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FEBRUARY 2005

Prospects for the UK marine energy sector

Biodiesel from Jatropha beans

Postgraduate energy research in London

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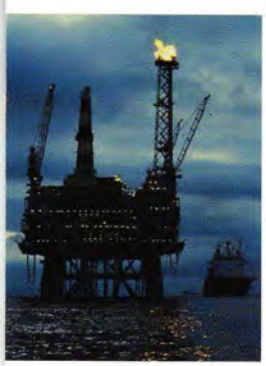

NEW COURSE

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Who should attend?

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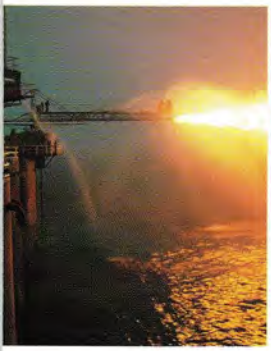

NEW COURSE

Global natural gas developments and opportunities: contrasting roles for pipeline, LNG, GTL, Gas-to-Power and petrochemicals

6-8 April 2005

EI Member £1,400 (£1,645 inc VAT) Non-member £1,600 (£1,880 inc VAT)

This **3-day** course reviews the development and opportunities of the natural gas supply chain from the subsurface reservoir through the wellhead and transportation system to the variety of end-user markets. Technical and cost-effective developments have made gas cost competitive against oil, solid fuel, nuclear and alternative energy options. A progressively liberalised gas market presents new commercial opportunities. Selected case studies underline the challenges and opportunities being exploited and developed in this growing market.

Who should attend?

This course is designed for a multi-disciplined audience with diverse commercial, technical, corporate, operations, planning and risk management backgrounds from various sectors of gas and power supply chains. Course content addresses issues and skills relevant to professionals working within companies producing, trading and marketing gas and the many service sectors supporting the industry, including: analysts, asset and portfolio managers, bankers, economists, engineers, gas traders, geologists, insurers, lawyers and risk managers.

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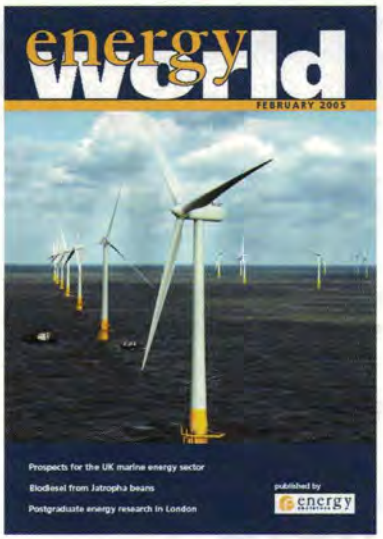
Commissioning of the 60 MW Scroby Sands wind farm, just off the beach at Great Yarmouth, has doubled the UK's offshore wind generating capacity, and there is more to come – see page 8.
But, this issue we also take a serious look at the prospects for Britain's other marine renewable technologies – wave and tidal power. This is an area where, with sufficient foresight and investment, Britain really could become the world leader – see page 10.



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Ten years on from Kyoto – more leadership required

Mark Kenber,
Policy Director, the Climate Group

March 2004 marked the tenth anniversary of the entry into force of the UN's Framework Convention on Climate Change and so the end of a decade of international efforts to reduce emissions of greenhouse gases and introduce the technologies and practices that will set the world on the path to a low carbon economy.

In the Climate Convention, countries agree that they "should take precautionary measures to anticipate, prevent or minimise the causes of climate change and mitigate its adverse effects." In particular, industrialised countries agree to "adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs." In doing this, governments explicitly recognised that "lack of full scientific certainty should not be used as a reason for postponing such measures". The mandate is clear.

So how have we done in meeting this challenge? Assessing the progress that has been made in this decade is not easy. While our knowledge of the problem is considerably broader and deeper than before, we still do not know exactly what we have to do or how far we have to go to solve it. Wrong policy choices may lead to failure to resolve the problem and large costs, but doing nothing will undoubtedly make the problem worse and restrict our options.

In both industrialised and developing countries, there is far greater awareness of the climate change problem. 189 governments have ratified the Climate Convention and 132 have also ratified the Kyoto Protocol. All undoubtedly have some legislation on their statute books that refer to the problem and many have measures designed to limit the growth of greenhouse gas emissions in place. Europe's introduction of emissions trading is perhaps the most ambitious of these.

The effects of these policies are beginning to be evident. In most countries emissions growth has begun to slow. Emissions in the EU-15 countries had fallen to 2.9% below 1990 levels by 2002, with the UK and Germany having cut their emissions by 15% and 19% respectively. The emissions intensity of production has been cut almost everywhere. Accompanying this has been widespread promotion of renewable energy. A combination of subsidies and market-based incentives has led to a more than six–fold increase in wind and annual solar PV capacity growth of over 20%.

Nevertheless, despite over a decade of action, emissions are still far above the level required to stave off dangerous climate change. Only 16 of the 36 industrialised countries covered by the UN Climate Convention fulfilled their voluntary commitment to reduce emissions to 1990 levels by 2000, and the vast majority of those that did so achieved it through one-off contractions in economic output. The Kyoto Protocol is a direct response to this. As a whole, global emissions are more than 10% above 1990 levels, with those of the developing world having grown by over 40%. Emissions in the transport sector in particular are continuing to accelerate and effective policies are proving elusive.

Overall, therefore, while a reasonable start has been made on designing and implementing policies in a number of countries and regions, emission levels are still stubbornly rising. Nor do recent developments in the international negotiating arena offer much immediate hope. The last three COPs have been characterised by a lack of vision and unwillingness to compromise on even the most technical details. In many senses backward steps have been taken.

The debate has been hamstrung by a condition self imposed by many countries, under pressure from a number of business sectors, that measures to mitigate climate change should do no harm to the economy. In economic terms, this means we are optimising the wrong variable subject to the wrong constraint: the appropriate formulation is to optimise the economy subject to some science-based acceptable emissions level, not the reverse. In other words, we should be prepared to accept some short-term losses where we are convinced that these are likely to reduce economic disruption in the longer-term and/or bring secondary advantages, even where these costs and benefits may not be fully computable.

With negotiations on future international commitments due to start this year, a change in attitude based on a recognition that mutual action at different levels can bring mutual benefits is sorely needed if these are to be productive. Fortunately, a growing number of organisations – companies, local governmental and other pubic institutions – are demonstrating that emissions can be reduced, often dramatically, and with increased revenue or cost savings. Recent research by The Climate Group has highlighted a wide range of companies and local and regional governments that have made major emission cuts and saved billions in the process. For example, five major international companies that have achieved emissions reductions of over 60% and saved nearly US$3 billion.

Not all firms will necessarily be able to replicate these successes and strategies will vary across organisations and sectors. Nevertheless, there are doubtless thousands of organisations where similar no-regrets opportunities exist but which are yet to be taken up. There are clearly advantages in leading the way: it is the leaders who will begin to define the technology options that are taken up and gain competitive advantage in the low carbon world.

If we are to respond to the threat of climate change in time and without imposing high costs on ourselves, we need to act early. The means a shift from thinking about the risks to a focus on the opportunities to cut emissions decisively, while bringing wider financial, economic and social benefits. This is what the leaders to date have done. After ten years of the Climate Convention these leaders are still too thin on the ground. If we want to say that we are succeeding ten years time, the practices and visions of these current leaders will need to have become accepted good practice.

Contact the Climate Group at **www.theclimategroup.org**

COP 10 inches forward as global emissions accelerate

Last December's tenth-anniversary UN Conference on Climate Change (COP 10), held in Buenos Aires, limped to a conclusion with an agreement that participants would meet again in May to begin discussions on policies to tackle climate change after the main provisions of the Kyoto Protocol expire in 2012.

The 'conference of the parties' was being held just a few weeks before the Kyoto Protocol, initially agreed in 1994, is finally about to come into force this month following its ratification by Russia.

The conference also succeeded in adopting a package of measures aimed at helping countries to prepare for climate change, said Joke Waller Hunter, Executive Secretary of the Climate Change Convention: the 'Buenos Aires Programme of Work' on adaptation and response measures. The programme includes further scientific assessments of vulnerabilities and options for adaptation and support to the national action plans on adaptation of least developed countries.

However, environmental groups were disappointed that significant progress towards post-2012 policies and targets was not made, reporting that the US and Saudi Arabia united to argue that discussions on setting new targets for 2012 onwards was premature. Meanwhile, several developing countries sought assurances that post-2012 agreements would not require them to cut greenhouse gas emissions.

Several new countries, namely Indonesia, Liechtenstein and Nigeria, joined the Protocol during or just before the conference, bringing the total Kyoto membership up to 132 parties. Several others announced that their ratification was underway. Other highlights of the conference included the much-anticipated submissions by Brazil and China of their first national communications outlining their strategies for addressing climate change.

- The most recent IEA statistics on worldwide carbon dioxide emissions make uncomfortable reading. They show that global carbon dioxide emissions from fuel combustion increased by 2% in 2002, following a much lower increase in 2001 of 0.8%. For Annex B countries of the Kyoto Protocol (those countries that have agreed to targets under the Protocol and have ratified it), carbon dioxide emissions were 8% lower in 2002 than in 1990. However, this achievement masks great variations among countries, with emissions from Russia decreasing by 26% and those of Japan increasing by 19%. And, since 1990, emissions increased from the three largest countries *not* bound by Kyoto targets: the US (+17%), China (+45%) and India (+71%).

Could fibre ropes take the strain? The third phase of the Deepwater Installation of Subsea Hardware (DISH) joint industry project is underway to study how to install subsea hardware in deepwater without the self-weight limitations imposed by steel wire ropes. Increases in oil and gas prices and the pressing need to develop gas finds in ever deeper waters have given added urgency to the need to understand how to install subsea hardware in deepwater.

Now, under the management of British Maritime Technology Ltd, DISH Phase 3 will address the remaining uncertainties and risks associated with the installation of subsea hardware weighing up to 250 tonnes in ultra-deep water (beyond 2,000 m). In particular, it aims to provide the technology and confidence needed to design, develop and operate synthetic fibre rope deployment systems.

DISH Phase 3 will include a post-mortem investigation into fibre rope failure and wear, as well as experiments to evaluate rope life on sheaves of heave compensators and winches.

Megawatt-sized fuel cells for the US

US companies the Dow Chemical Company and the General Motors Corporation have launched the second phase of their joint demonstration project to build a 1 MW fuel cell pilot plant and integrate it into Dow's facility in Freeport, Texas. The system, reports the US Department of Energy, will be fuelled with hydrogen that is produced as a by-product at the chemical plant, and will feed power into the plant's power distribution grid. According to GM, the new facility will provide valuable experience in learning to work with 'real-world hydrogen' that has some impurities, rather than the pure hydrogen obtained in a laboratory setting.

A second 1MW fuel cell installation is proposed for California. FuelCell Energy Inc is to team with Chevron Energy Solutions to provide a fuel cell system to the Santa Rita Jail in Alameda County. The establishment already features a 1.2 MW solar power system.

FuelCell Energy has also worked with Caterpillar Inc to install a 250 kW fuel cell system at an electrical substation in Westerville, Ohio. The companies brought the fuel cell power plant online last November, fuelling it with hydrogen produced from natural gas.

REEEP promotes biomass in Africa; climate monitoring 'inadequate'

The international Renewable Energy and Energy Efficiency Partnership (REEEP) is supporting a proposal to speed up the development of biomass-fuelled cogeneration projects in Africa by promoting awareness among policy makers, investors and stakeholders and by removing barriers (political and policy, regulatory and licensing and financial) to the development of cogeneration. The proposal is to target the industrial sector currently producing biomass waste with a view to improving their alternative income streams while generating low carbon electricity.

Renewable energy sources abound in sub-Saharan Africa and a 10% target for the renewable contribution within the East African countries is considered achievable, and indeed has already been met in Kenya using geothermal energy alone, says REEEP. However, Kenya, Uganda and Tanzania all suffer power shortfalls and an energy mix which depends heavily either on single sources or on thermal energy, or both.

The use of biomass in cogeneration would take renewable generation beyond the 10% target, and would also create jobs and generate national savings on petroleum imports for the three countries. Vitally, all three have ample stocks of bagasse and wood wastes that could be used for medium to large-scale cogeneration, says REEEP. Initially, the project will focus on Kenya, and, should it prove successful, will then be rolled out across the region to take in Tanzania and Uganda.

Meanwhile, a new *Africa Climate Report* published by the UK Government suggests that substantial gains may be made within Africa through improvement of its climate monitoring, forecasting and modelling systems. But more needs to be done to overcome a number of deficiencies that are a threat not only to Africa, but also have implications for our understanding of, and ability to predict the global climate system.

The scientific understanding of the African climate system as a whole is low, says the report, particularly in the vital climate system of the Congo Basin. The level of technical expertise to carry out climate change modelling in Africa, and therefore the level of activity, is very low.

Climate change and the challenge of development in Africa are the two priorities for the UK's presidency of the G8 countries. The report highlights the links between the two issues. UK Secretary of State for International Development, Hilary Benn, said: "Many of the world's poorest people are the most vulnerable to hazards such as flooding, landslides and pollution brought about or made worse by environmental degradation. We need the best possible information about the impact of climate change if we are to achieve our goals of reducing poverty in Africa."

EOLE-RES, part of international wind energy company Renewable Energy Systems, has completed installation of the Plateau Ardéchois wind farm in the Ardèche region of south-east France. The wind farm consists of 8 Vestas 850 kW turbines, giving a total installed capacity of 6.8 MW. It is EOLE-RES's first wind farm in the Ardèche region and brings the total wind power capacity instigated by EOLE-RES in France to 45 MW since 2001.

The site is in a remote part of the country and 1250 m above sea level, making it France's highest wind farm. The site enjoys excellent wind speeds and will generate 15 GWh of pollution-free electricity annually for export to the French state electricity company, EDF.

Subcontractors included Vestas France SAS for the turbines, RAZEL for the civil works, AREVA for the substation and EXBRAYAT for the electrical works. This is the first time RES has used the Vestas V52 turbine, which has a hub height of 55 m.

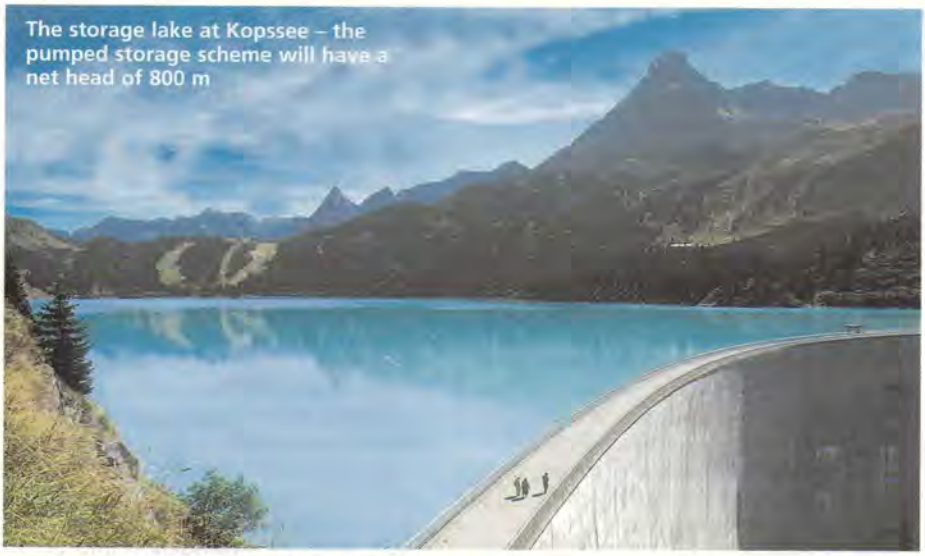
EU trading scheme opens for business – in most countries

The EU's carbon dioxide emission trading scheme (EU ETS) opened for business at the beginning of January with several of its 25 member states not participating. National emission allowance allocation plans (NAPs) for at least five countries — Greece, Italy, Poland, the UK and the Czech Republic – did not receive Commission approval before the scheme went live. Five NAPs, for Spain, Hungary, Lithuania, Cyprus and Malta, were given the green light on 22 December, after 15 had already been approved or partially approved.

Once fully operational, the scheme could prove to be a very important milestone in EU environmental policy. Under it, some 12,000 industrial installations, accounting for half of European carbon dioxide output, will have their releases capped. The first phase, now underway, runs from 2005–07.

A second phase, to run from 2008 to 2012, is thought likely to involve stricter emission caps for market participants and could be expanded to cover new industrial sectors such as chemicals, aluminium and, possibly, aviation.

Pumped storage power station for Austria



The storage lake at Kopssee – the pumped storage scheme will have a net head of 800 m

Construction has begun of a new, high-head hydropower plant, Kops II, being developed by Austria's electricity supplier Vorarlberger Illwerke AG, working with the German EnBW AG, in the Austrian Montafon area in Vorarlberg. The new, 450 MW plant will have a net head of around 800 m.

Germany's Voith Siemens Hydro has won a €60 million contract for equipping the pumped-storage power station and will design, supply, install and commission three sets of three-stage storage pumps, hydraulic torque converter equipment, six sets of spherical valves for the turbines and pumps, and two emergency shut-off butterfly valves.

Water will be conducted from the already existing Kopssee storage lake to the surge tank in Tafamunt village and into the cavern of the power station. The already existing compensation reservoir Rifa close to Gaschurn will serve as tailwater reservoir and will be connected with the cavern through a newly built tailrace channel. Commissioning of Kops II is scheduled for 2007/2008.

Power companies 'failing to invest in a clean energy future'

The world's power companies are not investing enough in renewable and efficient energy in order to reduce their greenhouse gas emissions, according to a new report by WWF: *Ranking Power*. The report gives two-thirds of the world's leading power companies a score of less than 1 out of 10 for their response to global warming, and more than 90% rank less than 3.

US companies came out worst and European companies hardly did any better in the analysis, which assessed 72 power companies in terms of their use, sale and investment in renewable energy and highly efficient, natural gas-fired CHP.

Nearly 65% of the European companies surveyed have shares of renewable energy in their fuel mix below 1%. Only one-fifth of European companies surveyed had shares of renewable energy in their fuel mix greater than 2%. Of the 22 companies assessed, Iberdrola in Spain scored the highest with a ranking of 4.3. UK-based Scottish Power was second best with a ranking of 3.7. Although the company has 74% coal in its current fuel mix it scored high for its planned future investment in renewable and efficient energy.

Amongst American firms, 24% scored 0 and 76% scored below one. In Japan and Australia the use of renewable fuel is extremely limited as the fuel mix is often dominated by lignite coal, one of the dirtiest and most carbon rich fuels of all.

The report was released to mark the launch of WWF's new international climate change campaign, PowerSwitch! The campaign will target the power sector to make the switch from coal to clean energy.

"The power sector is the biggest single polluter of greenhouse gases, responsible for 37% of carbon dioxide emissions from the burning of fossil fuels," said Nicola Saltman, Climate Change Programme Leader for WWF-UK. "However, the companies we analysed are completely unprepared for fundamental change in the way they invest in clean and efficient energy. And three-quarters of the companies surveyed were not prepared to disclose their strategy on global warming."

Offshore power cable to link Canada and California?

An American company is progressing plans to install a major offshore power cable to enable the output of proposed wind energy schemes in Canada to be fed to consumers in California. The Sea Breeze Power Corp., in partnership with Boundless Energy LLC, has filed an interconnection application with the local utility, Pacific Gas & Electric Company of San Francisco, for the first submarine transmission line that would allow for the direct transmission of electricity from Canada to California.

The initial application is for a 1,600 MW high voltage direct current (HVDC) undersea cable (expandable to 3,200 MW) to run 5–20 km offshore along portions of British Columbia, Washington, Oregon and California for approximately 1,900 km. Sea Breeze Pacific has contracted with ABB Inc for technical support.

The west coast submarine transmission corridor was conceived as an answer to the challenge of unlocking the many thousands of 'stranded' megawatts of clean, renewable energy that remain unutilized along the rugged and windy west coast of Canada. The region is rated by many as having the best wind resource in the world.

Other significant benefits of the proposed cable would be to help stabilize the western continental power grid by making load flows more predictable, along with freeing up conventional energy resources currently constrained as exports from western Canada to California.

US dependence on imported energy to grow

The growing US appetite for oil and natural gas will draw increasingly on foreign imports over the next 20 years, according to the US Department of Energy's Energy Information Administration (EIA). The EIA's *Annual Energy Outlook 2005* says that, by 2025, as much as 68% of US petroleum demand could depend on imported oil, up from 56% in 2003.

Meanwhile, US natural gas consumption will increase by 9 trillion cubic feet, a 41%, of which 6.4 trillion cubic feet are expected to come from imported liquefied natural gas (LNG). That will cause LNG imports to increase 16-fold from the 2003 level of 0.4 trillion cubic feet. Meanwhile, the amount of electricity produced from renewable energy – including large-scale hydropower and CHP – is projected to grow by only 1.4% per year, says the EIA.

Electricity industry accepts price control; new incentives for NGC

All of Britain's 14 electricity distribution network companies have accepted the five-year price controls proposed by energy regulator Ofgem, with effect from April 2005.

Under the new price controls, companies will be able to spend £5.7 billion in strengthening and developing their networks and will be required to improve quality of service. The price controls will also provide for investment to accommodate the growth in renewables.

The need for increased investment, combined with additional tax and pension costs facing companies, will result initially in an average increase of around 1% on distribution charges, or around 6p a month on the average domestic bill in real terms. Thereafter distribution charges will increase by no more than the rate of inflation (RPI-0), says Ofgem.

Allowances for capital expenditure to maintain and improve Britain's electricity distribution networks will increase on average by 48% above current levels, and should lead to £5.7 billion being invested in the networks. There continues to be scope for distribution companies to achieve further efficiencies in their day-to-day running costs, adds Ofgem, although not on the same scale as in previous reviews. Over the lifetime of the price control, distribution companies will be expected to reduce their operating expenditure by 3% on average, or around £21 million a year.

The growth in renewable and CHP generation is placing new demands on the distribution networks, says Ofgem. The new price controls reflect this changing environment by providing real incentives to distribution companies to connect new forms of generation, and to invest more in research, development and innovation to help realise the potential of renewable generation.

The union representing electricity engineers and managers welcomed Ofgem's proposal to pass on part of the pensions costs of staff employed by distribution network operators to customers. Deputy General Secretary of Prospect, which represents 14,000 power engineers across network operators, Terry Lane, said: "It will give great comfort to thousands of members of the electricity supply pension scheme, who will know that whatever else happens in the next five years, £190 million will flow into their pension funds. In the current climate, the security that brings must be welcome."

- Meanwhile, the National Grid Company (NGC) has learned that it could face fines of up to £12 million a year under a new incentive scheme announced by Ofgem, or the opportunity to earn up to a maximum of £8 million a year for improving performance on the grid. The regulator is to introduce an incentive scheme for NGC, after its investigation into power cuts in London and Birmingham in 2003. This will provide the company with incentives to improve on its standards of overall network reliability.

Sizewell A, British Nuclear Group's 420 MW Magnox nuclear power station on the Suffolk coast, has just returned to full production with the help of ABB, who pulled forward a £1.7 million turnkey contract to deliver and install a replacement GSU (generator step-up unit) transformer nine days ahead of schedule.

Together, Sizewell A's two reactors produce more than 10 million kWh of electricity. However in March 2004 one of the two GSUs, which step up the power station's 17.5 kV terminal voltage to the 132 kV required for the national grid, came to the end of its 38-year life causing Reactor One to be taken off-line. Although Sizewell A is scheduled to stop generating for good at the end of 2006 there was a clear business case for returning Reactor One to power, as the cost of lost production far outstripped the cost of a new transformer.

British Nuclear Group gave ABB the task of manufacturing a new transformer on a fast-track basis and installing it as a turnkey project including low voltage busducting, high voltage cable works and site preparation. The new generator transformer was manufactured in ABB's Lodz factory in Poland, shipped across from Germany to Lowestoft and transported by road to Sizewell.

Enter the BG Group Energy Challenge

Do you fancy some serious outdoor physical exertion and charity fundraising at the same time? Are you – and some colleagues – free for the weekend of 25 and 26 June this year? Read on.

2005 will be the tenth year that the BG Group has sponsored the 'Energy Challenge', a mystery mountain-based challenge event in the UK designed for corporate teams within the energy sector. Since it began in 1996, this annual event has raised over £1.25 million for the overseas project work of humanitarian agency CARE International.

Teams can have up to seven participants and must raise at least £5,000. Although they know they are required to climb three mountains and complete a mystery outdoor activity within 24 hours on the day, details of the exact starting point are kept secret until few weeks before the event. Past locations have ranged from the Outer Hebrides, to Isle of Mull, Yorkshire, and the Lake District, while the mystery activity has ranged from orienteering, to cycling or canoeing.

CARE International works with impoverished communities in over 60 countries worldwide, including places dependent on revenue from oil and gas production such as Angola, Brazil, Chad and East Timor.

Visit **www.challenge.org.uk** or call t: +44 (0)20 7934 9470 for further details.

EI to respond on Climate Change Programme review

The Energy Institute is inviting members to participate in formulating a response to the Government's review of the UK Climate Change Programme. The Government launched what it calls and an "extensive and open consultation" on the review of the Programme, which itself dates back to November 2000, last December. The closing date for comment is 2 March.

According to the Department of Environment, Food and Rural Affairs (Defra), the Government is well on course to meet its Kyoto emissions reduction target, but more needs to be done to achieve the national goal of reducing carbon dioxide emissions by 20% below 1990 levels by 2010. The Kyoto target is to reduce greenhouse gas emissions by 12.5% below 1990 levels by 2008-2012, while the national goal concentrates specifically on carbon dioxide and is more ambitious.

The Government says that emissions of the six main greenhouse gases have fallen by 14% since 1990 and, as a result of the policies currently in place, are projected to be 21% below 1990 levels in 2010.

The consultation highlights areas where the Government has identified opportunities to further reduce carbon emissions.

- *The EU Emissions Trading Scheme (EU ETS)* – the scheme's first phase, which runs until 2007, will cover around 46% of UK carbon dioxide emissions. The Government is now looking beyond 2007 to consider its approach to the second phase, that runs from 2008–2012.
- *Energy efficiency* – a range of measures to stimulate take-up of energy efficiency measures in households has been introduced, which include regulatory and incentive-based policies; grants and other economic incentives; and providing information and advice. The Government also announced last December a £20 million package of measures to accelerate the development of energy efficient technology (see *Energy World* January 2005).
- *Biomass* – the Government would like to see a rise in the production of biomass, which will not only help meet renewable energy targets but also boost farming, forestry and the rural economy. Sir Ben Gill, former NFU president, will this year report back the findings of his task force that is looking at optimising the contribution of biomass to climate change.
- *Transport* – the Government is committed to sustained investment in public transport, providing the public with more environmentally friendly travel choices and to encouraging its use. It is vigorously seeking the inclusion of intra-EU aviation in the EU ETS. And it is considering the feasibility of road-pricing, as well as the scope for including surface transport into a phase of the EU ETS.
- *Biofuels* – cleaner fuels, such as biofuels, and cleaner vehicle technologies, are being encouraged by the Government.

Details of the EI event on the review are available at **www.energyinst.org.uk**

More money to reinforce networks in Scotland and the north

New money is to be made available to strengthen electricity transmission networks in Scotland and the North of England so they respond better to the growth in renewable generation. Energy regulator Ofgem launched a new funding mechanism which means that the amount of money that can be spent on transmission reinforcement to accommodate more renewable generation is increased by more than 50% – from £360 million, proposed initially, to £560 million. This money can be spent now, subject to planning approval for individual projects.

The new arrangements will protect customers by allowing transmission companies – Scottish and Southern, ScottishPower and National Grid Company (NGC) – to invest in an efficient and timely way, says Ofgem. They also mean that the development of renewable generation will not be delayed unnecessarily.

Chief Executive, Alistair Buchanan, said: "We remain committed to enabling transmission companies to make the right investment to respond to the growth in renewable generation – but it must be made in the most efficient way and not place an undue burden on customers. The next price control review for the transmission companies, which is not due until 2007, is the time when decisions about future investment would normally be made. We have decided to take action early to respond to the need for investment to accommodate new renewable generation."

"This action, combined with the opening of the new GB–wide electricity market in April, will ensure that neither a lack of network capacity nor a marketplace will act as a barrier to the efficient development of renewable sources in Scotland."

The Centre for Engineering and Manufacturing Excellence (CEME) in Dagenham, Essex has won the Best Design-led Regeneration Project award at the 2004 Regeneration Awards held in London last November.

Built on a brownfield site, CEME is an essential component of the regeneration of the Thames Gateway. The low energy building benefits from a 115 kWp PV array, which is said to be the largest in the UK at 1,200m², and which was designed by whitbybird. It contributes some 15% of the site electricity requirements. Whitbybird secured over £400,000 in external funding for the PV system through the DTI's Major PV Demonstration Programme and the European Commission.

Scroby Sands doubles UK offshore generating capacity

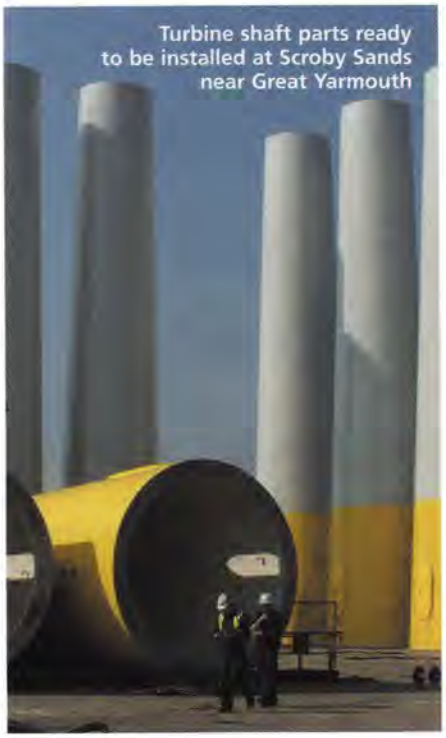
E.ON UK Renewables has completed commissioning of Scroby Sands, the UK's second large offshore wind farm. The 30 turbines at the site, just off the beach at Great Yarmouth, will generate a maximum of 60 MW. Now, with a total of 124 MW, the UK is the second-largest offshore wind generator in the world, after Denmark.

Figures released by the British Wind Energy Association (BWEA) show that over 250 MW of new capacity was built both on and offshore in the UK in 2004. This is about the same as the total capacity built in the three previous years put together. This year will, says the BWEA, see an even bigger expansion of wind power, with about 600 MW of capacity currently under construction, all of which should be completed in 2005. This 600 MW includes 90 MW from the Kentish Flats project, currently under construction off the north Kent coast, and the Barrow project off the coast of Cumbria, also 90 MW.

Other developers are readying projects for construction in 2006 and beyond, so that in the next two years the UK will establish itself as the leader in this exciting new energy sector, says the Association.

Gordon Edge, Head of Offshore at BWEA, said: "The commissioning of Scroby Sands is another important milestone in the development of an industry in which the UK can be the global powerhouse, building on our wind resource and experience in extracting energy from the marine environment. As our offshore capacity grows, so will UK companies' skills, which they will be able to export to Europe to the country's economic benefit."

- Mott MacDonald has been appointed sub consultant by AREVA T&D Systems in Stafford to provide electrical design services for an offshore wind farm to be built 7 km off the coast of Walney Island in Cumbria. The £100 million project is being built by a consortium comprising Kellogg, Brown and Root and Vestas Celtic Wind Technology (KBRV) on behalf of Barrow Offshore Wind Limited. The proposed wind farm comprises 30 turbines which will be connected via a 33 kV subsea cable to a 33/132 kV substation mounted on an offshore platform. An additional 132 kV subsea cable will then connect the wind farm to the shore near to an existing 132/400 kV substation at Heysham.



Turbine shaft parts ready to be installed at Scroby Sands near Great Yarmouth

Largest-yet onshore wind farm for Ayrshire; turbine for Orkney

With attention recently concentrated on the development of offshore wind farms, it might be easy to ignore developments on land. However, the construction of the UK's largest (120 MW) onshore wind farm, Hadyard Hill situated in South Ayrshire, Scotland began last November with contractor Mowlem plc starting work on site.

Mowlem Civil Engineering was awarded the £7.5 million contract to construct the foundations for the 52 wind turbines, along with the formation of access tracks and work on offsite highway improvements, by client Scottish and Southern Energy Generation Ltd (SSEG). The wind farm is being constructed as part of the Scottish Executive's target to have 40% of Scotland's energy supplied from green sources by 2020.

The design strategy for the wind farm has focussed on minimising the visual impact of the development as much as possible and, by careful turbine siting and use of shorter tower heights, the visibility to the nearest population centres has been dramatically reduced.

Mowlem is also working on the Artfield Fell wind farm, near Glenluce in Dumfries & Galloway, also for SSEG. This site will house 15 turbines and have a total output of 19.5 MW.

Meanwhile, a new landmark has appeared on the Orkney islands' low skyline, an 850 kW wind turbine standing on top of a 44 m tower at Northfield, Burray. The turbine has been funded by a consortium of Orkney residents who aim to reinvest profits from the machine into similar developments elsewhere in the country.

The innovative project, which has delivered the first commercial, community-owned wind turbine in Scotland, was developed by the Orkney Renewable Energy Forum, and has been achieved by a group of independent people from the local community investing their own resources and expertise, with no loans or grants from the public sector or banks.

The turbine, from Campbeltown-based Vestas-Celtic Wind Technology, arrived in Kirkwall as a kit waiting to be assembled. All the component parts were then delivered by road to Burray, where the tower and nacelle were erected during a lull in the strong Orkney winds. Three days later, the hub and three blades that form the rotor were lifted into place during an early morning operation.

Two new centres on transport technology

Two new transport technology centres of excellence, aimed at helping to reduce traffic congestion and tackle the effects of global warming, have been announced by Industry Minister Jacqui Smith. The two centres will help the UK take a world lead in 'smart' transport and zero emission vehicle technologies by bringing together key stakeholders such as government, manufacturers and academia in developing new technology.

The first centre, on fuel cell and low carbon technologies, will be in based in Loughborough. Hybrid vehicle systems have already established a foothold in car markets across the globe, delivering improved fuel efficiency while fuel cell vehicles are set to reduce reliance on fossil fuels.

The second centre, on 'roadsmart' intelligent transport system (ITS) technologies will be developed at the new centre for Transport Telematics and Technologies for Sustainable Mobility. ITS uses information and telecoms technologies to tackle road congestion, safety and transport ineffi

continued on p9...

PV panels arrive at bus interchange and council house roofs

Photovoltaic panels integrated into the roof construction at Lambeth homes

Fifteen new solar photovoltaic (PV) energy projects across the UK are to receive almost £1 million in Government funding under the solar PV grant programme, bringing the total amount awarded to medium and large-scale projects to £17.4 million. The programme is funded by the DTI and managed by the Energy Saving Trust.

Since the establishment of the scheme, 166 medium and large-scale projects throughout the UK have been granted funding and will, on completion, generate more than 5.3 MWp of electricity.

Recipients of this latest round of grant awards include:

- London's National Maritime Museum, which is going to incorporate its PV installation into an 'eco-exhibition' where the use of solar power will be discussed and the system's monitoring equipment will form part of the exhibit;
- Moreton Hall Primary School in Suffolk, which will use the funding to install a PV array to provide 20% of the energy used within the new school;
- Plymouth Council, which is to follow the installation of 350 solar powered bus stops with the incorporation of 112 advanced, hybrid-crystalline PV modules built along a curved, standing seam roof into its bus interchange; and
- the remote Scottish island of Foula, Shetland's most westerly island, where the population of just 31, completely isolated from the national electricity grid, will benefit from a hybrid system that will provide 100% of the island's power requirements through the use of a PV array fitted to the community hall roof, together with a hydro electric plant.

Separately, UK solar company solarcentury and Lambeth Council have launched the first local authority-housing scheme in the UK to benefit from a fully-integrated solar tiled roof. The PV panels have been installed on the roof of a sheltered housing scheme in Langholm Close on the Clapham Park Estate. The roofs will produce around 19 MWh of electricity a year.

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ciency. Recent Telematics projects in Europe have cut road journey times, improved traffic information accuracy, reduced traffic accidents and increased motorway capacities.

Jacqui Smith said: "By making better use of our road network, these centres could play a key role in reducing congestion on Britain's motorways and improving the environment. And we are also sending a strong signal to manufacturers around the world that the UK is the place to come to carry out research in cutting-edge areas."

- Meanwhile, the Energy Saving Trust (EST) has welcomed the Department for Transport's (DfT) renewed commitment (and £24 million of funding) for EST's TransportEnergy programmes, which are designed to incentivise the market for cleaner vehicles. The DfT is revising the TransportEnergy programmes to move to a technology-neutral approach that will incentivise take up of the cleanest cars. The timescale for introduction of the new programmes will depend on the process of reviewing and clearing new programmes with the European Commission, but the intention is to ensure a smooth transition between programmes and to ensure they are consistent with State Aid rules, says EST.

New plan steps-up efforts to end fuel poverty in five years

The Government has launched a new plan, involving increased spending, to "eradicate fuel poverty in vulnerable households (those with children, elderly, disabled or people with a long-term illness) in Britain by 2010."

An extra £140 million will boost the Warm Front scheme, the Government's main weapon against fuel poverty. The scheme provides central heating and insulation. More than 940,000 vulnerable households have been helped by Warm Front since 2000, says Defra, backed by £600 million in funding from the Department of Environment, Food and Rural Affairs.

Warm Front will be improved and expanded under *Fuel Poverty in England – The Government's Plan for Action*, including, says Defra:

- central heating for all eligible households;
- bigger grants;
- action more targeted on areas with a high proportion of fuel poor; and
- where possible, increasing the energy efficiency of properties to a level where there is a minimal risk of fuel poverty.

More people will be given benefit entitlement checks which have yielded nearly £1,500 per year extra, on average, for Warm Front applicants, says Defra. There are also plans to give local councils new powers to intervene where a private landlord refuses Warm Front assistance, to assess if the property needs work to protect tenants from cold or damp.

Fuel poverty is a combination of low income and poor energy efficiency in homes. According to Defra estimates, the number of fuel poor households in England has dropped to 1.4 million, from 4.3 million in 1996.

- Meanwhile, energy regulator Ofgem has published new research which exposes how many vulnerable customers are unaware of the free help and support available from energy suppliers. The research found that almost a half of the customers surveyed did not know that help and support on energy efficiency is available from suppliers, and less than a fifth of customers had ever taken up such help and support. Also, three quarters of vulnerable customers surveyed did not know they could receive, at no charge, special services from their gas and electricity suppliers such as gas safety checks and more frequent meter readings.

Wave, wind and tides – prospects for the UK marine energy sector

Britain has among the best marine renewable resources (wind, wave and tides) in the world, together with considerable experience of working offshore in oil and gas engineering. The UK is also home to most of the developers of early marine renewable technology devices. So the country is in a good position both to develop a marine renewable technology industry, and to pioneer its large-scale use. Britain could be a world beater, but progress relies entirely on supporting and investing in the still-small, and very young, marine energy industry.

Here, the Carbon Trust's Paul Jordan *discusses ways forward for the industry, including a view of how the Government's £50 million Marine Deployment Fund might be allocated.*

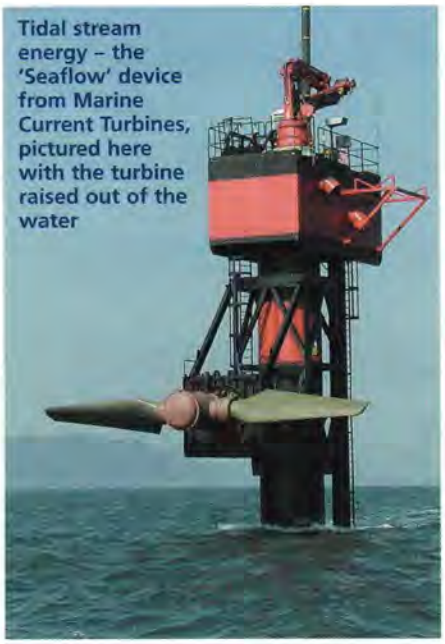
To its opponents, renewable energy is an expensive solution to climate change that interferes with life as we know it by scarring the landscape. To its supporters, it represents an essential element within a low carbon economy, a world where less energy is used and where the energy that is used emits less carbon dioxide.

In the past, we have had a small number of very large power stations feeding electricity into the grid – out of sight and out of mind. However, in a growing economy where energy demand will increase, renewable energy may well turn out to be a low-cost alternative to oil and gas. Over the next decade much of the development of renewable energy is likely to move offshore with wind and wave and tidal technologies, once they prove themselves and attract sufficient investment.

What makes renewable energy so exciting is the real potential for it to come down in cost and to be deployed at a large scale – and so economically offset significant quantities of greenhouse gas emissions from fossil-fuelled generation. Offshore there is enough renewable energy resource to meet the world's need for energy several times over. But our ability to capture this resource hinges upon a wide range of technical, economic and social constraints, often specific to a country or location.

While the debate about renewable energy pros and cons continues, we should not forget that renewable energy is also a great business opportunity – one that needs Government support if it is to benefit UK businesses.

The 2003 UK Energy White Paper set out an aspiration to reduce our carbon dioxide emissions by 60% by 2050. These cuts will require a lot more energy saving and the rapid development of significant new supplies of clean energy, including renewables. As clean energy costs more than energy saving, the Government could arguably pursue its environmental goal by focusing its support on energy efficiency and 'importing' clean energy technologies once their cost has been driven down by scaled development elsewhere – in essence letting other countries subsidise their growth. But why not develop technologies here that could be globally competitive, where the UK has competitive strength, thereby creating economic value for the UK whilst meeting the environmental challenge?



Tidal stream energy – the 'Seaflow' device from Marine Current Turbines, pictured here with the turbine raised out of the water

Assessing the renewables options

To assess the likelihood of achieving this, the Carbon Trust reviewed five renewable technologies and estimated their potential to come down in cost, and the UK's competitive position in these rapidly growing global markets. The technologies were onshore wind, offshore wind, solar PV, wave and tidal stream. The conclusions were stark and pointed to clear differences between the technologies. On the best sites, on-shore wind is cost-competitive today against gas-fired electricity generation and offshore wind should become cost-competitive by 2020. Solar PV should become competitive with retail electricity in developed countries and off-grid developing country markets in the medium term. Wave and tidal stream technologies are at an earlier stage of development, so costs are more difficult to estimate, but these technologies could also become cost-competitive over time and have a significant environmental and economic impact.

No country has yet taken a leading position in marine energy. The UK has the potential to become a global leader in marine energy given its huge exploitable natural resource, high concentration of early-stage marine technology developers and significant relevant expertise within the workforce from sectors such as oil and gas, shipbuilding and power generation.

Over the last five years the marine energy sector has moved forward rapidly and a number of devices are now being tested and proven in the UK and overseas at full scale in open sea conditions. The Carbon Trust is actively investigating the future potential of the sector and helping to remove the technical, economic and regulatory barriers to accelerate the development of the marine renewables industry.

Despite the UK's potential in marine

Wave power – the 'Pelamis' wave energy device from Ocean Power Delivery, pictured here in dry dock

energy, a number of engineering challenges remain. The question of whether electricity derived from ocean waves and marine currents can become cost-effective with other renewable and fossil-fuelled power generation is crucial to attract private investment and establish a route to commercialisation. A major, £2.5 million project – the Marine Energy Challenge (MEC) – was launched in January 2004 by the Carbon Trust to respond to this. By bringing together leading marine energy technology developers and multinational engineering consortia, the MEC is designed to accelerate the sector in three key ways:

- Identify whether the cost of energy of existing wave and tidal stream power technologies can become cost-competitive – and if so, to what extent the cost of energy can reduce.
- Where reductions are possible, give marine energy technology developers 'next generation' prototype designs to help them accelerate their development.
- Highlight generic requirements of wave and tidal stream devices that could benefit from development outside particular design concepts and could lead to new businesses, providing additional equipment or services to the sector.

Considerable progress has been made in moving the UK's marine energy sector forward since the launch of the MEC. A partnership of eight technology developers and five engineering consortia have worked together to deliver the following work programme:

- establish the different costs associated with the wide variety of generation methods – for example, attenuator, point absorber, overtopping, shoreline/ floating OWC (oscillating water column), rotor type wave concepts and horizontal/vertical-axis turbines, reciprocating and venturi tidal stream concepts;
- estimate the performance of these devices in real sea conditions, by using the best natural resource data currently available and state-of-the-art modelling tools to assess the interaction between each device and the environment – for example, numerical modelling of hydrodynamics;
- predict the cost of energy of the different concepts for deriving energy from the waves and tidal streams, according to their current state of development;
- critically review opportunities for cost of energy reduction with a view to the lowest cost of energy that might be achieved, as well as highlighting generic components and areas of further research required; and
- where substantial opportunities exist, to revise the engineering design and work towards an improved design basis, with specifications, costs and performance characterised in detail.

So what has this achieved for the UK's marine energy sector in practice? The most significant development has been to reduce the cost of energy generated by a number of current device designs. A clearer view of costs and performance, as well as potential market sizes for certain device types has also been developed. For the players within the sector, this has delivered tangible benefits. Technology developers have access to rigorous, independent assessment of their device concepts – in effect, the technical due diligence that is vital to secure ongoing investment. Engineering consultants involved in the MEC have been able to expand their technical and commercial capacity to assess marine energy technologies – which has maximised the potential for technology transfer from other sectors, such as oil and gas. Insights into the cost potential of energy secured through different methods of extraction are also helping to identify the potential for marine energy to be cost-competitive over time. These insights are highlighting opportunities to further accelerate the sector and to provide advice to other key stakeholders in the industry.

How to support the marine energy sector

The issue of funding is pivotal to the UK's bid to become a global leader in marine energy. The critical factor which underpins potential investment is the cost of energy from marine renewables. Why? Because to be attractive to the energy industry and financial investors, wave and tidal stream technologies must demonstrate that they can compete with more traditional, better-understood forms of renewable and fossil fuelled power generation. The Carbon Trust recognises this and has focused the MEC on the cost of energy and its key components – performance, capital cost, risks, operation and maintenance costs. Electricity generation companies and developers, the potential customers of marine renewable technology developers, must be assured that the products on sale offer a good balance of reliable performance coupled with low costs and risks.

High performance is not yet a given and it is recognised that working offshore can be difficult, with special consideration needed to ensure survivability and high reliability in tough offshore weather conditions. These are all high hurdles for marine energy technology developers, yet from an economic and environment point of view, the prize is undoubtedly huge.

The MEC is certainly highlighting the potential for marine energy to compete in the well-established electricity industry, but we should not forget the need to create a market for marine energy devices. To date, marine energy devices tested at full scale have typically been funded by a combination of government grants, venture capital investment, and individual investment from the device 'founders' however, for the next and future phases of industry growth a different type of investor must now be attracted to build the first wave and tidal stream energy projects.

The next critical phase in establishing a sustainable marine energy sector is the development of the first 5 MW to 10 MW 'pre-commercial' wave and tidal stream farms. Where as early 1 MW to 2 MW prototypes could be manufactured using funds attracted from venture capitalists for equity stakes in the 'start-up' companies, the 'first farm' phase will require a different approach to attract the necessary private investment from project investors such as utilities, oil and gas majors, and other project developers.

In August 2004, the Government announced a £50 million Marine Deployment Fund primarily focused on supporting developers through the funding gap between early demonstration and commercial deployment. How the UK should establish mechanisms to best use the £50 million fund to overcome the 'pre-

commercial' or 'first farm' phase was hotly debated over the later half of 2004, but consensus across the sector now appears to be building.

There have been a number of highly informative reports produced over the last year. The BWEA (British Wind Energy Association), the RPA (Renewable Power Association) and the Marine Energy Group of FREDS (Forum for Renewable Energy Development Scotland) have all produced studies. The BWEA *Into the Blue* report was the catalyst for the debate and the report clearly outlined the merits of a market pull system for marine energy devices and proposed a premium tariff of 10 p/kWh on top of the market value for ROC (Renewable Obligation Certificate) for the first five years of a project, as well as support for 'device-blind' elements such as grid connection and decommissioning. The *Harnessing Scotland's Marine Energy Potential – Marine Energy Group (MEG) Report 2004* also outlined a vision for the development of the marine sector in Scotland, highlighting that we could see 1,300 MW of installed marine capacity by 2020 – certainly a feasible target given the right Government support and industry development strategy.

The Carbon Trust has sought to understand how any proposed mechanisms would actually generate the necessary flow of private capital into first farm projects. Although a market pull could be created through a reward mechanism (eg a feed-in tariff or other form of revenue support), it would need the addition of some form of risk reduction mechanism (eg capital grants, tax breaks, or other form of upfront subsidy), in order to maximise the flow of private capital into the sector.

A multi-phase investment programme

Revenue support mechanisms are tried and tested in other renewables sectors. Denmark and Germany have employed these mechanisms to stimulate the development of wind industries in their countries. Other countries have also implemented, or are thinking of implementing, a feed-in tariff approach to developing a wave and/or tidal stream industry, Portugal for example introduced a 12-year, index-linked tariff of approximately €0.235/kWh for early wave energy developments. So should the UK implement a similar approach for marine energy? Certainly, revenue support is necessary, but there are two distinct features of wave and tidal energy in comparison to wind that need to be taken into account and that may promote the need for a combined pull/push approach.

Firstly, the initial investment to establish a first wave or tidal farm is much greater than that needed for a first wind farm. A typical early stage wind farm would have included three to five wind turbines of 100 kW each, for instance, and this would have cost approximately £500,000 to £1 million for the complete project. By comparison, a first wave or tidal stream farm is likely to be three to five devices of 1 MW each and so cost in the region of £5 million to £10 million; an order of magnitude difference in the amount of capital exposed to market conditions.

Secondly, the core technology involved in wind power has had the opportunity to prove its performance and commercial viability on land before moving into the offshore environment. Although smaller wave and tidal stream models are tested in wave tanks and some scale models tested in open seas, it is difficult for marine devices to be developed gradually at full-scale in real-sea conditions. By comparison to the first offshore wind projects therefore, the first wave and tidal farms will inevitably have a more uncertain output and increased financial risk.

Different types of investor need to be engaged at different stages of the industry's development. There will be a number of steps in the development of the marine industry, but it is worth thinking about the four basic phases of the wave and tidal stream industry development and the varying risk and return expectations and investment sizes exhibited:

1. *Model testing phase* – very high risk (concept may not be viable); very high return expectation; low level of investment required – less than £500,000; investors include the founders, business angels and R&D grant providers.
2. *Full-scale prototype* – high risk (device may fail during real sea trial); high return expectation; medium level of investment (£1 million to £3 million per company); investors include venture capitalists, strategic investors and grant providers.
3. *First farms* – high/medium risk (economic return may be less than expected); medium return expectation; medium to high level of investment (£5 million to £10 million per project); investors typically include utilities, oil and gas majors, and project developers.
4. *Commercial farms* – medium/low risk; medium/low return expectation; high level of investment (above £100 million per project); investors will also include banks and other project financiers.

To understand appropriate mechanisms for the next phases of industry development, the Carbon Trust carried out informal interviews with the potential sources of finance, deliberately focusing only on those companies who could make actual marine project investments both now and in the future (utilities, project developers, oil and gas majors, project financiers and banks).

This informal review helped shape the Carbon Trust's view on the objectives for the next phase of industry development:

- build a strong foundation for a UK-based world class wave and tidal stream energy industry;
- provide a suitable risk/reward profile to attract in sufficient private investment to build the first wave and tidal stream farms;
- develop and carry-out the necessary environmental and consenting requirements to allow installation and grid connection of the first sites;
- build coherence and develop engineering and assessment capability in the marine renewable energy industry; and
- prepare for the next phase of marine renewable energy project development.

Allocating funds

We believe consensus is now building across the industry as to how the £50m Marine Deployment Fund could be allocated, as follows:

1. *transitional funding* – capital grants and revenue support to provide project investors (eg utilities, oil and gas majors etc) with a suitable risk/reward profile;
2. *site development* – base-line surveys and blanket consents of sea areas that could develop into wave and tidal stream hubs across the UK, and preparation work for large scale site development (eg a licensing round) should continue in parallel; and
3. *industry capability building* – further engineering and standards work to move the industry towards a technical due diligence procedure for a project financeable industry akin to wind (eg standard process for investor's evaluation of projects).

Investor confidence is key to attracting private investment, so it will also be important to start preparing now for a larger roll-out of wave and tidal stream projects in the medium and long-term future.

The future is bright for the UK's marine energy sector, given the right level of investment at this pivotal stage. The Government is clear in its desire to see the world's leading marine renewables industry in the UK, and as Energy Minister Mike O'Brien has said: "The fledgling marine industry that we have developed is in itself a success story. Most of the world's leading wave and tidal stream companies are British. But we mustn't throw this lead away. I want the world's first wave and tidal stream farm to be in UK waters!"

The Government is certainly making the right noises, but time is of the essence and decisions around the structure and implementation of the £50 million need to be made at the start of 2005 to maintain investor confidence and momentum. Surely the prospect of low cost marine electricity and creating jobs and exports for the UK is one that we should back wholeheartedly. It's a challenge, but one we should take up in pursuit of the commercial and environmental benefits it promises.

Contact Paul Jordan at the Carbon Trust
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Consolidation support for the independent generation sector

It's been some time since Energy World *included an article bemoaning the negative impact that 'new' electricity trading arrangements (NETA, instituted in 2001) were having on small, independent power generators, CHP and renewable plants in particular. Now, NETA is due to become BETTA (see below), but many problems remain.*

Here, Steve Armitage *from SmartestEnergy explains how his company is helping small generators to trade their electricity output in excitable markets, and thus compete with the big boys.*

Global warming, emissions, Kyoto, renewables targets .... hardly a week seems to go by without Tony Blair or one of his ministers confirming the Government's commitment for the UK to transform itself into a sustainable, low-carbon economy with ambitious targets for a significant proportion of our power to be derived from renewable, small-scale generation. With such support from Government, one might be led to think that there has never been a better time for the independent generation sector to thrive and help deliver some of these targets, but the reality is that it's still a very tough market out there.

One of the main reasons for this is that, fundamentally, despite some specific incentives, a combination of other factors (such as the uneven treatment of different generation technologies) is making it difficult for market participants to make the investments necessary to deliver on those targets.

The background to all this is the electricity trading environment which came into force in March 2001 (NETA or new electricity trading arrangements, themselves due to be superseded by BETTA, or British electricity trading and transmission arrangements, this spring). This provides the main framework for the way in which power is traded in the UK. NETA heralded a 'brave new world' for the power sector and introduced a decentralised market which meant that smaller, independent generators could enter into an 'off-take contract' with a 'counter-party' of their own choosing, at any time, for any duration. However, NETA also exposed these generators to potential penalties for under or over-delivery of power – a problem which they had not faced before.

A 4 MW landfill site at Pilsworth in Lancashire

When NETA was introduced, it was always envisaged that there would need to be a mechanism for generators to deliver their power into the market through a new breed of market participant, known as consolidators. Consolidators would purchase the power (as well as the associated benefits), from the generator and simultaneously offer a guarantee to that generator, so that he would be covered for any shortfall or over-supply, thereby minimising his exposure under NETA.

Consolidators would then package up the parcels of power, LECs (levy exemption certificates), ROCs (renewables obligation certificates) etc that it had purchased from its customers and sell on these larger units to one of the big, vertically-integrated supply companies, other wholesale market participants, or via brokers.

SmartestEnergy is one of the players that entered the consolidation market back in 2001 and today it is the leading consolidator for the independent generation sector. It currently handles a portfolio in excess of 850 MW of generation capacity at over 120 sites throughout the UK. These sites cover all the main generation technologies, including biomass, large and small-scale CHP, coalmine methane, energy-from-waste, landfill gas, onshore gas and wind.

Although the ability to match buyers and sellers of power (or gas) at the right price for all parties concerned is fundamental to SmartestEnergy's business, the company also puts together a tailor-made contract for each individual customer, bringing together a combination of components from its own range of value-added products and services.

At one end of the scale, such as for a small landfill site, SmartestEnergy will build a contract which will offer the customer a best price for the power (including imbalance risk and embedded benefits), plus ROCs and LECs which are split out to give full transparency. Prior to signing, there is often a dialogue over many months, during which time the company will regularly update the generator on current price movements, so that the actual contract can be agreed at a time – regardless of contract start date – which is likely to give the generator best value.

Looking at the April 05 Annual Baseload Power Chart (Figure 1), one can see the high level of power price volatility over time. Even for a modest, 3 MW landfill gas site, getting this initial contract price 'right' can make a difference of many thousands of pounds per annum.

Although a 3 MW landfill gas site may have an agreement that is not due to start until 1 April 2005, the operator can contract by selling forward his power at any time prior to that date. (Historically, annual contracts were signed around February.)

If we assume an average load factor of 85%, the 3 MW generator will produce

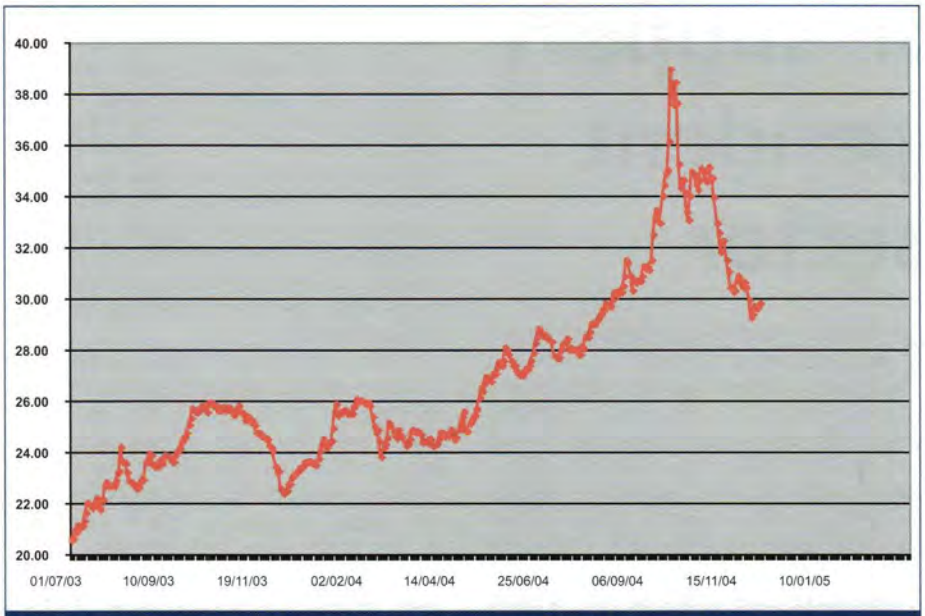


Figure 1. April 05 wholesale annual baseload power price £/MW

This CHP plant at British Sugar's Wissington factory near Downham Market in Norfolk, exports up to 50 MW to the national supply network from a 50 MW gas turbine and a 30 MW steam turbine

This biomass plant at Widnes in Cheshire processes 260,000 tonnes of animal by-products each year and can export 9 MW of power. All three installations use SmartestEnergy to trade electricity.

around 22,300 MWh per annum. Should the generator be able to commit that volume at any time and achieve a price of say £34/MWh (only the very lucky or very clever hit markets at their highs), he would achieve revenues of £758,000. Contracting at around £28/MWh (current market levels), revenues would only amount to £624,000. This fall in revenue can run be much larger if the generator has a multi-site portfolio.

Of course we do not know what level the April 05 baseload will reach in the coming months, though most market commentators agree that the high levels seen in the autumn of 2004 are unlikely to be repeated. If we were to look at similar charts for April 03 baseload and April 04 baseload, similar trends emerge. Keeping a close eye on market movements and being ready to execute the sale of the power at very short notice can help the generator obtain higher value.

SmartestEnergy calls this timing issue, 'extracting the hidden value'. Steve Armitage, Sales and Marketing Manager takes up the story, "We are actively trading power and gas on behalf or our customers in real time and so are well-placed to have as good an understanding as anyone on what is happening and what the price drivers are. This means that, as contract renewal time approaches or when we have a new customer to contract, we really think long and hard and provide our customers with up-to-the-minute information to ensure they can make timely decisions. In many cases, this has even meant encouraging existing customers to sign today for a forward off-take contract which will not even commence for a number of months, in order to capture the high prices that are currently in the market. Timing has become the watchword for any independent generator."

Larger customers, such as CHP generators with an output greater than 10 MW can also sign up for an energy trading service agreement (ETSA), which gives them the opportunity to maximise their income by offering closer access to the power markets on a daily basis. This is something SmartestEnergy's own in-house electricity team is able to deliver by trading – on its customers' behalf – with counter-parties, via brokers and through screen-based exchanges, and managing all the associated credit risks.

This means these customers can then sell their electricity within a broad spread of time frames and volumes, ranging from a few hours ahead, days months, seasons or even years into the future. In addition, they can also buy power through the ETSA to cover short positions. This helps them achieve a balanced position, trade profitably and match the profile of their generation/demand.

British Sugar has been trading through a SmartestEnergy ETSA contract for the past two years and, as its CHP export capacity amounts to 125 MW, maximising

the possible income from export power has become an important part of its business. There is daily communication between British Sugar and the traders at SmartestEnergy and it is they who execute the trades on British Sugar's behalf. These range from within day right across the curve and are typically in 10 MW or 20 MW tranches.

The company's priority is to help British Sugar manage its overall position in real time and get the best possible price for its output within the prevailing market conditions. On any given day, its traders provide British Sugar with a direct route to market, quoting the best bids and offers on both prompt and curve contracts. Upon request, trades are executed in real time, which, given the current market volatility, can prove highly advantageous.

As well as the standard ETSA, SmartestEnergy can also offer a supply ETSA. Good Energy, one of the UK's leading green electricity supply companies is a supplier which manages its imbalance exposure in this way.

Good Energy needed this type of contract because as a significant purchaser of renewable power (wind 75%, small hydro 25% and solar power <1%) from a number of renewable generators, it has less control over outputs than would be the case with conventional generation. Therefore, Good Energy needed to ensure that any risks under NETA were fully managed.

Ensuring that Good Energy can deliver power to its customers on a round-the-clock-basis, whatever the demand profile happens to be, whilst simultaneously ensuring that any potential risk exposure is professionally managed as cost-effectively as possible, is exactly what SmartestEnergy's supply ETSA delivers.

Steve Armitage confirmed, "This contract is really a development of our generation ETSA which enables power producers to maximise their income by gaining closer access to the power markets via SmartestEnergy's own in-house electricity team.

An additional offer which is now being developed for users of gas such as CHP generators, is a gas trading service agreement which allows a CHP generator to trade its gas on a similar basis to the way in which it trades its power. This significantly reduces uncertainty as the gas purchase price, the power sale price and the contract duration are all agreed to at the same time.

In conclusion, it is a tough market out there for the independent generation sector, but as we have seen here, there are also opportunities and with the right kind of support, generators can significantly reduce their exposure to risk and lay the foundations for developing long-term, profitable generation businesses.

Contact Steve Armitage at SmartestEnergy on t: +44 (0)20 7448 0900, or e: **www.smartestenergy.com**

Q4 2004 price rises – help or hindrance?

With significantly higher power bills now dropping on our doormats at home, it's easy to assume that the generators which produce our power are lining their pockets at our expense. But as with so many things in life today, the truth just isn't that simple. Certainly, amongst the independent generation sector, you'd be hard pushed to find a business which was able to take advantage of the higher wholesale prices of power and gas to increase their profits.

Let's take a few examples. CHP operators are only going to benefit from a high power price if their off-take contracts are structured in such a way that they can deliver power into the market at those higher prices. The chances are that their contracts were determined some months before and so they are unable to take advantage of those higher prices, unless they have 'spare' capacity and can deliver additional power at that higher price into the market.

We also have to remember that CHP runs on gas. Unless they had an arrangement which linked their gas purchase price to the price at which they sell their power, they will have been squeezed as gas prices rose and yet their selling price for power remains fixed. As for any additional power that they might have been able to deliver into the market, again the price of gas at that time will have determined whether or not it was actually worth their while to generate. And in the autumn of 2004, many CHP generators reduced overall output and in some cases, shut down completely as the price hikes effectively pushed them into the red.

As can be seen from Figure 2, which depicts the movement in price of wholesale power and gas for the month of January 05 over the past few months, the correlation is absolute. Generators not buying their gas and selling their power for the same period at the same time are really rolling a dice.

But it wasn't all bad news for the independent generation sector. In fact, the high prompt prices (ie current prices) had an immediate knock-on effect on forward prices. This meant that timing (as discussed above) was suddenly right for generators to enter into their next round of off-take contracts to take advantage of the higher prices.

What about a renewable generator such as a landfill gas site? Again, an off-take contract is likely to have been fixed some months before so a higher power price was of no consequence. The only advantage for renewable generators is that they are not purchasers of gas and so were not exposed on the supply side. However, the nature of their businesses meant that they could not raise output to exploit the higher prices, though they could contract early as prompt prices always have some effect on the curve.

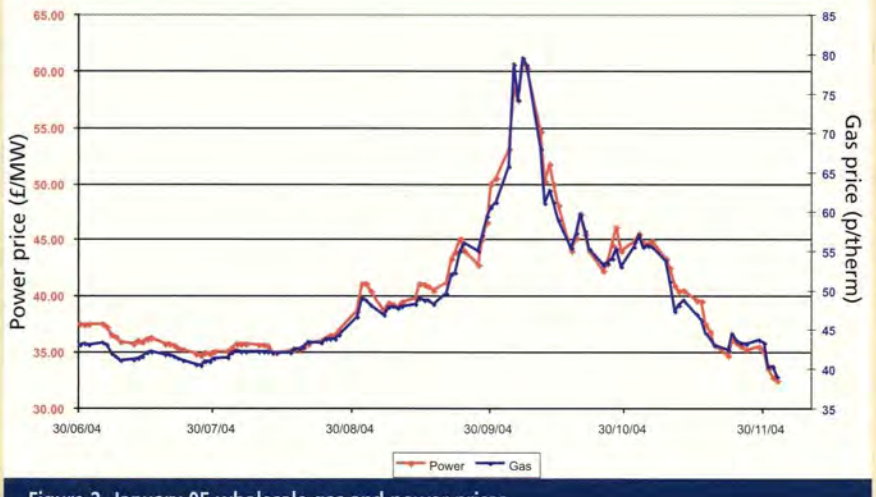


Figure 2. January 05 wholesale gas and power prices

Could an African bean crack Europe's biodiesel

Along with hydrogen, biomass-based transport fuels are often quoted as the solution to rising emissions from the transport sector world-wide. Biodiesel is perhaps the most important of these non-fossil fuels – but from where are the very large quantities of biodiesel required to make a difference to be sourced? From beans produced in Africa and Asia from the Jatropha tree, according to the British company D1 Oils.

The potential to run diesel engines on vegetable oil goes all the way back to Rudolph Diesel's successful trials of his first engine on peanut oil a century ago. Yet it is only now, with the transport sector likely to be the fastest growing contributor to greenhouse gas emissions this century, and diesel prices climbing steadily as oil appears to be scarcer and less secure, that the advantages of biodiesel are being appreciated by governments around the world. However, there is as yet no source of biodiesel that is cheap and plentiful enough to meet the potential demand. Running trucks on the residue in the nation's chip pans is not going to be a large-scale option.

However, across the developing world there's growing excitement about the possibility that an up-to-now obscure tree, *Jatropha Curcus*, might offer a sustainable, large-scale source of biodiesel. This non-edible shrub is planted as a hedge in both Africa and India, and its beans are used as a laxative in traditional medicine. When crushed the beans produce oil that can be refined into biodiesel.

According to the International Energy Agency (IEA), the use of oil, including diesel, for road transport will double in the next 25 years and greenhouses gases will increase commensurably. In the EU, legislation is already in place to mitigate this by increasing the proportion of biodiesel in Europe's transport energy mix. The EU biofuels directive requires a minimum level of biofuels, as a proportion of fuels sold in the EU, of 2% by 2005, 5.75% by 2010 and 20% by 2020. The main green fuels will be ethanol and biodiesel, and demand for biodiesel is expected to be up to 10.5 billion litres by 2010.

If that demand can be met, it will be good news for the environment and for our general health. While combustion of any fuel releases carbon dioxide into the atmosphere, biodiesel produces lower emissions than mineral diesel. Furthermore, because it comes from crops that absorb carbon dioxide as they grow, biodiesel's overall contribution to greenhouse gas emissions is extremely low. A 1998 biodiesel lifecycle study, jointly sponsored by the US Departments of Energy and Agriculture (USDA), concluded that pure (B100) biodiesel reduces net carbon dioxide emissions by 78% compared to petroleum diesel. With a B20 mix (a 20% biodiesel solution), net carbon dioxide emissions are reduced by 16%. Compared with mineral diesel, biodiesel reduces particle emissions (PM) by 30%, carbon monoxide, which affects air quality and human health, by 50%, and sodium monoxide by 50%. Unlike mineral diesel, bio-diesel is non-toxic and is biodegradable.

The EU biofuels policy currently relies on an assumption that the heavily-subsidised cultivation of rapeseed will meet its biodiesel targets. However, this is a very large assumption. Already some 3 million hectares of agricultural land across the EU, an area roughly the size of Belgium, grows 10 million tonnes of rapeseed. But since just 20% of this is ultimately used for biodiesel as opposed to food oil, another whole Belgium would have to be covered in the yellow rapeseed blanket to meet the targets. This would not only be bad news for asthma sufferers. Rapeseed tires the land, and requires expensive crop rotation and fossil-based fertilisers. Growing rapeseed also has an opportunity cost of preventing farmers from growing more environmentally-friendly, less intensive, and often more profitable produce such as cereals or organic root vegetables. Under these circumstances, the supply of rapeseed oil is unlikely to be able meet the demand.

Oil from beans from Africa and Asia

One UK-based company, D1 Oils plc, has put itself at the forefront of efforts to fill this gap with Jatropha oil. Jatropha grows quickly, is hardy, establishes itself easily even in arid land, and is drought-tolerant, requiring only 300 mm of annual rainfall. It grows especially well in south and west Africa, and south east Asia. Jatropha can even be grown on semi-arid land using waste water, making it a useful tool in the prevention of desertification. Each Jatropha tree can produce an average of 3.5 kg of beans each year, depending on irrigation levels. According to D1's estimates, if 2,200 Jatropha trees are planted per hectare, each hectare could yield up to 7 tonnes of beans per annum. Jatropha beans can produce oil yields of up to 40%, and D1 expects each hectare to deliver about 3,000 litres of biodiesel.

In the established process for refining biodiesel, the vegetable oil is esterified, reacted with methanol and sodium hydroxide to produce diesel and glycerine. D1 has adapted this method to create its own proprietary process producing biodiesel from Jatropha and various other feedstocks. The Jatropha biodiesel meets the European EN14214 standard for use as a pure or blended automotive fuel for diesel engines.

D1 has already secured plantation agreements in Burkina Faso, Ghana and the Philippines totalling 37,000 hectares, and has the option to extend planting to approximately 990,000 further hectares of land in Burkina Faso and 5 million hectares of land in India. The company recently raised £13 million in a London Stock Exchange flotation to fund these initiatives.

According to Philip Wood, Chief of Executive of D1 Oils, the company is on the way to delivering enough Jatropha biodiesel to meet EC demand. "We have created a unique business model and put in place the right mix of technology and contracts, as well as a strong team, to

deliver results and grow the business. With a total of 6 million hectares under option, roughly the same size as two Belgiums, we could be producing 18 billion litres of biodiesel, which at current estimates would meet demand expectations in Europe."

Local benefits, on-site refining

However, the demand for biodiesel is not coming solely from developed markets. One of the main reasons for the excitement around Jatropha is that developing countries also want their own biodiesel blends for domestic transport and power generation, both as a substitute for expensive oil imports and to prevent pollution. The President of Burkina Faso Blaise Compaoré, recently welcomed the biodiesel initiative undertaken by D1 in west Africa, saying, "By producing our own biodiesel, we will gain greater energy security, save valuable foreign currency, and potentially become an exporter of biodiesel."

The potential for local demand for biodiesel, as well as for export, has been anticipated by D1 Oils. According to Philip Wood, the company has structured its production technology to offer developing countries small refineries that can produce biodiesel close to the plantations. "Our small, economic, modular refinery is easily transportable, produces minimal emissions, uses virtually no water and can be powered in remote locations by its own biodiesel," says Wood. "In addition to our refinery in Newcastle, the first of its kind in the EU, we have plans to provide modular refineries in India, the Philippines and South Africa."

The benefits for the developing world go further than producing fuel for local use. Since the planting, growing and refining of Jatropha seeds requires manpower, its cultivation will generate large numbers of jobs in areas of low employment. D1 estimates that its Jatropha plantations are likely to create at least one job for every four hectares of planted trees, and with 6 million hectares under option the total impact on agricultural employment for that company alone could be huge. The biodiesel refining process also produces profitable by-products such as glycerine for cosmetics and seed cake for fertiliser and animal feed, and Jatropha can potentially be intercropped with other valuable plants such vanilla or patchouli.

Fuelling transport growth in India

However, it is Jatropha's ability to grow on marginal, waste or arid land and produce energy crops without displacing food crops that is perhaps of most potential importance to the developing world. This aspect of Jatropha has made it particularly attractive to the Indian government. Given India's booming economy, its transport sector will consume ever higher amounts of fuel over the coming years. Indeed, demand for diesel fuel is expected to grow from current levels of 44 million tonnes to 67 million by 2010. Aware of these predictions, the government of India has a $300 million biofuels programme in place which foresees India replacing 5% of current diesel with biodiesel by 2005/6, eventually rising to 20%.

Above: Jatropha trees planted in Ghana Right: Jatropha beans – each tree can produce an average of 3.5 kg of beans per year, depending on irrigation levels

However, the Indian government is also aware of the environmental benefits of growing the tree on marginal and arid land. In a recent speech, the Indian President, A P J Abdul Kalam, declared that "India needs to grow Jatropha to tackle dry land and generate biodiesel." India has large areas of poor quality land ideal for the cultivation of energy crops, so growing Jatropha won't divert land away from growing vital food crops.

D1 Oils is currently in discussions with the Indian government to see how it can help India meet its biodiesel targets. According to D1 estimates, for India to reach its target of 20% bio-diesel mix, some 2 million hectares of Jatropha will be needed. With this target in mind, D1 has been working with the Tamil Nadu agricultural university on research into Jatropha and large-scale planting, and has put forward proposals to plant Jatropha in the states of Tamil Nadu, Madhya Pradesh, Rajasthan and Chattisgarh. D1 has also entered into a joint venture agreement with India's Mohan Breweries to operate and control future projects in the region. A pilot scheme of approximately 5,000 hectares has been established with Mohan and planting is anticipated to be completed during early 2005.

Developing countries are also aware that, as the mechanisms of the Kyoto Treaty come into force to reduce industrial and commercial greenhouse gas emissions, the planting of biofuel crops may well create carbon sinks that can earn them cash through their sale of emissions credits to polluting industries in developed countries. The Clean Development Mechanism (CDM) created by Kyoto is still in its infancy. However, if CDM credits do become available for planting trees, it could add a further inducement to plant Jatropha to act as an energy-producing carbon sink.

'Money doesn't grow on trees'

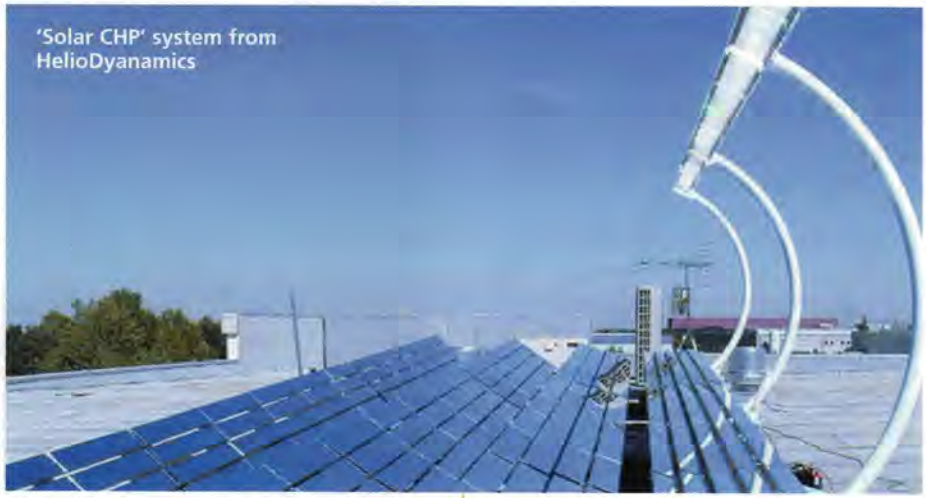
The history of the commercial contacts between the developed and the developing world has not been smooth, particularly in the sphere of agriculture and energy. However, the fact that Jatropha requires a warmer climate than we have in Europe could enable it to make a very positive impact on the environments and economies of developing countries. Money, as the old adage goes, may not grow on trees, but a possible energy solution clearly does. In today's world of mounting fossil fuel prices and concern about global warming that could amount to the same thing.

Contact D1 oils plc at **www.d1plc.com**

Postgraduate research in London concentrates on renewables

What sort of research and thinking into energy matters is taking place at London's universities? Last year, the London & Home Counties Branch of the EI ran a competition to find the best. Energy postgraduate students were asked to submit a written paper, with three shortlisted entrants also giving an oral presentation. Below are a considerably shortened versions of Oliver Knight's winning paper and the two runners up.

All three students were studying at Imperial College London and can be contacted via Dr Matthew Leach at m.leach@imperial.ac.uk



'Solar CHP' system from HelioDyanamics

Concentrating PV-thermal technologies – the potential to reduce costs

Oliver Knight

Solar CHP (SCHP) is a term to describe a group of solar PV-thermal concentrator technologies currently in development. The fundamental theory behind each of the different systems identified is that, through concentration and the generation of both electrical and thermal energy, total overall efficiency can be dramatically improved whilst simultaneously reducing material costs. Four SCHP systems are identified, all at similar stages of development; all four technologies are designed for building-integrated or freestanding installation for medium-scale industrial or commercial use. These are: HD Solar Cogen (HD211), by HelioDynamics Ltd (UK); BiSolar, by Solar Focus Inc. (US); CHAPS, by the Centre for Sustainable Energy Systems at Australia National University; and finally MaReCo, which is being developed by Vattenfall AB, the Swedish energy company.

Although each design is different, all the devices work by first concentrating incoming radiation onto a small strip of PV, behind which heat is collected via circulated water. The first three systems are designed to produce heated water at or in excess of 85°C, which is high enough for many industrial applications and can be used to power an absorption chiller for cooling purposes. The MaReCo system is the exception, being designed to provide hot water for domestic use under high latitude conditions (this puts it just outside the term solar CHP).

Cooling is an ideal application for solar power due to the obvious synergy between solar radiation and times of maximum cooling demand; it also reduces the so-called 'street canyon effect' associated with conventional cooling, whereby additional heat created through electricity consumption increases the cooling demand, especially in confined or urban environments. Some research has been conducted in this area though the Solar Heating & Cooling Programme run by the International Energy Agency (2002) but, faced with high costs (evacuated tubes are usually necessary to provide the higher temperatures required), solar cooling has not yet become commercially viable.

The research model used to assess SCHP is based on just one of the technologies: the HP211 system by HelioDynamics. This system is mid-range in terms of quoted performance. The model uses hourly temperature and direct normal irradiance (DNI) data for a statistically average year for the location of Las Vegas, in Nevada, USA. This was used to estimate the cooling demand for an average 1000 m^2 commercial building, based on a series of standard assumptions. The performance of the system (made up of generated electricity and avoided electricity consumption, minus additional operating costs) was then fed into a discounted cash-flow analysis that took account of the additional capital cost of the SCHP system over a 30-year period. This additional cost included the cost of the SCHP system (based on mid-term manufacturer projections), the back-up systems (cold water storage tank and gas boiler), and the cost of the absorption chiller over a standard vapour-compression system. Two key assumptions were: zero fuel price inflation (electricity and gas), and an 8% commercial discount rate; the first was judged to be on the conservative side.

From this model the net present value of the theoretical SCHP system was determined, along with sensitivity analysis of two key factors: baseline fuel prices and yearly fuel price inflation. The NPV results were also calculated to take account of the Nevada PV rebate scheme, which offers up to $5/W for grid-connected PV systems.

The results give the SCHP system a negative NPV both with and without PV rebates. However, SCHP significantly outperforms evacuated tubes, which were also modelled. When simple payback is considered, SCHP manages 14 or 28 years (with PV rebates and without) compared to 21 or 41 years for a conventional PV system; this is a significant improvement. More interestingly, if annual fuel price inflation is increased from zero to 2.5%, the NPV of the SCHP system becomes positive with rebates included. Separately, if electricity prices are increased from Nevada's average 7.7 cents/kWh to around 16 cents/kWh, SCHP becomes profitable today, without rebates.

Such electricity prices can be found in several appropriate (albeit small) countries, including St Lucia (17 cents/kWh) and Barbados (21 cents/kWh).

However, several potential non-user benefits are identified which may help to improve the economics of SCHP, if they can be justifiably internalised. In many hot countries cooling loads form a large and growing percentage of peak demand, representing a high cost to utility companies. In Nevada, cooling represents up to 50% of Nevada Power Company's peak summer load. Solar CHP-powered cooling could help to reduce these costs by generating embedded electricity at times of peak demand, whilst simultaneously eliminating cooling demand at installed sites. This would also reduce transmission costs, and could have benefits for grid stability. Small amounts of PV embedded on the US grid may have been sufficient to prevent the collapse of north-east grid on 14 August 2003; SCHP would more than double this effect through its simultaneous electricity generation and substitution.

Utility companies (or generators, depending on the structures in place) may also find that the 'portfolio value' of SCHP, as with all renewables, is higher than the unit cost, as diversity of supply (particularly towards generation without fuel costs) has a value in its own right. Finally, and on a more technical point, SCHP-powered cooling may benefit grid operators by reducing reactive power demands, which are strongly associated with the induction motors found on conventional chillers. This would help to improve system efficiency and voltage control.

Further research would be needed to quantify and value these non-user benefits, but there is certainly a case for their inclusion when viewing the economics of SCHP. This may require the promotion of different ownership models, whereby utility companies undertake to install, own and operate SCHP plants at or near their customers' premises by offering fixed-price energy services (such as cooling or process heat). This might represent a key target market for SCHP developers, along with niche markets in certain developing countries where the price of electricity is already high. What is certain is that these technologies could signify a breakthrough in the cost of solar power and their development ought to be strongly encouraged and supported.

Contact HelioDynamics at
www.heliodynamics.com

Locational signals and their impact on UK renewables and embedded generation

Matteo Di Castelnuovo

This paper investigates the importance of implementing adequate locational signals into the electricity industry and their possible effects on renewable energy sources, with particular reference to the UK case. UK energy policy, as well as the regulatory and commercial frameworks of the electricity market, have been analysed against the background of locational signals and renewable sources.

Locational signals may be defined as economic incentives that are given to market players to reflect their relative geographical situation; the purpose of these incentives is to influence trading decisions (short-term effect) and investments in energy infrastructures (long-term effect) in order to contribute to the efficient operation and expansion of an electricity system. However, with particular reference to the British case, there seems to be a conflict between the implementation of adequate locational signals and the development of renewable energy, particularly wind energy in the north of the country.

In fact the UK Government has a target for renewable generation to provide 10% of electricity supply in 2010 with a further aspiration to double this share by 2020. Several market players, backed by the Government, appear to be convinced that the UK will not meet its renewable target in 2010 unless significant quantities of onshore wind are built in remote Scottish locations. However this argument is threatened by stakeholders like Ofgem, which is concerned that the location of renewable generation in Scotland is inefficient and argue that, if appropriate locational signals are provided, then generators will face incentives to build capacity where networks need little or no reinforcement, i.e. much less in Scotland and more in England and Wales.

Two recent proposals on locational signals are investigated against the renewable target. In the first proposal, it is suggested to introduce GB-wide zonal charges for transmission losses – whose cost is currently averaged across all transmission users. According to the second, zonal transmission use-of system charges (currently applied by NGC in England and Wales) should be extended also to Scotland, as part of the British Electricity Trading and Transmission Arrangements (BETTA).

Based on the analysis of the ongoing debate and of a short industry consultation, this paper argues that, in theory, there is no conflict between locational signals and renewable energy – as the purpose of introducing locational signals is to make the electricity market more efficient, irrespective of what happens to a particular technology. It will be for the market to decide which combination of technologies and locations represent the least costly solution, provided that network charges do signal the locational factor. If market participants are exposed to the costs caused by a particular location, then market forces will be able to encourage an efficient decision. However, in practice locational signals could be seen as a threat for the development of wind farms due to political pressures and to some issues of inadequacy surrounding NGC's transmission model.

The value of domestic PV for electricity suppliers in England and Wales

Justin FitzHugh

The UK government is encouraging the development of microgeneration and, specifically, of domestic photovoltaics (PV). However, many of the benefits of PV microgeneration reach generation operators only through electricity suppliers. As a result, for domestic PV operators to receive the value of government incentives and the market-based benefits they bring, suppliers need to participate in the microgeneration market, most likely by offering a tariff for electricity generated.

The study used a model to quantify the value of domestic PV customers to suppliers and the value that PV operators would receive, were they to be passed the full value of all the incentives and benefits they bring. These two values share many components, including the value of the energy they export, embedded benefits, the disbenefits of additional uncertainty and Renewables Obligation Certificates (ROCs). However, the value of PV customers to suppliers is lowered by lost demand (PV customers generating a portion of their own energy needs) and the relatively high bureaucratic burden that such customers bring.

The study found that, under base case assumptions that reflected current market conditions, domestic PV customers create less value for suppliers than either conventional or green tariff customers. However, at just over £5 per customer per year compared to a value for a green tariff customer of £72 per customer per year, the difference is relatively low. It may be possible to remove this deficit by streamlining bureaucracy, providing better regulatory certainty, creating the potential for greater competition and offering suppliers alternative ways to create value from domestic PV customers.

Under the base case, suppliers would be passing through approximately 60% of the benefits that PV operators could receive. Given the size difference, this compares favourably with the commercial terms offered by suppliers to some larger distributed generators. However, as the majority of this value comes from ROCs, it suggests that the Renewables Obligation is not a particularly efficient tool through which to incentivise smaller renewable generators.

The study concluded that government and the regulator should seek ways to allow suppliers to create more value from PV operators by lowering the bureaucratic burden associated with earning ROCs and allowing them to capture value in additional elements of the value chain. These may allow suppliers to create as much value from PV customers as from conventional ones and should also raise the proportion of value passed through.

Low maintenance, small-scale wind power

With multi-megawatt offshore wind farms at one end and those little battery-charging turbines you often see attached to the back end of pleasure boats at the other, the wind power spectrum also has room for turbines generating just a few kilowatts for an individual farm or rural estate. British manufacturer Iskra Wind Turbines also aims to export turbines to developing countries.

Small wind generators can generate enough electricity to allow individuals, schools, farms and businesses the chance to become generators and consumers, using what they need and exporting the rest. Home-grown power can enable energy independence and, through more consumer involvement in power generation, should encourage greater energy efficiency. In fact many small generators end up making a fair income from their turbine.

The major benefit of small wind for the owner over any other power source, including large wind turbines, is that the owner does not just get paid the wholesale price for the electricity sold back to the grid. By being both generator and consumer, using the energy that would otherwise be bought off the grid, the full retail price of each kWh is realised. The turbine owner still gets paid the export price for the power they do not use, plus renewables obligation certificates (ROCs) and levy exemption certificates (LECs), for all the power generated. The more expensive grid power gets, the better-off the turbine owner is.

In the UK over the last few months legislation has altered the planning permission scene for small turbines and the selling of power back to the grid, making the whole process much more accessible and viable. While at the same time the massive increases in power costs have made alternative energy sources far more attractive

Until this year, UK planning and grid connection regulations did not clearly differentiate between giant wind farm-scale turbines and the sort of farm machinery-type turbines produced by companies like Iskra. Turbines were either tiny battery-charging units seen on yachts or immense power generating units installed by utility companies. This made it very difficult for generators of our scale to enter the market.

In the last few months a piece of planning policy (PPS22) has laid out clearly the distinctions, making it harder for planners to turn down small turbine applications (see *Energy World* September 2004). The grid connection regulations and limits on power export have also been changed.

The economic case for any one with space to install a small turbine is now highly attractive. With up to 50% grants available; ROCs and LECs awarded for every unit generated and the ability to sell excess power back to the grid, it is now possible in some cases with Iskra's 5 kW turbine to recoup the cost of purchase and installation in under five years. The Iskra turbine is designed to last 20 years

Non grid-connected applications

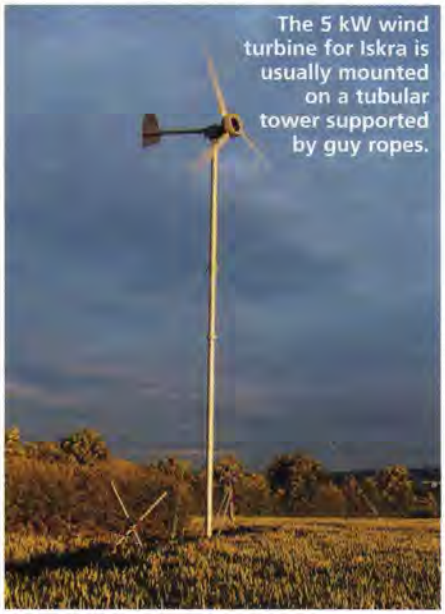
While the Economic case is easy to make in the UK, the potential for small-scale wind power is most obvious in developing countries. The United Nations Development Programme (UNDP) estimates that there are 2.5 billion people living in remote rural villages throughout the developing world who do not have electricity.

It has been shown that access to even a small amount of electricity improves the health and prosperity of these communities. But there is little chance of the grid being extended to remote districts.

Grid systems in underdeveloped countries are usually so overstretched as to be incapable of handling increased energy demand, especially over long distances. Local solar, wind and micro-hydro power are therefore the only practical alternatives, and already thousands of small wind turbines are deployed in successful village power projects worldwide. These systems are sustainable, cutting a community's dependence on expensive consumables, which have to be brought long distances, such as kerosene for lamps, dry batteries for radios or maybe diesel for a generator.

A wind turbine can pump water or charge batteries. The electricity from small turbines can enable small-scale businesses to function and so prosperity increases. The country's dependence on imported fuels is significantly reduced.

It is essential to select 'appropriate technology' for proposed usage and location. Many of Iskra's customers are in isolated rural locations, so low maintenance



The 5 kW wind turbine for Iskra is usually mounted on a tubular tower supported by guy ropes.

requirements, reliability and simplicity are all paramount. We use rotor and yaw bearings, which are supplied grease-filled and sealed for life. Assembly and maintenance of the turbine, tower and electrical system is straightforward and can be performed with a few standard tools.

In order to minimise the amount of steel and concrete used in the wind turbine, a guyed tower is normally adopted. In some circumstances, the tower will not require concrete foundations and soil anchors or rock bolts can secure the tower guy-cables to the ground. This makes installation in remote regions easier

Small wind turbines have an important role in ensuring a bottom up approach to sustainable economic development globally and a robust electricity generation profile in the UK, the windiest country in Europe.

Contact Iskra Wind Turbines at **www.iskrawind.com**

The Iskra turbine	
Wind turbine rating	5.3 kW at 12 m/s (26.8 mph)
Rotor speed	240 rpm nominal (variable)
Cut-in wind speed	3 m/s (6.7 mph)
Survival wind speed	60 m/s (134 mph)
Rotor diameter	5.0 m
Rotor orientation	Upwind
Number of blades	3
Blade material	Glass reinforced polymer composite
Mechanical control system	Passive blade pitching
Gearbox	None
Brakes	Electro-dynamic
Generator	Permanent magnet alternator
Rectifier output voltage	400 V at 240 rpm
Yaw control	Tail vane
Tower height	From 12 to 30 m, depending on site

Energy Manager of the Year – the 2004 story from Knowsley MBC

Barry McKean's considerable achievements as Energy Conservation Manger at Knowsley Metropolitan Borough Council won him the major energy management award last year. Now, as entries are being gathered for this year's award (see below), we tell Barry's story.

Barry McKean was initially a team of one within Knowsley MBC and, over the last couple of years, has built the team up to four people. One of his team collects cost and consumption data, another undertakes corporate site surveys and proposes remedial works where required. The final member of the team is the Home Energy Efficiency Officer, with responsibility for all things HECA.

In the year 2003/4, corporate financial savings were just over £400,000 on a £2.7 million annual energy spend. In addition, to counter fuel poverty and to enable vulnerable households to afford to heat their homes, over £1 million was spent on installing home energy measures such as loft and cavity wall insulation into more than 2,700 homes. Barry estimates that each participating household saves over £100 and 1.2 tonnes of carbon dioxide per year.

The year began well, with the relatively new Knowsley Energy Team being shortlisted for a Groundwork Merseyside 'Waste Minimiser' LA21 Award. This was quickly followed by the team picking up a Knowsley MBC, 'Improvement Team of the Year' award. Then the icing on the cake, for Barry, was being awarded the accolade, Energy Manager of the Year 2004. But recognition did not end there, as the Home Energy Efficiency Officer went on to collect the North West 'Home Energy Officer of the Year' award.

The Energy Manager award was Barry's personal highlight of the year and no one was more surprised than the recipient on that night in March when Professor Martin Fry made the announcement. But, says Barry, the award is a reflection on all those in Knowsley who have made a difference. Certainly the Energy Team is at the centre of that, but others such as councillors and senior officers ensure that resources are in place to 'green' the authority, and other partners, both internal and external, have worked towards the common goal.

"We in the energy industry are in a privileged position in that we are able to influence the lives of so many at home and at work. On the wider global front, those who look for recent evidence of climate change need look no further than Boscastle in Cornwall or Glen Ogle in Scotland, two British villages suffering the catastrophic effects of floods, which destroyed homes and businesses alike," says Barry. "Our role enables us to reduce harmful greenhouse gas emissions, principally carbon dioxide. In Knowsley, we now purchase 100% green electricity for all of our sites, including schools, and I estimate that this has reduced carbon dioxide emissions by a third, from a total of about 30,000 tonnes to nearer 20,000 tonnes pa."

"As well, though, we all need to actually reduce our consumption," adds Barry. "Five years ago we installed real time energy monitoring systems into our six leisure centres at a total cost of £12,000. In year one, we saved £36,000 and, in year two another £31,000 and our consumption fell significantly as a result of the installation. Over a five-year period the six centres reduced their electricity consumption from 4 million to 3.2 million kWh, and gas consumptions fell from 15 million to 10.2 million kWh. The benefits of this type of real time energy monitoring are well proven and I believe that this technology allied to simple enthusiasm can make a difference on a grand scale in our efforts to reduce carbon dioxide emissions and the effects of climate change."

"Fuel poverty is also a scourge but with funds provided by the utility companies, courtesy of the regulator, all domestic properties should have access to low or even zero cost installation of energy saving measures, such as loft and cavity wall Insulation. In Knowsley we have pioneered the 'Heatstreets' scheme in partnership with Powergen, which is now being rolled out to the benefit of others. In the past twelve months we estimate that such works have resulted in our participating households saving a total of 3300 tonnes of carbon dioxide emissions and £324,000."

Schools are also benefiting from active energy conservation works. "On average our secondary schools are now paying £10,000 less per year for their energy and water than five years ago (although this trend is changing); our primary schools are paying £1,000 pa less, despite the introduction of the Climate Change Levy."

The reasons for these projected increases are well known, but those responsible for energy management are still expected to deliver financial benefits. How is that to be achieved? Barry McKean again: "My own personal experiences lead me to believe that computerised monitoring is essential. Sites with annual energy spends in excess of £10,000 should be able to recoup 15% pa utilising such a system. An average all-in cost of £3,000 per site gives a payback period of better than three years. Some of our sites have recouped their investment in months rather than years."

For the future, funds flowing from the Energy Efficiency Commitment could be directed toward industry and commerce, including schools," says Barry: "preferably in the form of say a 50% grant toward the installation of energy saving measures such as monitoring systems."

Finally, back to the Energy Manager of the Year accolade. "On the evening of the ceremony and prior to the announcement of the winner we had dinner. As I listened to the exploits of those who shared my table, especially the private sector representatives I was flabbergasted, not only at their achievements, but at the fact that they did not enter the competition. To win it, you've got to be in it."

Entries are now being accepted for the 2005 NEMEX Energy Manager of the Year awards. Nominees can propose themselves or a colleague, and should submit a 300 word synopsis entitled 'Why I should be Energy Manager of the Year' to highlight their achievements. The winner will be announced at the annual NEMEX gala dinner, to be held in Birmingham on 24 May. The deadline for nominations is 4 March. Submissions should be sent, with a copy of your CV or job description, to Gill Haben at the Energy Institute e: **ghaben@energyinst.org.uk**

Cutting use; saving money

Every year, UK businesses spend over a billion pounds on more than 1,300 million m³ of water. But, as supply gets scarcer, a focus on sustainable consumption could bring huge financial returns, says Martin Gibson, *director of the Envirowise programme.*

Water may be 'on tap', but it is not a limitless resource. Recent Environment Agency figures reveal that water is more plentiful in the desert states of Syria and Sudan than it is in the south east of England. The rest of the UK is not much better off – reservoir stocks declined significantly during an exceptionally dry year in 2003. Indeed, this most basic of natural resource is in worryingly short supply.

This message, however, has not filtered through to the wider business community. Water consumption continues to rise and few are taking steps to tackle it (just 14% of employees are encouraged to save water). If the UK is to develop a truly sustainable economy this must change, and quickly. Any business relying heavily on water will see costs increase in the coming years as supply struggles to keep pace with demand.

This startling fact is not lost on everyone. Some forward thinking businesses have taken positive steps to limit their reliance on mains supply, preferring to take a longer term, sustainable approach to water use and reuse. For instance, Westbury Dairies Ltd, a dairy based in Wiltshire, has introduced an innovative system to collect and reuse condensate formed during the milk evaporation process (see box). Cost savings from purchasing water alone exceed £340,000 per year.

But businesses like Westbury Dairies Ltd are still in the minority. For many, tackling water consumption still seems a daunting task. In my experience, however, it need not be like this. Envirowise provides hundreds of businesses with free advice on environmental issues including water use – with a little help, many of them find it relatively easy to cut water consumption, and bills, considerably.

When it comes to water, even small changes to business practices can deliver huge benefits. For instance, UK businesses could cut annual water consumption by up to 70 million cubic metres through the simplest of measures. By placing a full one-litre water bottle in each of their toilet cisterns, businesses would reduce every toilet flush by around one litre. Just that small change could save the UK economy as much as £12 million in reduced water costs.

But this is just one of many simple techniques businesses can employ – others include fitting push taps in toilets and spray nozzles on hoses – and more concerted efforts would bring greater rewards.

However, before any business can really start to make big savings, it must have a clear understanding of how much water it uses, when and where. This means putting in place effective systems to monitor water use.

Clear monitoring makes it much easier to identify ways to reduce the use of water during process activities such as cleaning and cooling. These could include:

- optimise cleaning schedules to avoid unnecessary cleaning and reduce water use for cleaning;
- prevent products from becoming dirty, with re-usable covers or other devices;
- consider pedal-operated water flow for intermittent rinsing or washing operations;
- consider re-use/recycling of wash or rinse water;
- reduce the use of cooling water;
- use natural convection or forced air cooling instead of water cooling where appropriate;
- consider using process wastewater as cooling water; and
- if possible, use cooling water from a low temperature circuit to cool a higher temperature circuit before discharge.

The incentive to take these measures seriously is potentially huge. In total, UK businesses could cut total annual water consumption by one third – or a huge 390 million m³. That would represent total cost savings of more than £300 million.

Westbury Dairies

In 1999, five groups of dairy farmers merged to form Westbury Dairies Ltd. To process the combined milk volume, a state of-the-art facility was designed and constructed in Westbury, Wiltshire. At the site, milk is received by road tanker and then processed into milk powder, cream and butter.

The scale of production capacity at the site means that it falls under IPPC regulations, so Westbury had to adopt an integrated approach to the management of raw materials, with particular focus on water use.

Before the company could set about minimising mains water use, it was important to understand water use on the site. A detailed water mass balance was prepared (based on the maximum milk throughput and knowledge of the production processes in other UK milk processing facilities), which highlighted the areas where significant amounts of water were used and wastewater generated.

The water mass balance identified evaporative condensate as a major source of wastewater. This abundant source of water is warm (44°C) and relatively clean, being low in suspended solids, making it an obvious target for recovery and re-use. United Milk installed a reverse osmosis (RO) membrane plant to treat the recovered evaporative condensate. The RO plant produces 1,900 m³/day of hot (65°C) permeate when the plant is running at full capacity. The permeate is treated using chlorine dioxide prior to re-use, to ensure the quality of the recovered water.

The recovered and treated evaporative condensate is used hot for a number of applications on-site, including boiler feed make-up and hot cleaning-in-place operations, where otherwise cold water would have to be heated. The heat from the condensate is also recovered by a number of heat exchangers, including the raw milk heater, realising further energy savings.

Despite fairly high associated capital and running costs, Westbury Dairies recovered its investment in just nine months:

- water-related cost savings of over £2,000/day;
- additional energy savings worth over £1,000/day through reuse of warm condensate;
- use of mains supply water reduced by 1,530 m³/day; and
- savings of almost £1.13 million expected in the first year of operation.

Contacting Envirowise

Free, confidential help and advice from Envirowise helps thousands of businesses across the UK to improve environmental performance and boost profits – in the last ten years, it has helped businesses to save more than £1 billion.

Free services include the Environment and Energy Helpline, t: 0800 585 794, at which a dedicated team of experts provides up two hours of free consultation and advice. There is also a website **www.envirowise.gov.uk**

Finally, free, on-site consultancy provided by an independent expert – 'FastTrack' visits are designed to identify sources of waste and enable businesses to start making savings immediately.

Over the last six months the EI has been reviewing the best way to develop the Institute's technical and scientific publication the Journal of the Energy Institute. *Last autumn it was decided to outsource the management to a professional journal publishing house, whose expertise matched the very specific needs of the journal and importantly its readers, both within the Institute and externally. To this end, Maney Publishing* (www.maney.co.uk) *has been contracted to publish the* Journal *from 2005 onwards.*

Exciting changes for the Journal of the Energy Institute

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One of the few remaining independent publishers, Maney was founded at the beginning of the 20th century and has offices in Leeds, London and Boston in the USA. With Maney's expertise and track record in enhancing research journals, the trustees are confident that there is a tremendous opportunity to move the Journal forward. Maney currently publishes over 50 peer reviewed research journals and professional publications, including the journals of the Institute of Materials, Minerals and Mining, and the Manual of Environmental Policy of the Institute for European Environmental Policy.

Copyright and ownership of the Journal remains with the EI. Members' subscriptions will continue to be serviced by the Institute at specially reduced rates. Institutional subscriptions will be serviced by Maney Publishing directly.

As part of the review process and following the appointment of Maney Publishing, we are also very pleased to announce that Professor Alan Williams CBE, FREng FEI, Research Professor in the Energy and Resources Institute at Leeds University, has been appointed as the Journal's new Editor. Professor Williams has published widely on the combustion of fossil fuels, biomass and hydrogen as well as more generally in the field of energy.

In line with the interests of the EI the editorial scope of the Journal has been amended to reflect more accurately the wider interests of members, while maintaining the core topics that it has covered since it was established.

Professor Williams will be working closely with the current editorial board to ensure that the high standards of publishing are not only maintained but developed as the journal adapts to its expanded remit and coverage.

Members wishing to submit papers to the journal should write to the editor:

Professor Alan Williams,
Energy and Resources Research Institute,
Houldsworth Building,
Leeds University,
Leeds LS2 9JT, UK

or, for electronic submissions, which are encouraged, e: **fueaw@leeds.ac.uk**

Members interested in subscribing or receiving sample copies of the Journal should contact the EI's Library and Information Services department **lis@energyinst.org.uk**

For information on non-member subscriptions please log onto: **www.maney.co.uk/eni** or t: +44 (0)113 284 6133

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- Combustion engineering and associated technologies
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- Alternative energy sources
- Biomass utilisation and biomass conversion technologies
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to 15.5°C base temperature

	Region	Oct 2004	Nov 2004	Dec 2004
1	Thames Valley	103	198	289
2	South East England	137	228	327
3	South Coast	106	194	265
4	South West England	120	164	235
5	Severn Valley	135	216	285
6	Midlands	164	232	300
7	West Pennines	150	235	315
8	North West England	177	223	308
9	Borders	160	226	306
10	North East England	172	244	319
11	East Pennines	148	235	305
12	East Anglia	136	244	327
13	West Scotland	198	236	306
14	East Scotland	183	250	325
15	North East Scotland	186	253	325
16	Wales	151	194	267
17	Northern Ireland	201	215	291
18	North West Scotland	196	235	286

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University of Leeds,
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Tel: 0113 343 2494 Fax: 2511
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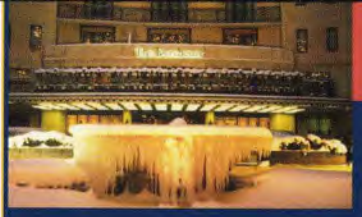

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a) Tickets can be purchased by members and non-members of the Energy Institute.
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c) Seating arrangements will be organised by the EI bearing in mind guests' wishes. Companies or individuals wishing to share tables must state this when completing the application form, as changes cannot be made are tickets have been allocated.
d) Special dietary requirement will be accommodated if notified to the EI by 4 February 2005. An additional charge may be incurred.
e) Guests' names should be submitted in writing to the EI by Wednesday 26 January 2005 at the latest for inclusion in the printed guest list. Name changes or additions submitted after this date cannot be included in the printed guest list.
f)This event is included in the IP Week Pass as well as the Tuesday Morning Pass and Tuesday Afternoon Pass. If you cancel your order after it has been processed, a refund less a 20% administration charge of the total monies paid will be made provided that notice of cancellation is received in writing by 10 January 2005. No refunds will be paid or invoices cancelled after this date.
g) Upon EI receiving your booking form (by fax, post or e-mail) you become liable for full payment of the fee and you undertake to adhere to the terms and conditions as specified.
k) Dress is lounge suit.

Photocopies of this form are acceptable

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