of new marine energy resources.

The OPET-Scotland booklet has been produced with the help of wave energy companies Wavegen and Ocean Power Delivery; the Tidal Current Group at Robert Gordon University; Tom Thorpe of ETSU and John Griffiths of new trade association SeaPower Europe, with support from Scottish Enterprise Energy Group.

Copies are available from Maurice Millar at NIFES in Glasgow, tel 0141 332 2453, e-mail: maurice.millar@nifes.co.uk

Holsworthy biogas – fuelled by manure and food waste

Construction of the UK's first, large-scale anaerobic digestion plant is nearing completion at the market town of Holsworthy in Devon. The plant has been built by the German company Farmatic Biotech Energy ag, which is also a shareholder in the project, which was established in 1998. Remaining shares will be held by the local community and the supplying farmers.

Farmatic started construction in February 2001, and aims to have full production from the plant by May or June.

Holsworthy Biogas will eventually process 146,000 tonnes per annum of cattle, pig and poultry manure plus organic food waste. The manure will be collected from 25-30 local farms within a 10 mile radius of the plant. The food processing waste will be collected direct from food processors in the South West.

The manure and food waste are first discharged into a reception pit. During unloading a ventilation system operates in the receiving hall. The air taken from the hall passes through a bio-filter in order to reduce any risk of odour.

The manure and waste are thoroughly mixed before being discharged into a larger mixing tank. The mixture is then heated to 70°C through a three-stage heat exchanger. The pasteurisation process takes one hour and kills all pathogens, viruses and weed seeds. The material that eventually leaves the plant is therefore safe for farmers to spread on their fields, and the risk of disease spread has been removed, says Farmatic.

After pasteurisation the mixture is pumped through the heat exchanger into either of the two 4000m^3 digesters located at the plant. Anaerobic digestion takes place at 37°C with an average retention of 20 days in either tank.

The biogas released by the digestion process is methane. It is initially cleaned in a de-sulphurisation unit and then stored in a gas holder above the final storage tank. The digestate (the digested waste mixture) is eventually returned to the supplying farmers as a valuable bio-fertiliser.

The plant will operate its own lorries, transporting the bio-fertiliser to the supplying farms and then returning with animal manure. The new lorries are specially designed for the task and can load 20 tonnes of manure in two minutes.

Extra storage facilities to hold the bio-fertiliser are provided on the farms by Holsworthy Biogas. This has been possible because of an EU grant. The bio-fertiliser has a higher nutrient value than the original animal manure, which means that farmers can reduce their use of mineral fertiliser. The extra storage capacity provided on farm means that farmers only have to spread the fertiliser during the growing season.

The methane produced by the plant will be used to generate electricity and heat by powering two, V-20 gas engines with a combined total power capacity of 2.1 MW.

The Holsworthy biogas plant under construction

The electricity produced will be sold at 5.72p per kWh (2001 price level) according to the NFFO contract (Non-Fossil Fuel Obligation) granted to Holsworthy Biogas. The price is indexed linked and will increase over time according to the Retail Price Index.

It is anticipated that all the excess heat produced by the plant will eventually be sold through a new district heating system, which will supply the market town of Holsworthy. The amount of heat available to supply the district heating main will be about 15 million kWh per year. Initially, it is planned that the hot water will be used to heat the town's new hospital and school.

The project in Holsworthy, which is based on many years experience gained from the successful operation of similar plants in Germany and Denmark, is expected to be the first of several anaerobic digestion plants in UK.

Jørgen Fink, Managing Director of Farmatic (UK) Ltd, believes that there is potential in the UK to build at least 100 plants. These would either be plants that co-digest animal manure and food waste (like Holsworthy), or plants that just digest food and household wastes.

Contact Jørgen Fink on tel: 01409 254 269, e-mail: fink@farmatic.co.uk.

New biomass plants

Paris-based ALSTOM has won an order worth around 75 million euros to supply German Utility E.ON Kraftwerke GmbH with two 20 MW biomass power plants.

To be built at Landesbergen in Lower Saxony and Zolling in Bavaria the plants will use mainly waste wood as fuel. Each plant will have a net power output of 20 MWe and a net plant efficiency of more than 30% in condensing operation mode. The two plants are scheduled for commissioning in December 2003.

ALSTOM will supply the two plants on a turnkey basis, including key components such as the steam turbine, cooling system, boiler and firing system, flue gas cleaning system and fuel and ash handling systems. ALSTOM will be responsible for overall engineering, site preparation and civil works in addition to erection and commissioning of all mechanical, electrical and control systems.

for Germany

The plant design minimises emissions whilst optimising the boiler, steam turbine and water-steam cycle to maximise efficiency, says the company. The boilers will be equipped with selective non-catalytic reduction technology as well as ALSTOM's state-of-the-art flue gas cleaning system. The firing system is based on the well proven and referenced ALSTOM travelling grate.

All equipment supplied will be fully compliant with Germany's stringent environmental protection and renewable energy laws.

ALSTOM has recently supplied equipment for biomass projects in Australia (wood and bagasse) and Spain (olive-oil residue).

In Germany, ALSTOM recently carried out conversion work at the Rosenthal power plant to allow an existing boiler to burn wood residues.

Model wave power device

Edinburgh-based Ocean Power Delivery Ltd (OPD) has received the cylindrical sections, from Poole based composite materials manufacturer Fibaflo, which make up its one seventh model of the Pelamis wave energy converter.

The Pelamis concept is semi-submerged, articulated structure composed of cylindrical sections linked by hinged joints. The wave induced motion of these joints is resisted by hydraulic rams, which pump oil through hydraulic motors via smoothing accumulators. The hydraulic motors then drive electrical generators with power from all the joints being fed down a single umbilical cable to a junction on the seabed.

Pelamis devices could be linked together to form 'wave farms' and OPD has set a provisional target to install perhaps 900 devices by 2010, with a total installed capacity of some 700 MW. The new prototype converter is one step towards that goal. The company already has a contract to install two 375 kW devices in Machir Bay under the Scottish Renewables Obligation.

PV-powered pump cuts parasitic losses for solar thermal system

A new study of eight solar water heating systems available in the UK has confirmed that the environmental benefits of a solar water heating system can be substantially improved simply by eliminating the use of mains electricity to run it. So say the makers of Solartwin systems, which incorporate a solar powered water pump rather than a mains-fed pump.

According to the report, around 20% of the supposed environmental benefits of using solar water heating systems are lost by using mains electricity to run them. A 100% solar approach was only used by one system in the test, Solartwin. All the other solar heating systems used mains electricity for measuring water temperatures and pumping water through the panels.

The environmental benefits were judged by how each reduced carbon dioxide emissions from burning gas in a boiler. Typically, the 'parasitic' use of electricity meant that carbon dioxide reductions had to be scaled back by 17% for flat plate type solar collectors, and by 23% for evacuated tube technology.

"Cutting parasitic electricity use to zero is important to users of solar water heating systems - not least because people use solar precisely because of its environmental benefits", commented Solar Twin's Barry Johnston.

Contact Solartwin at tel: 01244 403407, e-mail: barry@solartwin.com

Repowering Northern Ireland water turbines

Belfast based second tier electricity supply company Energia is benefiting from renewable electricity supplied by Harperstown Power, with the help of a Flender FZG geared water turbine.

Harperstown Power has redeveloped its water power plant at Hillmount, which dates back to the 18th century. The site had been used to process cloth, where water was the essential ingredient for power and for processing. In the 18th century, two weirs on the River Maine supplied water to five large water wheels, but between 1881 and 1912 three of these were replaced by new Francis water turbines made by John MacDonald of Glasgow.

With the development of electricity after World War I, by 1928 all the turbines had been connected to DC generators to replace line shafting, and a fourth turbine had also been installed. From then, up until 1994 these four turbines ran in parallel with a DC generator driven by a 370 hp WH Allen steam engine.

The textile industry saw a steady decline during the 1980s, but the Government's announcement of NI-NFFO (Northern Ireland Non-Fossil Fuel Obligation) in 1993, gave the prospect of a new life for these machines.

At Hillmount, the thrust bearing arrangement on the 39" MacDonald turbine of 1909 was redesigned and coupled to an 80 kW synchronous generator and an equivalent ballast load with control panel. This worked so well that last year Harperstown Power rebuilt the 1912 MacDonald turbine, coupling it to a 55 kW synchronous generator with ballast load and control panel.

Flender's B2SV5 helical gear unit is one of two turbines that supply electricity to the mill and to Energia in Belfast. The other two turbines supply power that goes straight into the National Grid. Between them the turbines produce around 1.6 GWh of electricity per year, of which 25% is used on site, 12% goes to the second tier supply company, and 63% is sold to Northern Ireland Electricity plc under a NFFO contract.

Contact Flender on tel: 01274 657700, e-mail: info@flender-power.co.uk

Renewables begin at home

West Beacon farm is indeed a beacon for renewable and sustainable technologies. Steve Hodgson visited the home of Tony Marmont, one of the Institute of Energy's most recent Companions.

How many small farms do you know which incorporate a couple of wind turbines, a sizeable photovoltaic array, solar thermal water heating, two small hydro-electric schemes, a tiny CHP unit, a heat pump and a couple of electric cars? Tony Marmont's West Beacon farm in Leicestershire has all of these and the former soft drinks businessman turned farmer/renewable energy enthusiast has not stopped there.

Marmont and a team of advisors have converted a set of redundant farm buildings, at the adjacent Whittle Hill farm, into state-of-the-art low energy office space for Beacon Energy Limited and the Midlands Renewable Energy Technology Transfer (MRETT). The latter organisation was established in 1996 and was initially funded by Marmont with the aim of putting local energy academia in touch with industry to maximise funding and development opportunities for both. Its remit now is the "development of the environmental economy through the commercialisation of sustainable energy technologies".

MRETT has now reached a crucial stage of its development, seeking funding firstly to continue its work, and hopefully to expand its activities, to replace that provided during its first five years by Marmont.

Tony Marmont is a remarkable enthusiast for energy efficiency, renewables and sustainable technologies, putting his money, time and commitment into all three. Now 72, he sold a very successful soft drinks business, which held 20% of the UK market, in 1992. Previously he had worked for Shell. His interest in the environment and sustainability was stimulated very early on, initially when flying over the Alps in the 1970s and seeing dirty snow and receding glaciers.

He decided to do what he could at the home he had lived in since 1966, first, in the early 1980s, buying a 4 kW heat pump to replace his oil-fired boiler and then installing first one and then a second 4 kW wind turbine, later upgrading both to 10 kW models. This led him to buy an ailing American manufacturer of wind turbines, Carters and install two 25 kW Carter machines on his land. The company was bankrupt but the product was good, says Marmont, and someone had to start selling wind turbines in the UK.

The 6 kW solar array at West Beacon farm

But the business didn't thrive - these were still pioneering days for wind in the UK and planning was as serious a problem then as it has been since. Marmont eventually sold the business on to India were it continues still.

By then he had been well and truly bitten by the renewables bug, but, given his lack of success in selling wind turbines, Marmont was keen to find ways to circumvent barriers to renewables. He hit upon the idea of funding MSc courses in renewables. Graduates of these courses would eventually trickle into planning and legislative establishment, to help create an environment in which renewables could thrive, he reasoned.

Now, three nearby university research centres have successful masters programmes in renewable energy: the Centre for Renewable Energy Systems Technology (CREST) at Loughborough University; the Institute of Energy and Sustainable Development (IESD) at De Montford University, Leicester; and the School of the Built Environment at the University of Nottingham. All were established with endowments from Tony Marmont. Nottingham's MSc in renewable energy and architecture has been approved for membership of the Institute of Energy.

Then came the micro hydro schemes, the PV array; most recently a new, tracking PV array, which automatically adjusts its position to face the sun. And there is considerably more to come - Marmont and Beacon Energy is part of a consortium, including Solar Century, the University of Nottingham and two Spanish companies, bidding for EU funding to establish a giant, 1 MW tracking PV farm on nearby farmland. The array, which would be 150 by 180 m in size, would cost perhaps 6 million euros to build.

But, these schemes apart, Marmont is now ready to step away from MRETT and let others not only fund the organisation, but also to take decisions about its future direction. MRETT itself has already begun to diversify into DTI and EPSRC-funded research and dissemination work and employs four people.

One of its many projects is to research the feasibility of producing a carbon neutral bio-jet fuel for aircraft. Typically of MRETT projects, the partners include major aviation companies, midlands-based universities and government departments - two studies are now going ahead, at Imperial College and Nottingham University.

A bio-fuel would start to tackle an already serious - and fast-growing environmental problem - that of carbon dioxide and other emissions from aircraft. It would also help Tony Marmont feel easier about his other great love - flying helicopters. Among the wind turbines and PV arrays at West Beacon farm is a splendid stone-faced hangar containing his own flying machine - which he still pilots to London every week.

Contact Tony Marmont at MRETT and Beacon Energy, tel: 01509 610033, or via the website at www.mrett.co.uk

Transporting natural gas – time to explore the hydrates option

by R A Dawe and S Thomas, Petroleum Engineering Unit, Department of Chemical Engineering, The University of West Indies, Trinidad

Natural gas travels by pipeline, does it not, or occasionally as LNG. However these are not the only options. Here, Professor Richard Dawe compares these two transportation options with gas-to-liquids, gas-to-wire, as compressed natural gas and, perhaps the method with most potential, as hydrates in gas-to-solids.

Natural gas is a major energy commodity, but it is usually found in places where it cannot be used. Because of this location difficulty, getting gas to market has prevented development of gas reserves in many countries. Sources of gas may be non-associated reservoirs (ie only gas within the reservoir) or associated gas, which is gas produced along with oil as pressure drops. Crude oil cannot be produced without some associated gas also being produced.

Worldwide, governments are being forced to stop flaring associated gas as their publics perceive that it is a waste of a valuable, non-renewable resource. When such restrictions occur, oil production must stop unless this associated gas is somehow exported or reinjected. Much gas is therefore stranded, ie has no current market, for example the many on or off-shore fields where there is no pipeline, or when flaring of associated gas is prohibited. Hence, there is some urgency to find economic ways to transport the gas, or its energy, or its compounds to market in order to realise its economic value.

Transporting gas to market

A number of methods exist to export gas from an isolated field –see Figure 1. Methods include:

- pipelines,
- liquefied natural gas (LNG),
- gas to liquids (GtL) with a wide range of possible products including a clean fuel oil and methanol,
- gas to wire (GtW) ie generate electricity at the producing field and transport the electricity by cable,
- compressed natural gas (CNG), and
- gas to solids (GtS) ie hydrates.

Additionally the energy within the gas can be used, 'converted', to create a commodity, gas to commodity, GtC, for example aluminium, cement, iron bars, glass etc.

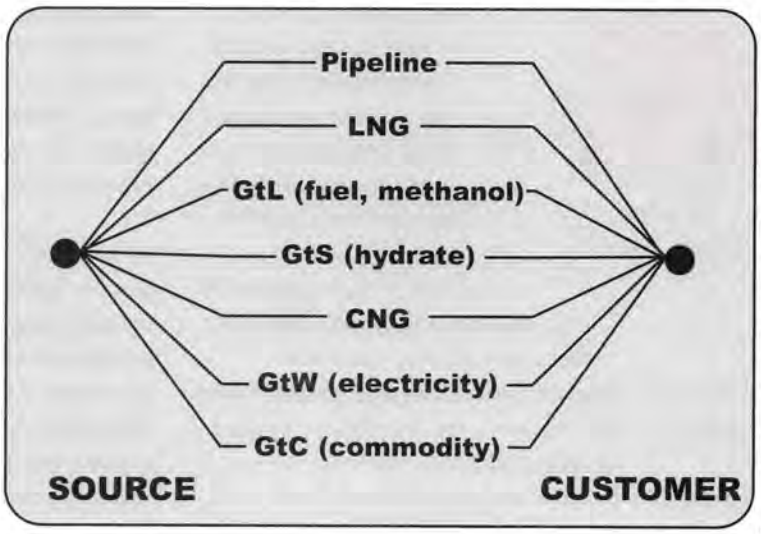

Figure 1 Gas transport options

Pipelines

Pipelines are a very convenient method of transport but are not flexible. Once the pipeline size is fixed the quantities of gas that can be delivered are fixed by the pressures, although an increase in the maximum quantity can be achieved by adding compressors along the line, extra pipe in the form of loops or increasing the pipeline pressure. Over, or at times, under capacity has to be catered for.

Export by pipeline, particularly subsea over 2000 miles (for example Middle East to Pakistan and India), has until recently, usually been regarded as uneconomic, because of subsea terrain making pipeline installation and maintenance expensive, and any recompression along the route difficult.

Pipeline pressures are normally 700-1100 psig (although 4000 psi lines are considered) depending on the material of construction and the age of the pipe. Pipeline installation currently costs, on average, $1-2 million per mile depending on the terrain (such as onshore, mountains or offshore, seabed flatness and depth) plus compressor stations. Overland pipelines are vulnerable to sabotage in hostile countries, often have to cross several political boundaries, and are uneconomic for small reserves. Subsea lines over large marine distances and difficult marine environments such as deepwater (trenches), ice scouring or where fishermen are active, can be difficult to maintain and also uneconomic.

Liquefied natural gas

LNG requires huge investment, complex machinery and special refrigerated ships. Export by LNG to Japan, the United States and Europe has now become economic due to improvements in technology and thermodynamic efficiencies of LNG facilities. Many more LNG trains are being built around the world, for example, in Nigeria, Angola, Qatar, Egypt and Trinidad, mostly with capacities of the order of 500

MMscf/day/train.

Currently gas transported as LNG costs around $15/bbl oil equivalent ($2.5 /Mscf of natural gas) for its journey from the reservoir to being landed at the consumers' storage tanks. One tanker of LNG can carry 135,000 m^3 LNG, equivalent to 3.2 Bscf of gas. At the consumer end an infrastructure for handling the reprocessing of vast quantities of natural gas from LNG is required which is also very expensive and vulnerable to sabotage.

LNG plants are large scale, long contract (20 years or more) and require large, perhaps greater than 3 Tscf gas reserves, and around $1 billion investment per 500 MMscf/day/train. Small volumes of intermittent gas are not economically attractive to the major gas sellers for LNG facilities or pipelines.

Thus, for the smaller markets for example islands, pipelines or LNG are not economic, although small, well-insulated container trade is being investigated.

Gas to liquids

Here natural gas is converted into a liquid via syngas (CO + H_2). The produced liquid can be methanol or a fuel, usually a clean burning motor fuel (syncrude), or some precursor for plastics manufacture (for example dimethylether or DME). The liquid is then exported by ship in a suitable tanker.

Methanol is a gas-to-liquids option that has been in commission since the mid 1940's. Methanol can be used in internal combustion engines as a fuel, but the market is limited, although the development of fuel cells for motor vehicles may change this. Methanol is best used as a basic chemical feedstock for the manufacture of plastics.

Other GtL processes are being developed to produce clean fuels, for example syncrude – diesel, or many other products including lubricants and waxes, from gas but require complex (and expensive) chemical plant with novel catalyst technology, and are currently only in their pilot stage. However, such premium sulphur free fuels may become mandatory in some downtown parts of cities to reduce poisonous pollution problems.

Gas to wire

With this option, electricity can be generated at or near the reservoir source and transported by cable (gas-to-wire). For instance, offshore or stranded gas could be used to fuel an (offshore) power plant (maybe sited in less hostile waters), which would generate electricity for sale onshore or to other offshore customers.

Unfortunately, installing high-power lines to reach the shoreline is almost as expensive as pipelines. There is also significant energy loss from the cables along the long distance transmission lines, more so if the power is AC rather than DC, and losses also occur when the power is converted to DC from AC and when it converted from high voltage used in the transmission to the lower values needed by the consumers. Some consider that having the energy as gas at the consumers end gives greater flexibility and better thermal efficiencies, using the waste heat for local heating and desalination. Operationally the generation plant must be able to shut down quickly (in around 60 seconds) and safely to keep a small incident from escalating, and must be able to start up again quickly.

One process group has described the process simply as, "just add water and stir"

GtW has been an option much considered in the US for getting energy from the Alaskan gas and oil fields to the populated areas, particularly California.

Compressed natural gas

Gas can also be transported in containers at high pressure, usually no more than 3000 psig. Originally these cylinders were heavy walled (and hence heavy in weight), but recently new designs using relatively long lengths of thin-walled tubing have been proposed (one perhaps 6.25 in outside diameter with a wall thickness of 0.25 ins and coiled into large diameter reels) and are being actively pursued. For instance a tube 9.6 miles long would become a helix of 50 ft outside diameter and 10 ft inside diameter and 11 ft high and contain 3 MMscf of gas at 3000 psig.

Recently special transport ships have been proposed which have long pipes contained within a hold and trademarked 'Votran'. Suitable sized ships or trucks would be needed to carry the gas to its destination. The gas has to be cleaned and compressed. Suitable compressors are needed, which may be large and expensive but would be standard, so that costs can be minimised.

CNG is used in some countries for vehicular transport as an alternative to conventional fuels (gasoline or diesel). However the time to fill a tank with 3000 psig gas can be slow and frustrating. The filling stations can be supplied by pipeline gas but the compressors needed to get the gas to 3000 psig can be large, multistage and expensive to purchase and operate. The thermodynamics of gas compression (heat generation), and gas expansion (significant cooling), have to be considered in any gas processing operation and appropriate heat exchangers used, which adds to the costs significantly. A gas network is also needed.

Gas to solids

Gas can also be transported as a solid, with the solid being gas hydrate. Hydrate is the product of mixing liquid water with natural gas to form a stable snow-like substance. In the industry, natural gas hydrates are mostly a pipeline nuisance and safety hazard, and require considerable vigilance by the operators to ensure that they do not form as they can block pipelines if precautions, such as methanol injection, are not taken. Millions of dollars are spent annually in their prevention.

However, hydrates also may become a major source of natural gas. Vast quantities of gas hydrate have been found in permafrost and at the seabed in depths below 500 m and, if properly exploited could become a major energy source in the next 30 years. Estimates have been made that the volume of methane in these

hydrates is two or perhaps as great as10,000 times as much as current conventional gas reserves, leading to considerable worldwide interest in finding methods to extract them.

Natural gas hydrate slurry can be deliberately formed by mixing natural gas and water at 80-100 bar and 2-10°C. One process group has described the process simply as, "just add water and stir". It has been found that if this slurry is refrigerated to around −15°C, it will only decompose very slowly at atmospheric pressure, so that the hydrate can be transported by ship to market in simple insulated (inexpensive compared to LNG carriers) bulk carriers ie a large thermos flask under near adiabatic conditions.

At the market, the slurry is converted back to gas and water by controlled warming for use in electricity power generation stations or other requirements. The manufacture of the hydrate could be carried out using mobile equipment for onshore and ship for offshore (FPSO – floating production, storage and offloading vessel) with minimal gas processing prior to hydrate formation, which is attractive commercially. In fact ethane and propane form hydrates under 'easier' conditions than methane. The water can also be used if needed.

One cubic metre of hydrate will contain about 160 sm^3 of gas per m^3 of water which makes the 'concentration' of gas very attractive compared to the 200 sm^3 compressed (high pressure, greater than 200 bar) or the 637 sm^3 liquid (at -162°C) gas because the hydrate can readily be stored at normal temperatures (0 to -10°C) and pressures (10 to 1 bar) which is easier, safer and cheaper. The thermodynamic and phase diagrams of water, hydrate and various gases have all been well researched and documented and a pilot plant has been demonstrated by Advantica Technology Ltd.

Comparisons

Detailed economic models for bulk gas transportation have been developed for the entire LNG, GtL, CNG and GtS chain for both onshore and offshore production facilities. Calculations of which is the better (cheaper and cost effective) transport scheme are fraught with danger of not always comparing like with like, ignoring the risks of higher capital borrowing for a more complicated process, differences in technical difficulty and maintenance costs as well as local idiosyncrasies. Although projects are location specific, the GtS dry process in particular is believed to be cheaper than LNG for similar duties for a green site plant of 500 MMscf/d.

the GtS dry process in particular is believed to be cheaper than LNG

A GtS hydrate plant will have capital costs much lower than for LNG, perhaps half or less. Consequently the payback period will be shorter for the same gas throughput. However, competition with LNG for expansion of these large sized gas transport projects is unlikely, as too much has already been invested in LNG. But, for green site developments and smaller niche markets, portable equipment can be brought onto site to process associated gas, and then used until either pipeline facilities are built, or other infrastructure developed or the gas production rate drops below economic values.

There is still the small volume needs, for instance the Caribbean, Black Sea, Indonesian and Mediterranean tourist industries which are using increasing quantities of electricity but really have only a 'small' energy demand. For instance, a large five star hotel may use perhaps 11 MkWh of electricity per year, which would use only some 70 MMscf/yr of gas (around 200 Mscf/d). Such small volumes of gas are available as stranded gas, or maybe even from flaring prohibition of associated gas in fields not connected to a major LNG facility.

Summary

Transportation of natural gas as hydrate or CNG is feasible at costs believed to be less than those for LNG and where pipelines are not possible. The competitive advantage of the GtS or CNG process over other non-pipeline gas technologies is that they are intrinsically simpler processes and, as a concept, far easier to implement. They should be feasible at lower capital costs and with variable gas inputs. The hydrate manufacturing process does not involve extreme temperature, either high or low, does not require an oxidant or a catalyst, nor feature any complex unit operations other than standard process equipment, and the pressures are not extreme. In addition, the technology is able to cope with an intermittent and variable gas production with time, as is often the case with associated gas.

The delivered cost of gas by hydrate or CNG should be able to compete in the energy market at any scale compared to LNG, by focusing on niches such as offshore associated gas or stranded onshore gas. The economics of gas transportation can become a small part of a much larger development. Perhaps an oil or gas field may not be developed if there is no means to dispose of the gas.

We must never forget that fuel oil can also be used in similar applications, with clean up of the exhaust gases, with users claiming that they are being clean and green. However fuel oil produces more carbon dioxide for the same energy output than gas, and the environmental cost is higher per tonne of carbon dioxide emitted. It must be remembered that 1 barrel of oil (0.16 sm^3) gives as much energy as 6000 scf (170 sm^3) of gas, so that if the oil price is $15/bbl then at equivalent energy rates, gas should sell at approximately $2.5 per Mscf.

Finally there is the ultimate solution where an alternative energy of solar, wind or wave power conversion is used and so is totally green. This must surely happen one day, but in the meantime perhaps power via gas transported by GtS or CNG is the answer.

Contact Professor Dawe on
tel: +1 868 645 3232 x 2164,
e-mail: radawe@eng.uwi.tt

Events

February 2002

Middle East Electricity
Exhibition and conference
3-6 February, Dubai
www.middleeastelectricity.com

Energy efficient utilities
Workshop
5 February, Plymouth
Contact: ETSU, Luke Allen
tel: 01235 436841
e-mail: luke.allen@aeat.co.uk

Be BETTA prepared
Conference 6 February
Edinburgh, £250 + VAT
Contact: ICIS Technology Ltd
tel: 01423 524192, e-mail:
nbroadley@icistechnology.com

Panorama 2002
Colloquium, 6-13 February
Brussels
Contact: The Institut Francais du Petrole
tel: +33 1 47 52 71 60, e-mail:
benedicte.reverdy@ifp.fr

InstE Branch Event
NETA - How was it for you?
Seminar, 7 February
Birmingham
Contact: Midlands Branch
Vian Davys
tel: 01332 666296
e-mail: vian.davys@eme.co.uk

Petroleum trading and international law
Conference, 11-12 February
London
Contact: Abacus International
tel: 01953 497099
email: register@abacus-int.com

Scandinavian gas and power
Conference
11-13 February, Oslo
Contact: IBC Conferences
tel: 0207 017 4052
www.ibcenergy.com

Sustainable transport
Transport Action workshop
12 February, Liverpool
Contact: Glasgows
tel: 01772 767781
www.transportaction.org.uk

Designing for BREEAM
Course, 12 February, Belfast
Contact: Mid Career College
tel: 01223 880016
e-mail: courses@mid-career-college.ac.uk

InstE Branch Event
Coal research: from the power station to a sustainable future
Seminar, 13 February, Leeds
Contact: Yorkshire Branch
Andrew Mallalieu
tel: 0113 276 8888, e-mail:
info@facultatieve-technologies.co.uk

Competition in gas & electricity metering
Conference, 13 February
London
tel: 01323 430816
fax: 01323 430817

E-world of energy
Conference and exhibition
13-15 February, Germany
tel: +49 201 1022 401
www.e-world-of-energy.com

Offshore wind energy
Conference, 18-19 February
London
Contact: Emma Woodward
tel: 01932 893851, e-mail:
cust.serv@informa.com

Alternative energy: is it the future?
Seminar, 19 February,
venue TBC
Contact: Chris Maude
tel: 01622 858762

Emissions trading
Conference, 19-21 February
Amsterdam
Contact: Hilton Mundy
tel: 020 7375 7575, e-mail:
hmundy@eyeforenergy.com

Strategies for the online energy market
Conference, 19-21 February
Amsterdam
Contact: Hilton Mundy
tel: 020 7375 7575, e-mail:
hmundy@eyeforenergy.com

InstE Branch Event
Offshore renewable energy
Seminar, 20 February
Newcastle
Contact: North East Branch
Andrew Cox
tel/fax: 0191 261 5274, e-mail:
awcox@eimr.demon.co.uk

Customer loyalty and profitability in the utilities
Conference, 20-21 February
London
Contact: IIR Conferences
tel: 020 7915 5055
e-mail: registration@iir-conferences.com

InstE Branch Event
Visit to the Commonwealth Stadium
21 February, Manchester
Contact: North West Branch
Brian Doran
tel: 0161 817 4036, e-mail:
brian.doran@burohappold.com

InstE Branch Event
Annual Idris Jones memorial lecture
Lecture, 22 February, Cardiff
Contact: South Wales & West of England Branch
Tony Boulton
tel: 0117 932 3322,
e-mail: a.boulton@talk21.com

Offshore pipeline technology
Conference,
25-26 February, Amsterdam
Contact: IBC Global Conferences
tel: 01932 893851
e-mail: cust.serv@informa.com

An introduction to CHP
Course, 27 February, London
Contact: Mid Career College
tel: 01223 880016
e-mail: courses@mid-career-college.ac.uk

The future of utility network management
Seminar, 28 February, London
tel: 01323 430816
fax: 01323 430817

Institute of Energy short courses programme 2002

A number of one-day short courses are being held this year on the following topics: managing energy, sustainable development, energy auditing, monitoring and targeting, and alternative fuels for road transport. To register your interest, please contact Katie Moore on tel: 020 7580 0008 or e-mail: events@instenergy.org.uk

Events

March 2002

InstE Branch Event
Optimisation of aluminium melting processes
Seminar, 4 March
Wednesbury, West Midlands
Contact: Midlands Branch
Vian Davys
tel: 01332 666296
e-mail: vian.davys@eme.co.uk

Fuelling the future: energy storage
Seminar, 5 March, London
Contact: Katie Moore
Institute of Energy
tel: 020 7580 0008
e-mail:
events@instenergy.org.uk

Power to the heat
Conference, 5 March, Brussels
Contact: Euroheat & Power
tel: +32 2 7402110
e-mail: info@euroheat.org

Environment strategy for upstream oil and gas
Conference
5-6 March, London
Contact: Global Business Network Ltd
tel: 0207 291 1030
e-mail: info@gbnuk.com

InstE Branch Event
Annual dinner
6 March, Culloden Hotel
Contact: Northern Ireland Branch, David McIlveen-Wright
tel: 028 7032 4477, e-mail:
dr.mcilveen-wright@ulst.ac.uk

InstE Branch Event
Developing the low carbon economy
Seminar, 6 March, Newcastle
Contact: North East Branch
Andrew Cox
tel/fax: 0191 261 5274, e-mail:
awcox@eimr.demon.co.uk

National science week
Special event, 8-17 March
Contact: Lisa Jones
tel: 020 7973 3500
e-mail: lisa.jones@the-ba.net

Life assessment of fossil fuel power plants
Conference, 11-13 March
Orlando, Florida
Contact: Katie Ahrens
tel: +1 415 455 9583
www.epri.com

Sustainable transport
TransportAction workshop
12 March, Cardiff
Contact: Glasgows
tel: 01772 767781
www.transportaction.org.uk

InstE Branch Event
Anything to declare?
Seminar, 12 March, Yorkshire
Contact: Yorkshire Branch
Andrew Mallalieu
tel: 0113 276 8888
e-mail: info@facultatieve-technologies.co.uk

Reassessing risk and emerging opportunities for the oil and gas industry
Conference, 13-14 March
London
e-mail: penny@gbnuk.com
www.gbnuk.com

InstE Branch Event
Young persons' short paper evening
Meeting, 14 March, venue TBC
Contact: South Wales & West of England Branch, Prof. Syred
tel: 01222 874318

The future of utilities
Conference, 14-15 March
London
Contact: Lee Gisbourne
tel: 020 7608 3491
www.marketforce-communications.co.uk
Co-sponsored by the Institute of Energy

Energy: new era, new governance
Conference, 18-19 March
London
Contact: Philippa Challen
tel: 020 7957 5700
www.riia.org

Opportunities presented by the Kyoto mechanisms
Conference, 18-19 March
London
Contact: Marcus Evans Conferences
tel: 020 7436 5735
fax: 020 7436 5741

UK Energy Policy
Seminar, 19 March, venue TBC
Contact: Chris Maude
tel: 01622 858762

InstE Branch Event
Annual AGM
AGM, 19 March, London
Contact: London and Home Counties Branch, Joanne Wade
tel: 020 7359 8000
e-mail: joanne@ukace.org

Power plant operations maintenance & management
Conference, 20-21 March
Berlin
Contact: Laura Beachus
tel: 01932 893851
e-mail: cust.serv@informa.com

Environmental challenges
Seminar, 20 March, London
Contact: Andrea Whitehead
tel: 01926 462908
e-mail: events@sbgi.org.uk
Co-sponsored by the Institute of Energy

InstE Branch Event
Annual General Meeting
AGM, 20 March, Warrington
Contact: North West Branch
Brian Doran
tel: 0161 817 4036, e-mail:
brian.doran@burohappold.com

Sustainable transport
TransportAction workshop
22 March, Glasgow
Contact: Glasgows
tel: 01772 767781
www.transportaction.org.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.

Training in energy management through open learning

The Institute of Energy's Training in Energy Management through Open Learning (TEMOL) course has been running since the mid-1990s, but it has never been more relevant. The last year or so has seen energy management take on a new importance as a result of the Government's Climate Change Programme and particularly the Climate Change Levy. But even those organisations not directly affected by the Levy are beginning to take the management of energy more seriously as the climate changes - both literally and metaphorically.

These changes in business and industry are affecting education and training provision on energy management, but this is a slow process. Although new energy management degree programmes are planned, they will take some years to come on stream. One can currently count the number of degrees in energy management in the UK on the fingers of one hand and this situation will not change immediately, even though the discipline's profile is improving.

TEMOL fills the gap left by higher education provision and provides a means for those requiring formal training in energy management to gain the knowledge that they require without having to commit to attending classes. Designed for practising professionals, by practising professionals, TEMOL has an emphasis on flexibility. Students study at home in their own time, but that's not to say that they're unsupported. Each student has a tutor to guide them through the assignments and to help with any academic difficulties. In addition, the InstE produces a regular newsletter for students, and staff are on hand to provide advice on obtaining reference materials and other administrative issues. Students have also taken the initiative and set up their own informal working groups to support each other. The now ubiquitous electronic communications media have facilitated these initiatives and helped to make open learning a far less isolating experience than it once was.

TEMOL comprises 260 hours of study materials - including the 7 assignments - at approximately first year degree level. In addition, students complete the course by undertaking a 100-hour workplace-based practical project. This is a strong selling point to employers, as students tackle real problems within their organisations whilst also meeting the course's educational requirements. Solving such problems, with the expert support of a tutor, could well lead to financial savings over and above the cost of the course itself.

The InstE recommends that the 360 hours of work should take around eighteen months, but this is a guide only. We appreciate that personal circumstances vary from student to student and that the situation of any individual student may change during their time on the course. As noted above, the emphasis is on flexibility. If students have taken the initiative with regard to their professional development and chosen to study in their own time, we certainly don't wish to impose restrictive rules and time scales upon them.

Successful TEMOL students are awarded the Institute of Energy's Certificate of Competence in the Fundamentals of Energy Management. This provides a recognised qualification as a Professional Energy Manager - having all the competencies required to do the job at line management level. Additional specialist units are being developed to reflect the increasingly diverse work of those responsible for managing energy. Students can also access the benefits of InstE membership upon enrolment on TEMOL and are invited to register at the appropriate grade - free of charge - for one year.

TEMOL is unique amongst energy management courses in terms of the subject areas that it covers. Whilst there are numerous technical training options available - to keep you up to date with the latest developments in plant and equipment - there are very few that recognise that as with other management functions, there are two aspects to the work of the energy manager. The ability to competently use and manage energy as a resource requires knowledge of energy equipment, energy transfer and energy use. This demands expertise and practical skills in science and engineering. But in addition, any manager is required to manage people and to direct or guide them. They must also be able to discuss with other managers matters of converging interest and concern, such as financial and personnel issues.

The table shows the structure of TEMOL and the subjects covered by its units. If you think that you, or a colleague, would benefit from training on these issues, contact the InstE's ***Education Department on 020 7580 7124 or e-mail education@instenergy.org.uk*** and we'll be glad to help.

TECHNICAL PACK	MANAGEMENT PACK
Block 1. Technical Aspects	**Block 2. Overview & Practice**
Element 1. Introduction to Energy Technology	Element 8. Overview of Energy Utilisation
Element 2. Principles of Fuel Combustion	**Block 3. Energy Management**
Element 3. Combustion Equipment	Element 9. Management Techniques
Element 4. Energy & Environment	Element 10. Developing the Financial Case
Element 5. Heat Transfer Fundamentals	Element 11. Energy Auditing
Element 6. Mechanisms of Heat Flow	Element 12. Energy Costs, Tariffs & Scheduling
Element 7. Instrumentation	Element 13. Monitoring & Target Setting
	Block 4. Energy Efficiency
	Element 14. Energy Efficiency

First technician member elected

The Institute of Energy is proud to announce its first applicant for Technician Member, Mr Frederik Wassing, has been elected into membership.

Available to those aged 21 and over, who possess an advanced GNVQ, National Certificate, Diploma or equivalent, and have completed a minimum of four years training and experience in an energy-related occupation, the InstE was able to offer this new grade of membership following changes to the InstE byelaws this year.

Mr Wassing is currently the Systems Engineer with Eternit Building Materials, responsible for the development and implementation of preventive maintenance systems and energy saving systems. With broad experience of technical and processing production problems within a FMCG environment, he has been instrumental in the implementation of innovative approaches to maintenance and engineering and preventive maintenance system improvements to production equipment. Having studied electronic engineering at degree level, with diplomas in electrical and mechanical engineering as well as certificates in electric welding and quality management & quantity control, Frederick felt that the Institute of Energy offered the right combination of disciplines that are vital for someone in his position.

Mr Frederik Wassing

If you would like to know more about either joining the Institute of Energy or transferring to the Technician Member grade, please contact Holly Naisbitt for more information on tel: 020 7580 0077 or e-mail: membership@instenergy.org.uk

MEMBERSHIP SUBSCRIPTIONS REMINDER

Thank you to those members who have paid their annual membership subscription for 2002, your prompt payment is appreciated.

If you have not yet paid your subscription, we would appreciate you doing so in the next few days.

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

Forthcoming events

In this, our 75th year, the Institute has a number of exciting events planned, covering a broad range of topics to educate and inform all those working in the world of energy.

Energy Storage for next 25 years

The Institute of energy will be organising a free event on the 5 March to consider new thinking in energy storage. This event encourages all those working in the field of energy storage and research to bring forward their thoughts as to future developments in this field.

Managing Energy

The Institute of Energy is running a series of one day courses designed to support all those involved in energy management. The course is delivered as a series of talks and workshops by expert practitioners with many years experience. It will allow energy professionals and newcomers alike to keep up to date with recent developments, to participate in valuable discussion and to meet like-minded colleagues in the energy management field.

Professional Practice for Sustainable Development

This is a one day course designed to enhance your understanding of sustainable development and help you put your learning into practice. The course has been developed to introduce the principles of sustainable development in a thought-provoking manner, requiring participants to assess their own knowledge, skills and experiences along with case studies from business and industry to illustrate how these principles are being applied.

Institute of Energy Lectures

The Institute is considering extending its events programme to run a series of lectures throughout 2002. These lectures would profile key individuals, organisations and issues of topical interest from the energy world. Please assist us in formulating our research into such an event. Let use know your thoughts regarding what time of day would be most preferable; how much would you be prepared to pay to attend such an event; and an indication of speakers who you would be interested in.

To register your interest for these events or for more information, please contact Katie Moore on tel: 020 7580 0008 or e-mail: events@instenergy.org.uk

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Hydrogen Energy Assocaition of the UK and Ireland

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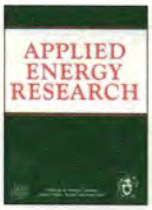
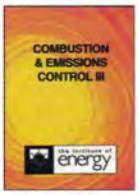


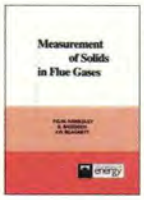
Applied Energy Research
Published by Institute of Energy and Adam Hilger, Bristol and New York.
Institute of Energy Applied Energy Research Conference proceedings 1989.
Sessions include: Optimising thermal energy transfer; renewable energy update; efficient generation and utilisation of electricity; energy management; and thermal energy processes.
Was £10.00 now only £5.00 (plus P&P of £1.80 within the UK*)

Ceramics in Energy Applications (1994)
Institute of Energy Ceramics in Energy Applications Conference proceedings, 1994. A collection of refereed papers on both the fundamental and applied aspects of the science and technology of high temperature ceramics, for engineers, manufacturers and users of ceramics. Chapters include: New developments and applications; power generation; energy saving and heat transfer; sensors and catalysts; and evaluation and performance.
Was £10.00 now only £8.00 (plus P&P of £1.35 within the UK*)

The Good Energy Manager's Guide Author: Trevor Boutall in conjunction with the Institute of Energy and British Gas, 1994.
The Good Energy Manager's Guide has 74 checklists for practical energy management. Based on the national standards for Managing Energy, this book is full of step-by-step checklists to help you deal with everyday energy management issues, including energy purchasing, managing information and championing energy efficiency.
Was £12.99 now only £4.00 (plus P&P of 80p within the UK*) Be in quick, limited copies available.

Combustion & Emissions Control III Editor: The Institute of Energy.
A collection of refereed papers from the field of combustion science and technology, reporting research and development in the field. Sections include: novel combustion systems; gas turbines; pollutants; power generation; biofuels; and industrial experience of new combustion systems.
Was £10.00 now only £5.00 (plus P&P of £1.20 within the UK*)





Measurement of Solids in Flue Gases Authors: P.G.W Hawksley, S. Badzioch, J.H. Blackett In conjunction with the Institute of Energy, second edition, 1997.
The purpose of this publication is to make available in a convenient form, the experience gained and conclusions reached from an extensive series of investigations into the sampling of solids emitted in the waste flue gases from solid-fuel-fired plant. The material is presented in three parts, covering different aspects of the subject and written to meet the needs of readers.
Was £29.00 now only £18.00 (plus P&P of 90p within the UK*)

Fire and Explosion Hazards - Energy Utilisation Published by the Institute of Energy.
Institute of Energy Fire and Explosion Hazards Conference proceedings 1991.
Sections include: Plant performance - codes of practice/guidelines; plant performance - practical safety aspects; explosion suppression/prevention; modelling/design criteria; energy storage and handling - industrial, LPG/compressed gases; and transportation.
Was £10.00 now only £5.00 (plus P&P £1.35 within the UK*)

Small Scale CHP Authors: L.L. Gill and A.J.P. Ward
A modular teaching pack providing in-depth coverage of combined heat and power technology and its applications. The pack provides a series of pick-and-mix modules, which can be used to illustrate practical applications of fundamental technologies. Published by the Institute of Energy, commissioned by the Energy Efficiency Best Practice Programme.
Was £49.00, now only £29.00 (plus P&P of £6.00 within the UK*)

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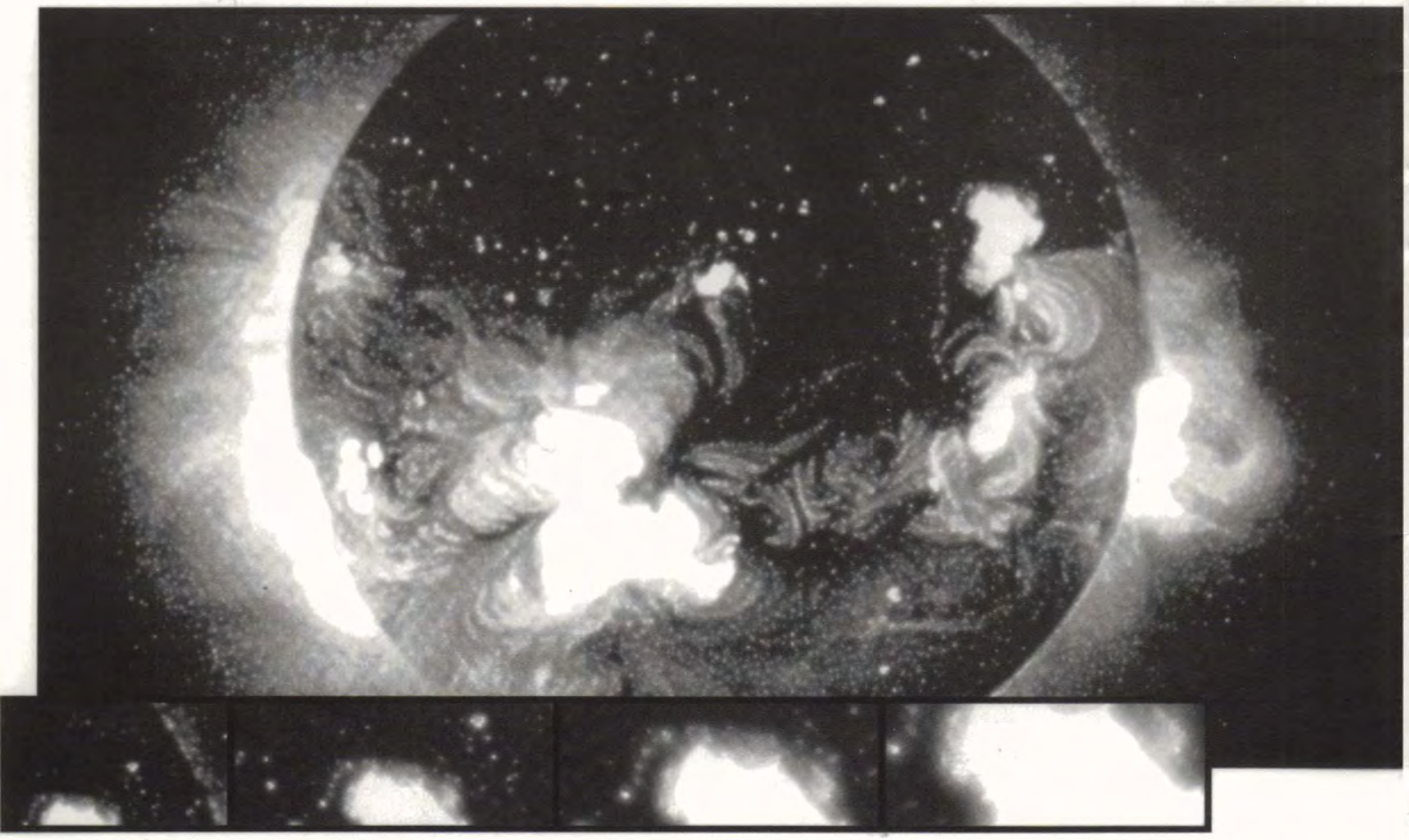
Conventional energy concepts have been around for a long time.



Unconventional concepts can be seen from 15 – 20 April 2002.

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