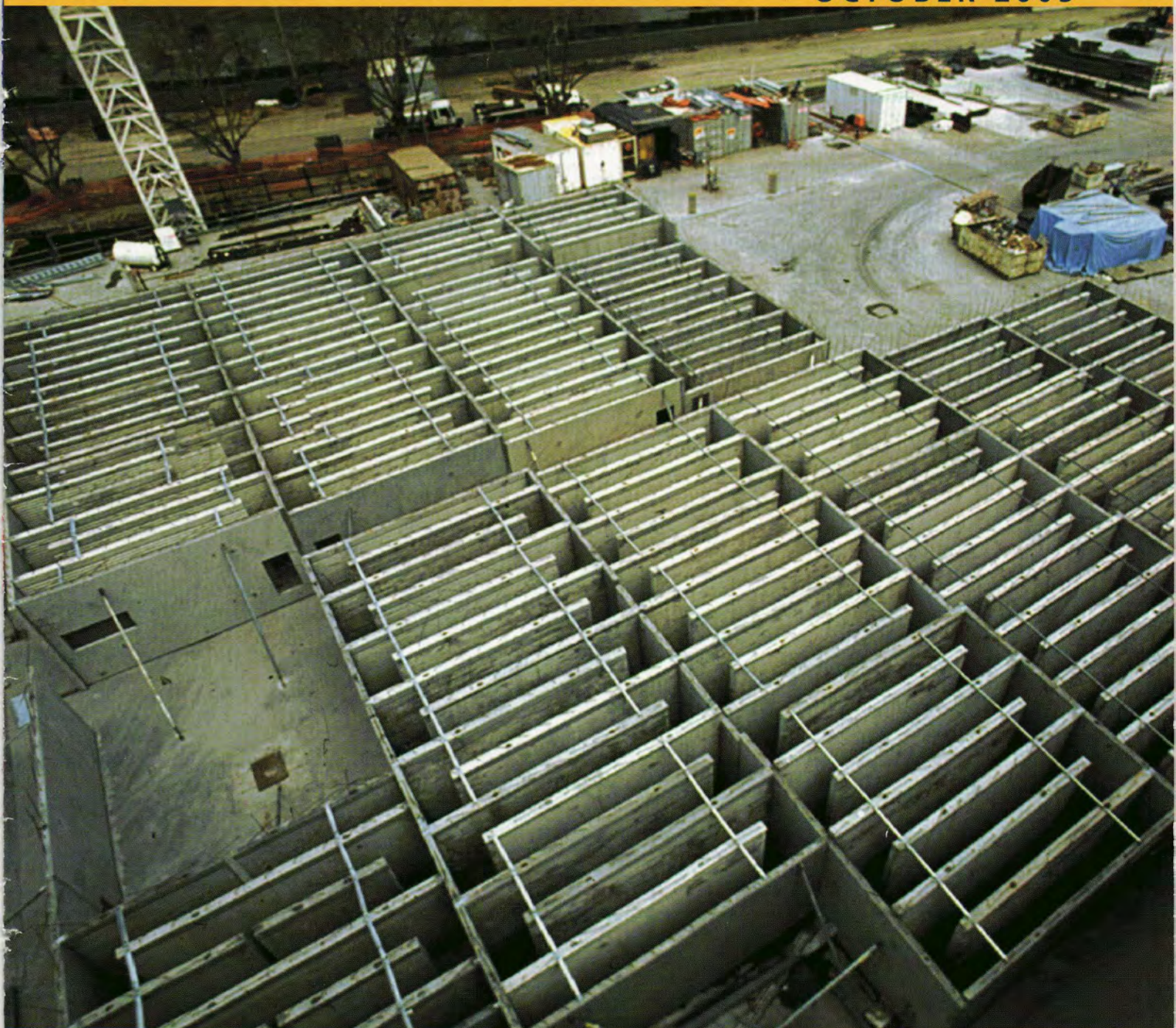


# energy world

OCTOBER 2005



Labyrinth thermal energy storage

Stationary fuel cells in Europe

Tackling fuel poverty

published by





# EI Autumn Lunch 2005

Guest of Honour and Speaker:

**Joan MacNaughton, Director-General, Energy Department, DTI**  
**Monday 17 October 2005, The Berkeley, Wilton Place,**  
**Knightsbridge, London, SW1X 7RL**



The EI Autumn Lunch is a prestigious and established date in the energy events calendar, providing a unique opportunity to hear a respected figure speak on contemporary global issues affecting our industry.

Joan MacNaughton, Director General, Energy, Department of Trade & Industry (DTI), joined the Home Office in 1972 with a degree in Physics from Warwick University. She has had a wide range of policy and managerial jobs in her Civil Service career – managing large-scale organisational change in several different sectors. She has been Principal Private Secretary to three Cabinet Ministers, and has also spent time in the private sector. Since January 2002 she has been DG, Energy, DTI, responsible for Oil & Gas, Nuclear Industries, Coal Policy, and the Engineering Inspectorate. In early 2003, she oversaw the publication of the Government's Energy White Paper, which defines a long-term strategic vision for energy policy combining the UK's environmental, security of supply, competitiveness and social goals. Overall aims of the Group include working with others to promote competitive energy markets, while achieving safe, secure and sustainable energy supplies.

In Spring 2004 she was elected as Chair of the International Energy Agency Governing Board. The IEA, based in Paris, is an autonomous agency linked with the Organisation for Economic Co-operation and Development (OECD). It was formed in the wake of the 1973/74 oil crises with energy security as its core activity and includes key consuming countries such as the US and Japan.

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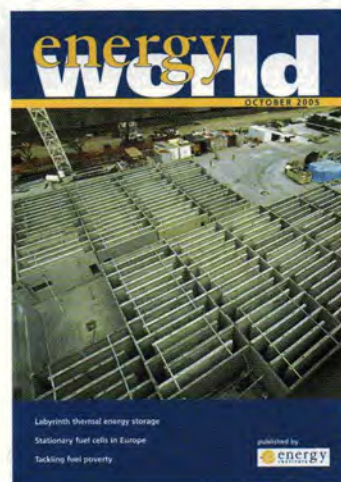
## Cover

A concrete 'labyrinth' under construction at for use at a building development at Federation Square in Melbourne, Australia. The labyrinth is used to condition air serving the buildings – cool, night-time air flows through the warren of rippled concrete walls, flushing the heat of the day out of the structure so that it is cool for the following day.

See page 14 for details of this and other free cooling technologies developed by atelier ten.

(Photo: atelier ten)

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## Building energy use in the balance



Mike Malina is energy manager at Commtech  
[www.thecommtechgroup.com](http://www.thecommtechgroup.com)

**A**t this year's NEMEX exhibition in Birmingham, it was clear that this industry has something of an obsession with measuring things. Metering companies far outnumbered other kinds of product suppliers and there was a positive battalion of energy advisers keen to show end users how they could reduce their energy bills by switching tariffs.

These things are very important and much of our efforts should be focused on measuring and monitoring to find where all this expensive energy is going and then finding ways to manage down the waste and cost. The trouble is that should be stage two, and we haven't cracked stage one yet.

Before we start 'tweaking', there are some pretty fundamental design issues that need to be faced first and which could make an enormous difference in almost every building.

Energy managers and commissioning specialists like Commtech are regularly called in to analyse what is happening in buildings around the country. In most cases, we find that energy consumption is far above design levels and even further above where it could be.

The reason is that most building services are either never properly (or at all) commissioned or have long fallen out of their best operating parameters due to poor maintenance or neglect.

A basic examination of the air and water systems will show, in most cases, that they are catastrophically out of balance. This is fundamental and relatively easy to put right if you call in the right people.

Having your main services unbalanced means your heating system, for example, will only operate in patches with hot water failing to reach all areas of the occupied zones. This will encourage individual users to turn up room thermostats and radiator valves in a doomed attempt to improve their conditions. All they will do is drive up energy costs.

Again if the air services are out of kilter, ventilation fans will be overworking to try and redress the balance and air conditioning systems will be consuming enormous amounts of electricity without delivering the controlled conditions expected by users. How many times have we seen the indiscriminate use of supplementary fan heaters? This certainly gives you more electricity to measure.

### Not delivering

Commissioning engineers can almost sense where the problems are simply by walking into an unbalanced building. They can feel where the airflows are not as they should be, but putting that right takes a bit of technical expertise and a lot of patience. End users could also do with a bit of basic building services education. Why do people behave so irrationally at work compared to their own homes when it comes to controlling temperature and ventilation?

Many commissioning firms find that building managers and facilities managers are simply at a loss to understand why their highly specified heating and air conditioning systems are not delivering the required comfort conditions. Do many of them even understand the concept of balancing and would they be able to point out a services riser to you, for example?

By applying their engineering skills and adjusting valves and dampers, commissioning companies can relatively quickly put a building back on a balanced footing. They can then use thermal imaging technology to check where any heat losses are taking place through the building fabric and from building services plant. As a result the building will be

more energy efficient, with the desired indoor climate conditions being achieved.

Proper balancing also avoids the extra costs incurred when individual users try to intervene to correct a system that is beyond correction due to poor air and water flows.

Commtech has seen an increase of up to 40% efficiency in some of the buildings we have rebalanced. Imagine the impact across all sectors in the UK if a comprehensive assessment was made of the entire building stock. This is a fundamental approach that industry and government seem to have missed in our battle to combat global warming. We accept that our car has to have an MOT, and be tuned for optimal performance, so why not our buildings?

### Investment decisions

The EU Energy Performance of Buildings directive will pile further pressure on building owners and managers when it comes into force next year (although there will probably be a three year moratorium while we get our act together). They will not be able to ignore the requirements of this legislation, which includes the need for all buildings over 1,000 m<sup>2</sup> to display an energy label. This will have an impact on investment decisions because you will not be able to let or sell your building without one.

The UK is using the revised Part L of the Building Regulations to move towards many of the targets set by the directive. Air tightness and ventilation leakage testing, as well as full and comprehensive commissioning, will be major improvements brought about by the directive and it is through this process that systems can be brought back into balance.

Once that is sorted out, building services consultants can look at improving the overall performance of a building on a much sounder footing. The use of the 'whole building approach' outlined under Part L will allow designers to 'mix and match' fabric measures, lighting and HVAC controls as well as being encouraged to design in renewable energy systems and CHP.

Heated and naturally ventilated buildings will have to improve their carbon emissions performance by 25% and mechanically ventilated buildings by 30% under the new regulations. Building owners will also be required to spend a further 10% on top of their planned refurbishments to upgrade energy systems with the aim of delivering a payback in less than seven years.

The solutions are there for both the short and long-term, but none of this makes any sense if the fundamentals of how a building runs are not examined first.



## 'Global warming contributed to Katrina' – Worldwatch

The early results of global warming – including water temperatures of 32°C in the Gulf and rising sea levels – may have exacerbated the destructive power of Hurricane Katrina, according to an assessment by the Worldwatch Institute. Worldwatch projects that the catastrophe will be the most costly weather-related disaster in history.

Alteration of the Mississippi River and the destruction of wetlands at its mouth have also left the area around New Orleans abnormally vulnerable to the forces of nature, says Worldwatch.

The catastrophe is a wake-up call for decision makers around the globe, says Worldwatch President Christopher Flavin. "If the world continues on its current course – massively altering the natural world and further increasing fossil fuel consumption – future generations may face a chain of disasters that make Katrina-scale catastrophes a common feature of life in the 21st century."

According to an assessment by Worldwatch researchers, the long-term lessons of Katrina include a need to address the links between climate change and weather-related catastrophes. Although no specific storm can be definitively linked to climate change, scientists agree that warm water is the fuel that increases the intensity of such storms and that tropical seas have increased in temperature by up to 1.1°C over the past century. Katrina transformed rapidly from a Category 1 to a Category 5 hurricane when it passed from the Atlantic Ocean to the much warmer Gulf of Mexico.

In the next few decades, water temperatures and sea levels will continue to rise, greatly increasing the vulnerability of many communities. Global warming and its anticipated effects on the hydrological cycle will make some areas more vulnerable as storms, floods, and droughts increase in frequency and intensity.

In addition, says Worldwatch, there is an urgent need to diversify energy supplies. Decades of failure to invest in new energy options has left the world dependent on oil and natural gas that are concentrated in some of the world's most vulnerable regions – the US Gulf Coast, the Persian Gulf, and the Niger Delta in Africa. Biofuels and other renewable resources now represent viable alternatives to fossil fuels, which are not only vulnerable to natural disasters but could have a big impact on the severity of future disasters.

## GE to develop hybrid fuel cell/gas turbine system

GE Energy has been selected by the US Department of Energy (DOE) to develop a highly efficient, multi-megawatt solid oxide fuel cell (SOFC)-based power system operating on coal.

Under a 10-year agreement with DOE valued at \$83 million, GE Energy's Hybrid Power Generation Systems (HPGS) business will design and demonstrate an integrated gasification fuel cell (IGFC) system that incorporates a hybrid SOFC/gas turbine as the primary power generation unit. A key objective of the effort is to achieve greater than 50% total system efficiency from coal – a typical conventional pulverised coal-fired power plant operates at about 35% efficiency.

The programme has three primary objectives: to develop a design for a 100 MW IGFC power plant; design and demonstrate a proof-of-concept system (POC); and resolve obstacles associated with the development of SOFC.

Phase I of the development programme, a three-year effort, will begin this month and will focus on system design of the IGFC power plant, IGFC and POC system cost analyses, and SOFC technology advancement. Phase III, beginning in the fifth year of the programme, will culminate in the demonstration of the POC system at an integrated gasification combined cycle (IGCC) power plant, says GE.

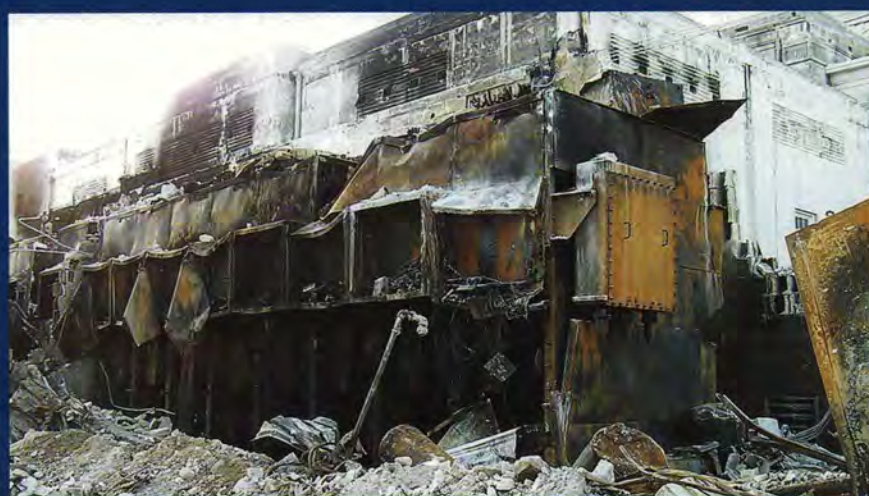
GE Energy is already a world leader in IGCC technology, which converts coal into

a cleaner-burning fuel that is used in a gas turbine combined cycle system to generate electricity.

The latest fuel cell technology programme continues GE's on-going fuel cell development work with the DOE. Since 2001, GE has been part of the DOE's three-phase Solid State Energy Conversion Alliance (SECA) programme, and is nearing the successful conclusion of Phase I with the demonstration of a 5 kW SOFC prototype.

Meanwhile, GE Energy's nuclear business has reached a milestone in the development of its new reactor design – the economic simplified boiling water reactor (ESBWR) – by formally submitting its design certification application to the US Nuclear Regulatory Commission. The company delivered its 7,500-page application package to the NRC in Washington in August. The submission, which represents the culmination of 150,000 man-hours of design work over a 10-year period, should lead to the final design approval of the ESBWR by late 2006, followed immediately by design certification, hopes GE.

The 1,500 MW ESBWR is a Generation III+ reactor design because of its design simplicity and passive safety features, says GE. It depends on fewer 'active' mechanical systems, with associated pumps and valves, and instead relies on more reliable passive systems that utilise natural forces, including natural circulation and gravity.



UK independent power engineering specialist EA Technology has been called in to investigate the cause of the fire which plunged Bermuda into darkness for a day in July. Forensic investigator Dr Dawn Miller has flown to the island to examine the wreckage of one of Bermuda Electric Light Company Limited's (BELCO's) power transmission boards, whose failure caused a fire with flames 20 metres high that took eight hours to control. The fire cut power to all 60,000 residents of the island, though the company restored power to 90% of the island the same day.



# California plans 500 MW solar thermal power station

Two US companies, Southern California Edison (SCE) and Stirling Energy Systems, have announced an agreement that could result in construction of a massive, 500 MW solar thermal generating station in Southern California. When completed, the proposed power station would be the world's largest solar facility, capable of producing more electricity than all other US solar projects combined.

The agreement also includes an option to expand the project to 850 MW.

The 20-year power purchase agreement, which is subject to California Public Utilities Commission approval, calls for development of a 500 MW solar project

110 km north east of Los Angeles using innovative Stirling dish technology. Initially, Stirling would build a 1 MW test facility using 40 of the company's 11 metre diameter dish assemblies. Subsequently, a 20,000-dish array would be constructed near Victorville, California, during a four-year period.

The Stirling dish technology converts thermal energy to electricity by using a mirror array to focus the sun's rays on the receiver end of a Stirling engine. The internal side of the receiver then heats hydrogen gas which expands. The pressure created by the expanding gas drives a piston, crank shaft, and drive shaft assembly much like those found in internal combustion engines but without igniting the gas. The drive shaft turns a small electricity generator. The entire energy conversion process takes place within a canister the size of an oil barrel. The process requires no water and the engine is emission-free.

Although Stirling dish technology has been successfully tested for 20 years, the SCE-Stirling project represents its first major application in the commercial electricity generation field, says SCE.

Experimental models of the Stirling dish technology have undergone more than 26,000 hours of successful solar operation. A six-dish model Stirling power project is currently operating at the Sandia National Laboratories in Albuquerque, New Mexico.

Tests conducted by SCE and the Sandia National Laboratories have shown that the Stirling dish technology is almost twice as efficient as other solar technologies, including parabolic troughs which use the sun's heat to create steam that drives turbines, and photovoltaic cells which convert sunlight directly into electricity by means of semiconducting materials.

- Meanwhile, Spain's Solucar Energia SA, is building an 11 MW solar power tower near Seville. Called PS10, the power plant will be the largest solar power system in Europe and the first tower-based solar power system to generate electricity commercially. The system will consist of a field of 624 large mirrors mounted on computer-controlled pedestals to focus sunlight onto the top of a 100 metre tower, generating steam to turn a turbine and produce electricity.

## World energy use, carbon emissions to grow – EIA

Growing energy demand in the rapidly developing countries of Asia will help increase world energy use by 57% over the next 20 years, according to the US Department of Energy's Energy Information Administration (EIA). The EIA's new: *International Energy Outlook 2005* projects a doubling of energy use in the emerging economies of China and India, while the US and other developed countries will experience a 27% growth in energy use. In addition, the EIA expects energy use to increase by 45% in Eastern Europe and the countries of the former Soviet Union.

As a result, the EIA expects world oil use to increase to 119 million barrels per day by 2025, requiring an increase in production of 35 million barrels per day relative to today's oil production. This is a slight decrease from last year's projection, because the EIA expects high oil prices to moderate demand. And, despite recent escalations in oil prices, the EIA still expects prices to decline to \$31 per barrel (in 2003 dollars) by 2010, then increase to \$35 per barrel by 2025.

Meanwhile, grid-connected renewable energy sources are expected to keep pace with energy growth, maintaining an 8% share of world energy use. And although the Kyoto Protocol is now in effect, the EIA expects global carbon dioxide emissions to increase by nearly 60% over the next 20 years.

## EU and China to co-operate on climate policy

Environmentalists have welcomed the announcement of a new EU and China Partnership on Climate Change. The deal, announced at the bilateral summit in Beijing in September, includes concrete targets on the development and deployment of clean energy technology, and a commitment to the objectives and framework of the Kyoto Protocol.

The Partnership includes an agreement on the development of zero emissions coal technology based on carbon dioxide capture and storage, as well as co-operation on promoting energy efficiency, energy conservation and new

and renewable energy.

Friends of the Earth said that the deal was a welcome step forward and acknowledged that, given China's growing energy requirements, the use of clean coal technology may be a necessary, if short-term solution. But it added that internationally agreed criteria on storage standards and site selection were needed before carbon storage could go ahead.

The environmental campaign group also said more emphasis should be given to the development and promotion of renewable energies.

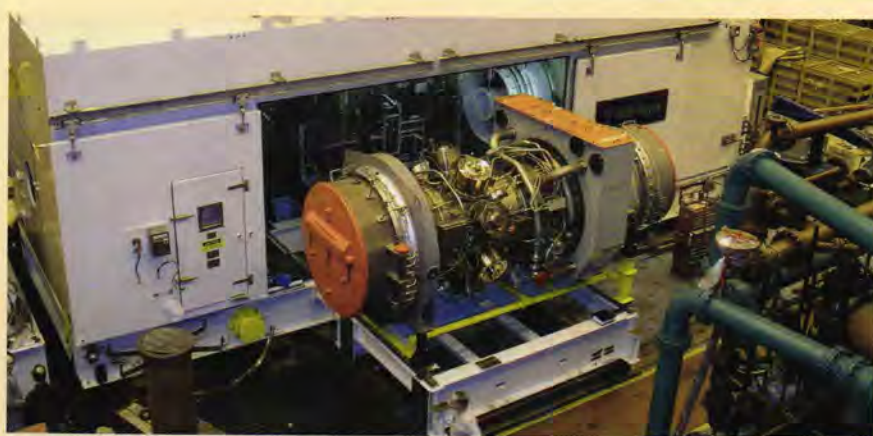
## Finns to study Iranian hydropower scheme

Iran's Water and Power Corporation of the Ministry of Energy has contracted Finland's Electrowatt-Ekono Ltd to review the feasibility study and tender design of the giant Bakhtyari hydropower scheme. The value of the assignment amounts to €1.2 million.

The project site is located in the Zagros Mountains, about 100 km north of

Ahwaz, in south-western Iran. The Bakhtyari Scheme will include a 315 metre high arch dam, the highest dam in the world, and a 1200 MW power station. It is a key technical challenge in the hydropower industry due to the size, technical complexity and geological conditions of the scheme.





A 58 MW Rolls-Royce TRENT 60 turbine is prepared for testing at the Dresser-Rand facility in Olean, New York. The turbine is one of six units that will serve as the mechanical drivers for Dresser-Rand DATUM compressors for the Dolphin Energy Gas project in the Middle East. The project represents the first application of the aero-derivative engine as a compressor driver.

The Dolphin Project, one of the largest energy-related schemes ever undertaken in the Middle East, will include the development of upstream facilities to extract wet gas from Qatar's North gas field and the construction of twin sea lines to transport the gas to Ras Laffan, an onshore site in the northern part of the state. Once there, natural gas liquid products and condensate will be stripped and the remaining dry gas compressed and transported along 370 km of sub-sea pipeline to the UAE.

Upon completion in late 2006, the project will deliver 2 million cubic feet of natural gas per day to the UAE, for at least 25 years, says Dresser-Rand.

## Fuel prices get to US drivers

Soaring gasoline prices are just beginning to have an effect on US car drivers, according to the US Department of Energy's *EERE Network News*. Drivers are driving less and considering more fuel-efficient vehicles, according to a report from the California Energy Commission (CEC), which notes that despite an increase in population in 2004, the state is now using less gasoline.

Comparing the state's total gasoline sales from the first four months of 2005 and 2004, sales actually declined by one half of one percent. In the same time period, gasoline prices rose from \$2.12 per gallon to \$2.60 per gallon.

Meanwhile, a public opinion poll and study by the Polk Center for Automotive Studies confirms the CEC findings, noting that 59% of the people polled say they will drive less at current gasoline prices. The Polk study also found that 55% said that when they buy a new vehicle, it will be a more fuel-efficient one.

## Australia – good on security and prices, poor on environment, says IEA

The International Energy Agency (IEA) has given the Government of Australia a very mixed report on its energy policies. "Due largely to pioneering market reform, Australian energy markets have low prices and high levels of security of supply; the competitive and transparent Australian markets could serve as a model for other countries." So said Claude Mandil, Executive Director of the International Energy Agency (IEA), at the launch of: *Energy Policies of IEA Countries – The Australian 2005 Review*.

However, "Environmental sustainability represents Australia's greatest energy challenge, with high and growing carbon dioxide emissions," added Mandil. The recently announced Asia-Pacific Partnership on Clean Development and Climate is a welcome development in this regard, said the IEA, as all options to address climate change should be kept open at this point.

Australia has been one of the leaders in energy sector reform and should be commended for its vision and implementation of a liberalised market, says the IEA, adding that the country has one of the most transparent and competitive electricity markets in the world and could well serve as a model for other countries. The

efficiency of this market, combined with low-priced domestic coal, give Australia some of the lowest electricity prices in the IEA and the world.

Current reforms are giving the electricity sector more of a national scope. Changes include creation of two national regulatory bodies and improved decision-making on inter-state transmission investments.

Australian energy security is sound, bolstered by abundant domestic fuels, an extensive energy infrastructure and good access to world markets, says the IEA. The government recognises the importance of this issue and will have a biennial review of the energy security outlook. However, one area that may warrant further attention is oil stocks. While Australia still easily meets its IEA obligation to hold oil stocks equal to 90 days of net imports, rising import levels and reduced domestic refining capacity will likely mean that necessary stock levels are to be increased in the coming years.

Australian energy production enhances not only domestic energy security but also global energy security, says the IEA. As the world's largest exporter of coal, a top uranium exporter and a major and growing exporter of liquefied natural gas (LNG), Australia provides a stable source

of fuel for many countries. This production is also a crucial part of Australia's economic success.

Environmental sustainability represents Australia's greatest energy challenge. Although Australia has chosen not to ratify the Kyoto Protocol, it is still on track to meet its Kyoto target of 8% emission growth from 1990 to 2008–2012, says the IEA, and Australia will meet this target mainly through large emission reductions in the land use and forestry sectors. However, emissions from the energy sector are projected to grow by more than 40% from 1990 to 2010, in line with projected economic growth.

Australian carbon dioxide emissions per unit of GDP are 43% above the IEA average. This is due to the widespread use of coal and the country's generally high energy intensity, which results in part from the presence of numerous energy intensive industries. The country will have to substantially alter future energy supply and/or demand behaviour if it wants to moderate emission levels and work with-in any future global climate change mitigation programme.

*Energy Policies of IEA Countries – Australia, 2005 Review* may be ordered from IEA Books. [www.iea.org/books](http://www.iea.org/books)



## New grants to support low carbon transport

The Energy Saving Trust has started administering a new grant programme to support the development of refuelling and recharging stations for alternatively powered vehicles in the UK. The grants are funded by the Department for Transport, with support from the Scottish Executive, with a grant budget of £690,000. The provision of improved infrastructure for alternative fuels is intended to encourage the uptake of the cleanest, lowest carbon vehicles.

The new grants aim to help increase the market for alternative fuels such as hydrogen and biofuels, bioethanol and biogas, which will provide both businesses and consumers with more options for choosing cleaner, low carbon vehicles.

Richard Tarboton, Head of Transport Business Unit at the Energy Saving Trust, said: "By supporting the alternative fuels market the Energy Saving Trust hopes to offer yet another option for reducing the UK's total carbon dioxide emissions from road transport and improve air quality. The programme should encourage manufacturers to produce more diverse vehicles that will ultimately lead to more business and consumer choice."



One of E.ON UK's two coal ships serving the Kingsnorth Power Station in Kent – the *Sir Charles Parsons* – has undergone a major re-fit and re-brand, and is now back at work keeping the station stocked up with fuel. The 14,000 tonne ship turned 20 earlier this year and, in line with the Department of Transport's regulations, was taken into dry dock for a mandatory re-fit and safety check.

The re-fit – which cost £500,000 – involved a complete overhaul of the engine and propeller, plus shotblasting, anti-fouling and anti-corrosion treatment of the hull. A completely new set of hatch cover hinges have also been installed to ensure they remain shut in the worst possible weather, along with new rubber seals throughout the vessel. A re-fit team at Harland and Wolff of Belfast completed the job in just 26 days.

The *Sir Charles Parsons* and sister ship the *Lord Hinton* each make weekly deliveries of around 21,000 tonnes of coal to Kingsnorth from cross channel ports like Le Havre, Dunkirk and Amsterdam.

## E.ON UK plans new CCGT and re-opens Killingholme despite uncertainty

Powergen's parent company E.ON UK has applied for government consent to build a new, £350 million gas-fired power station at Drakelow in Derbyshire. The new combined cycle gas turbine station would be built on the site of the old coal-fired power station. Rated at 1,220 MW, it would produce enough power for around a million homes.

The company has put in an application for Section 36 consent to the DTI and has also formally asked for tenders from power station manufacturers to build high efficiency gas-fired power stations at both Drakelow and at the Isle of Grain, where the existing oil-fired plant is to be replaced.

The company has also been consulting with South Derbyshire District Council and East Staffordshire Borough Council. If the application for the station, which would consist of three units, is successful work could start straight away with the

first power being produced in 2009 at the earliest.

The announcement was made at a ceremony to mark the re-opening of the 900 MW Killingholme Power Station, which was operationally withdrawn in 2002/03. Its return to use is believed to be the first gas-fired power station to be completely returned after an extended period out of service.

Dr Paul Golby, Chief Executive of E.ON UK, said: "The UK urgently requires major investments such as this as we try and bridge a generation gap that will only get wider as more coal-fired and nuclear power stations close their doors for the last time." But he also took the opportunity to criticise the Government for uncertainties in its energy policy: "This new station, combined with the hundreds of millions of pounds we're investing in renewables and our plans to convert our Grain oil-fired power station to gas, shows our

commitment to preparing to bridge our future generation gap and to reduce our carbon emissions. However, we can only spend the billions of pounds that need to be spent if we're confident the Government is putting in place a long-term energy policy that allows us to get a return on our investment."

"As a first step, we'd like the Government to define how coal plant will operate after 2008 under the Large Combustion Plant Directive. The role of long-term carbon dioxide targets is also critical – as a minimum, the Government needs to confirm the carbon dioxide emission caps for Phase 2 of the EU emissions trading scheme, which runs between 2008 and 2012, as soon as possible."

Killingholme's control system has been updated so that E.ON UK's gas-fired Cotnam Development Centre in Nottinghamshire can be controlled remotely by staff 40 miles away at Killingholme.



# PV support scheme draws to a close as UK lags behind competitors

London's Regent Street and an Eco Centre in Wales are among 18 projects that will share over £1.5 million in funding under the latest round of the Government's Solar Photovoltaic Major Demonstration Programme. The projects also include a 16th century Elizabethan farmhouse in Shropshire that has been given over £30,000 so that it can be converted into a carbon neutral eco-home. Housing development and education centre schemes have also been given the go ahead.

Administered by the Energy Saving Trust, the DTI's PV programme has given out grants totalling over £20 million since it began in 2002. But the programme is to end this year, and be replaced with a new Low Carbon Building strategy that is still being developed. The final deadline for applications is 2 December. (For more information on how to apply contact the Energy Saving Trust on 0800 298 3978 or visit the website: [www.est.org.uk](http://www.est.org.uk)).

The ending of the programme has led to concern that the UK solar PV industry now faces an uncertain future. Even if

the Government delivers the new Low Carbon Buildings Programme from April 2006, the earliest date for further funding allocations for large-scale PV projects is likely to be July 2006 and a hiatus in funding support of at least 6 months will undermine confidence in the sector and may persuade at some companies to pull out of the UK altogether, says PV company solarcentury.

Indeed the fledgling UK solar PV market has fallen further behind its major competitors, says solarcentury, quoting figures from the International Energy Agency that suggest the UK installed 2.2 MWp of grid-connect solar photovoltaic systems in 2004, equivalent to just 1,100 solar roofs. The same data showed the Netherlands (3 MWp), France (4.2 MWp), Italy (4.4 MWp) and Spain (8.5 MWp) all installing more grid-connected PV than the UK.

But the real front-runners in the rapidly growing global market for solar PV remain Japan and Germany. In 2004 alone, the Germans installed 360 MWp, equivalent to 180,000 solar roofs. Total

cumulative installations in Japan have now passed the 1 GWp mark, or approximately 500,000 roofs.

Jeremy Leggett, Chief Executive of solarcentury, said: "News that in 2004, the UK solar PV market was a little over half a percent of the German total, makes a mockery of the Government's successive White Paper commitments to this sector. It was only two years ago that the Energy White Paper confirmed the Government's pledge to deliver a ten-year solar PV programme to establish the UK as a credible player in the PV market, alongside Germany and Japan."

"Even at today's UK prices in a tiny market with zero economies of scale, the solar PV needed to reduce carbon emissions by 10% on an average home built to latest building regulations cost only £3,000, says solarcentury. This is just 1.3% of the cost of the average home in England or less than 1% in London, added Leggett. "The Japanese market experience suggests that this £3,000 figure can more than halve as economies of scale are achieved."

*The new wind turbine blade testing facility at the New and Renewable Energy Centre (NaREC) in Northumberland incorporates high efficiency drives from Control Techniques. The facility, which has its own deep water dock, has been specially designed to handle the new longer blades being developed for off-shore turbines and can test blades up to 70 metres (and more), the only facility in the world with this capability. It was officially opened in August and manufacturers from across Europe are said to be queuing up to book-in their latest designs for static and fatigue testing.*

*The control system for the full amplitude static testing, which features a step-by-step bending of the blade, comprises a series of winches under the co-ordinated control of drives from Control Techniques, the sole drives supplier at NaREC.*

*"It is essential to load the blade uniformly to recreate the same effect as the wind," explains Engineering Specialist, Dave Slee. "This is achieved by fitting up to seven specified load points along the blade, to which are attached cables. These are tensioned by winches, which move through a series of set-points under the control of Unidrive SP drives."*

*The Unidrive SP AC drives vary in rat-*



*ing from 2.5 kW to 11 kW and give line pull variations from 5 to 40 tonnes. A central PLC determines the loads, positions and sequences, communicating*

*with the drives via DeviceNet. A supervisory SCADA system provides feedback data, including loads, cable take-up and feedback from strain gauges.*



# First large-scale hydro-electric power station for 50 years

Perth-based Scottish and Southern Energy (SSE) has decided to proceed with the development of Scotland's first conventional large-scale hydro-electric power station for 50 years.

The new hydro-electric scheme is at Glendoe in the western end of the Monadhliath mountains, to the east of Fort Augustus in Inverness-shire. The power station itself, which will be built under ground, will be located close to the south east corner of Loch Ness. Scottish Ministers have given consent for the development under Section 36 of the Electricity Act 1989.

With an installed capacity of around 100 MW, Glendoe will be Scotland's second largest conventional hydro-electric station and the first large-scale station to

be built since 1957, when the 75 MW Errochty station in Perthshire was opened.

The power station will produce around 180 million units of green electricity in a year of average rainfall, says SSE. When synchronised, it will be able to start generating electricity at full capacity in 30 seconds and when operating at maximum capacity, Glendoe will be able to generate enough electricity to power almost 250,000 homes.

The scheme involves collecting water from around 75 km<sup>2</sup> – either directly or via 8 km of underground tunnels – in a new reservoir above Loch Ness. The drop from the reservoir to the turbine at the side of the loch – the head – is, at over 600 metres, the biggest of any hydro station in

the UK. The efficiency of a hydro station increases with the size of the head, making Glendoe the most efficient hydro scheme in the country.

The new reservoir will be situated at the head of Glen Tarff and will be impounded by a dam approximately 1 km long. The dam will be shaped to suit the topography and geology of the area and will be 35 metres at its highest point.

Following substantial refinements made to the scheme during the planning process, the overall cost of the project is expected to be around £140 million. Construction will start in the spring of 2006, and the new scheme is likely to be generating electricity commercially from the winter of 2008/09.

## Scotland to examine environmental impacts of marine renewables

The Scottish Executive has commissioned a study to examine the environmental impacts of harnessing energy from Scotland's marine environment. Consultants Faber Maunsell, in association with Metoc, will be assessing the potential impacts of a range of waves and tidal technologies. The study team will undertake a strategic environmental assessment (SEA) which will play an important role in informing the future development of a marine renewable energy industry in Scotland.

The study area will focus on the west coast of Scotland, Orkney and Shetland and the Pentland Firth. Within this area lies a considerable, and as yet untapped, renewable energy resource. A variety of new technologies are being developed which can convert the motion of waves and tides into energy. Some of these devices float on the surface while others lie on the sea floor or are completely or partially submerged.

The Executive's interest in marine renewable energy is driven by an ambitious target of increasing the amount of electricity generated from renewable sources in Scotland to 40% by 2020.

The SEA being undertaken by Faber Maunsell and Metoc will consider the environmental impacts of marine renewable energy devices, both individually and cumulatively. The study will include all relevant marine, coastal and land based environmental issues ranging from marine ecology, to fisheries, archaeology and the coastal landscape.

## Popular coalition to campaign against climate change

Eighteen campaign groups, including some of Britain's best known environmental organisations, have joined forces to launch the biggest coalition ever seen in Britain to demand action on climate change. Some 500 volunteers formed a giant human banner on London's South Bank at Jubilee Gardens to mark the launch of the movement.

STOP CLIMATE CHAOS says it will mobilise its millions of members and supporters to put pressure on the government, whose plans to tackle climate change fall far short of what's needed. The new coalition wants the government to slash the UK's global warming gas emissions and make fighting climate change a key part of its plans to deal with global poverty.

The National Federation of Women's Institutes, Greenpeace, RSPB, Oxfam, Christian Aid, WWF, CAFOD, Friends of the Earth, People & Planet and Tearfund are some of the groups already committed to the new movement, with others set to join.

Ashok Sinha, Director of STOP CLIMATE CHAOS, hailed the birth of the new movement: "We're facing a catastrophe, with hundreds of millions of people at risk from severe drought, starvation and disease and, by the middle of the century up to one third of land-based species may face extinction.

"The time has come to respond with the utmost urgency. The organisations that have come together today are supported by millions of people who will be

called upon to demand the steps that must be taken right now."

The coalition is campaigning for the UK government to:

- deliver substantial annual reductions in UK greenhouse gas emissions, meet its target of cutting carbon dioxide emissions by 20% by 2010 and to commit to an EU-wide greenhouse gas reduction target of 30% by 2020;
- make climate change a top international priority so that global warming is capped at a temperature rise of less than 2°C above pre-industrial levels – this will require global emissions to have peaked and be irreversibly declining by 2015; and
- ensure that its policies on combatting global poverty include investing in low carbon technologies and clean energy and providing significantly more assistance to the developing world to adapt to climate change.

The new movement believes politicians have so far failed to take anything like sufficient action to tackle the threat. Ashok Sinha added, "We've rightly seen huge movements assembled to fight world poverty, now we're ready to take on what the Prime Minister has called the greatest long term threat the world faces. Before this decade is out world leaders like Tony Blair need to live up to their duty to prevent catastrophic climate change. Politicians can save millions of lives by keeping the average global temperature rise under 2°C."





Killick House in Sutton is to benefit from what is thought to be the UK's largest domestic solar power installation, thanks to the combined efforts of plumbing and heating materials supplier, Plumbase, and solar thermal manufacturer, Solar UK. The project is part of an EU programme to bring the economic and environmental benefits of renewable energy to socially deprived areas.

The companies have teamed up to design and provide the largest copper cylinders to be used in a solar heating system in Britain. The two giant hot water cylinders are 1.9 metres high and 1.1 metres in diameter, and hold a total of 3,000 litres of water. The cylinders are heated by the system's solar panels in order to provide hot water for 55 flats.

Killick House is a council-tenanted block at Collingwood Estate, Crown Road, Sutton. Council tenants often pay higher rates for hot water, as residences tend to use expensive pre-pay meters. The solar installation is set to provide lower cost hot water in addition to sustainable environmental benefits.

## Second well produces gas from Arthur field

Mobil North Sea Limited (MNSL) has produced first gas from the second well of its Arthur field development in the UK southern North Sea. The Arthur Field is located about 30 miles east of Bacton, Norfolk, in approximately 40 metres of water. It was discovered in October 2003, and first production from a single well commenced in January 2005.

With the second well, the development is expected to produce at gross rates of up to 135 million cubic feet per day. The field will ultimately comprise three development wells. The field is a subsea development tied back to the existing ExxonMobil-operated Thames platform by a 20 mile, 12 inch pipeline and umbilical. The produced gas is exported via the existing pipeline to the Bacton Terminal.

MNSL is the operator of the field, with a 70% interest. Co-venturer EOG Resources UK Ltd, a subsidiary of EOG Resources, Inc., holds the remaining 30%.

- Meanwhile, a record 152 oil and gas production licences are on offer to 99 companies under the 23rd Oil and Gas Licensing Round, the highest number since licensing began in 1964, according to Energy Minister Malcolm Wicks. The offers could herald the entry of 24 new firms to the North Sea. The previous high was the fourth round in 1972 when 118 licences were issued.

## Severe winter to threaten power blackouts?

Britain faces a real challenge to keep the lights on this winter after a new long-term weather forecast from the Met Office predicting a long cold spell, according to the trade union Prospect, which represents staff at the Met Office and within the energy industry.

Predictions of severe weather and the potential for greater snowfall have prompted the Met Office to notify utility companies of the result of its annual North Atlantic Oscillation (NAO) forecast as they draw up their winter contingency plans. It is the first time in the five years the Met Office has used the NAO forecast, which looks at decade-long trends in winter time temperatures in the Atlantic Ocean, that it

has issued a warning based on its findings.

Prospect fears that, with improvements to the gas infrastructure still under construction, a prolonged cold spell this winter could see demand for gas exceed supply and place heavy strain on the UK's energy infrastructure. General Secretary Paul Noon said: "We have been incredibly lucky in recent years with a succession of mild winters. But the Met Office forecast means there is a very real threat this could be the winter our luck runs out."

Although the utility companies monitor weather predictions throughout the year, this latest forecast from the Met Office paints a significantly bleaker picture than the predictions for this winter drawn up by the National Grid for the Department of Trade and Industry, says Prospect.

Noon said: "Prospect has repeatedly warned that under current energy policy the UK is overly dependent on imported oil and gas supplies from producers such as Russia, Iran and Algeria – hardly the most reliable of trade partners. With the nuclear contribution declining sharply, and new pipelines from more reliable European countries such as Norway still under construction, it is clear that the security of the UK's electricity is under threat."

In addition to the inconvenience and economic damage that winter blackouts would cause, moves to provide additional power would have to rely on the emergency reintroduction of generating capacity with higher greenhouse gas emissions, Prospect warns.

Meanwhile, the National Grid has launched the annual tender for companies to provide a standing reserve service, under which electricity generators or large electricity users can earn income in return for helping to balance electricity supply and demand. Generators who win contracts agree to increase their output when instructed by National Grid, while large electricity users reduce their demand – for example by temporarily suspending a process or switching to on-site backup generators. Income is earned by making the service available and, additionally, when National Grid instructs an increase in generation or reduction in demand.

While generating companies are still the largest players in the reserve market, large electricity users are playing an increasing role, helping to boost competition and drive down the costs of operating the electricity transmission system, says National Grid.



## Stationary fuel cells – Europe lags maturing markets in the US and Japan

*Europe has fallen well behind the US and Japan in the development and deployment of stationary fuel cells, argues John Lidderdale. Still relatively rare and exotic here, fuel cells have entered competitive markets elsewhere in the world and can be found in many applications where combined heat and power (CHP) plants would otherwise thrive.*

*With manufacturing costs coming down, and a new niche opening-up which would put fuel cells alongside many renewable energy installations in order to help overcome intermittency issues, the technology is here to stay.*

To put it at its simplest, there is no European market for stationary fuel cells at the present time. There are quite a number of stationary fuel cells scattered across the continent but they have mostly been acquired by companies who have an appetite to stay abreast of an emerging technology or they have been placed as part of some government programme. These have had various drivers over the years, some have been the result of deliberate attempts to green the image of the area, some (far too few) have been demonstrator projects, some have been development projects under one of the EC framework agreements.

The outcome is that there are somewhere in the region of 200 static fuel cell installations across the EC, a number of which are no longer active. In any real sense this is a minuscule market penetration in the energy sector but there is latent interest and the beginnings of some rustlings in the undergrowth.

A considerable number of corporations and governments are moving as fast as they can towards reducing their carbon dioxide emissions using a wide spectrum of technologies amongst which static and transport fuel cells have their place.

### What is happening elsewhere?

In other parts of the world the picture is very different, most particularly in Japan and the US. The governments, in both cases, see fuel cells as an essential element of their future energy strategies and the move away from over dependence on fossil fuels, and have invested heavily in these technologies over many years.

Unlike the majority of renewables, a fuel cell produces power so long as it has fuel. The fuels it requires, hydrogen and oxygen, are two of the commonest elements on the planet and both of them are themselves renewable. In the US, for example, the first federal government investment in fuel cell research was in 1964 and this has been followed up consistently with funding for research and development, for product development and evaluation and for demonstrator projects of all technologies over long periods of time. These programmes are still running and are why the manufacturers in the US and in Japan are so far ahead of their European counterparts.

Companies such as Plug Power have a market capitalisation of close to \$500 million but have received almost the same amount of funding from various elements of the federal government over the years.

This system also ensures that the products developed in the US have field trials in real applications, and the manufacturers and their customers work the data mining very effectively to ensure dynamic advancements in the practicality and applicability of the products.

The consequence is that there is a developing market in the US that has all the essential elements to enable it to flourish. Manufacturers with real products, a fairly knowledgeable market place, and finally but by no means insignificantly, a systems integrator, LOGANergy, which has done nothing other than fuel cell powered systems since 1994 and is presently operating and maintaining over 60 installations of all available technologies.

### The economic factor

A few years ago fuel cell manufacturers had factory gate costs in the region of \$15,000 per installed kW. The present generation of units are looking at numbers that are less than \$3,000 per installed kW and in some cases less than \$2,000. As an illustration it is interesting to follow the progress of a single unit over the last five years. The PlugPower 5 kWe unit was released in beta form in 2000 for extensive field trials. In late 2001 it was replaced by the first production unit, the SU1 which, compared to the beta unit was:

- 40% smaller;
- 55% lighter;
- 65% cheaper to manufacture in labour costs; and
- 57% cheaper in material costs.

This was followed by a couple of other iterations which, by mid-2003 had settled down as the GenSys 5C, which compared to the SU1, was:

- 60% cheaper in material cost;
- needed seven times fewer service calls;
- had a five times increase in cell stack life; and
- is a multi fuel unit (LPG or natural gas).

LOGANergy is presently undertaking the final field evaluation trials on the first 40 of the next generation which, compared to the GenSys 5C, are:

- 40% cheaper in material cost;
- around 5% more efficient;
- 40% smaller; and
- truly grid independent.

This is remarkable progress in the time-frame but is not unique to this manufacturer; the same is true of those of them who have reached the stage where they actually have product available from a proper factory production line. It is absolutely not true of those manufactur-



ers who deliver their products from a research facility.

The viability of fuel cells is also affected by the spark gap (the interval between the delivered costs of gas and electricity) and by the cost of hydrogen. Most fuel cells presently obtain their fuel by reforming a hydrocarbon, most commonly natural gas or LPG. How quickly they become cost-effective in a straight commercial fight depends to some extent on what happens to the spark gap in future and to what extent custom and practise (or legislation) drives the adoption of CHP and district heating/cooling.

Most of the pundits appear to agree that the spark gap will widen inexorably over time; at this time it is clear that the cost of oil is not going to fall below \$45 within the next five or so years, indeed if it follows the 10 to 15 year cycles that it has followed for the last 100, then we are looking at high rates for about eight or nine more years.

Whatever your view, there is no question that the electrical distribution industry has to spend an enormous amount of money in the short to medium term to replace obsolete generating plant, the 20% of the present requirement that is generated by nuclear in the UK (the last unit of which is due to go out of service in 2012), and to make the network able to handle the renewable obligation which is distributed generation trying to feed a unidirectional grid. All of these pressures will conspire to force the spark gap wider and thus assist to make the case for all forms of distributed generation, including fuel cells.

### Current good examples

LOGANEnergy presently operates and maintains more than 60 separate fuel cell installations, representing somewhat over 12% of the installed fuel cell base of the entire world in output terms and has more experience of the practical applications than any other organisation. Some examples of applications that work very well are listed below.

#### Pure back-up

There are a number of installations where the fuel cell serves as back up to the primary power supply, usually but not always the grid. Some of these are powered by bottled hydrogen and some of them by LPG or natural gas. The advantage they have over a conventional battery-based solution is related to response times. In principle, a back-up fuel cell will operate for as long as it has fuel thus enabling the maintenance contractor to retain fewer service engineers in any given geographical area as they have far longer to deal with a shut-down of the primary power supply.

#### Indirect back-up

Sometimes known as the 'hot bus' system this is a very good use of a fuel cell power source because it can provide back-up for mission-critical heat requirements as well

as for electrical power. As an example of this, LOGANEnergy presently operates a 600 kWe CHP plant in Southern California where the fuel cell installation is powering a hot bus all the time in a grid parallel mode. When the grid fails, or goes brown, then peripheral functions are progressively shed as appropriate, leaving all the mission-critical equipment safely operating from the hot bus.

#### Domestic CHP and CCP

LOGANEnergy presently operates a number of installations in various parts of the US where all domestic hot water, heating and cooling are being provided by a fuel cell which is also providing power to both sides of the electrical meter so that, in effect, the grid is providing a back-up in the event of a failure of the fuel cell unit.

#### Hospital and hotel CHP schemes

LOGANEnergy operates a number of fuel cell installations as part of hospital CHP schemes. Hospitals are ideal candidates for CHP and fuel cells are extremely efficient in this mode. Hotels often make very good fuel cell installations, especially where they have fitness facilities such as swimming pools. The daytime requirement to heat the pool often mirrors the night time heat requirement, making the use of the fuel cell very efficient indeed.

I have tried to show some cases where the fuel cell competes particularly well but there are many others where, for some reason or other, the fuel cell makes an impact that is not always directly cost-related. LOGANEnergy operates systems running golf clubs, telecommunication switch centres, fire stations, mobile telephone cell masts, air traffic control centres, and refinery control rooms. The list goes on and on but I hope you get the drift. Any site that has a power requirement which favours the provision of local generation or CHP or trigeneration, in the right circumstance can meet that requirement, or some of it, with a fuel cell installation.

### Fuel cells in the renewables market

There is a common characteristic of most of the energy sources that are commonly regarded as renewables and that is that they are inconsistent. Wind drops, tides turn and sunshine hours vary enormously in the extremes of latitude and in equatorial regions, providing in some cases significant amounts of energy for 12 hours of each 24 and none for the other 12.

Technology to harness all of these grows ever more sophisticated and efficient at electrical generation but the 'Eldorado' of a cost-effective method of storing electricity remains a 'chimera' as far into the future as ever it was. In order to provide a smoothing function between the erratic production of power by these sources and the erratic demand that is real life it becomes necessary to use some of the elec-

### What is a fuel cell?

Without going professorial a fuel cell works in exactly the same way as an electrolyser, except backwards. Feed it with hydrogen and oxygen (air), force it through a suitable membrane made of the right stuff and a chemical fusion results that produces water. The electrochemical process that achieves this generates electrons and heat so that the output is electricity and hot water. How much of each and what sort of temperature is achieved is a function of the technology used in the process. There are several technologies that have been or are being successfully developed and no doubt more will appear over time. The main technologies at the moment in no particular order are:

- phosphoric acid
- proton exchange membrane
- molten carbonate
- solid oxide and
- alkaline

tricity so generated to produce power that we can store. One of the most obvious and most practical of these is to use electrolysis to produce hydrogen that we can then store and use to power fuel cells when needed. Conventional wisdom presently says that if you are to provide fuel cells to cover the base load demand when your source of renewable energy is temporarily not available, then it also makes sense to use them for the two hours twice a day of predictable peak demand.

Most of the fuel cell work related to these types of renewables so far undertaken has been tied to wind generation but there has been some work undertaken on solar projects. To the best of my knowledge none has yet taken place connected to a tidal flow or water current project.

There are also reliable renewable energy sources in which the variations in quality and volume that they exhibit happen over far longer and more manageable time scales. These almost all generate methane, which is an excellent and extremely convenient fuel for most types of fuel cell technology. Anaerobic digester gas (ADG) is an ideal fuel for fuel cells and there are already a number of installations producing excellent results and demonstrating efficiencies around 92%. The largest of these installations presently operating produces 1 MWe but the experience has been so good that a 2 MWe plant is presently being commissioned and fuel cell installations associated with anaerobic digester plant are becoming commonplace.

In most cases the heat from the fuel cell is used in the anaerobic processing and the electricity is sold to the grid, depending on the size and complexity of the installation. In some cases the calorific value of the ADG is so variable that it is necessary from



# Stationary fuel cells

## Ceres partners with British Gas and BOC to develop fuel cell products

Despite being described as trailing efforts in the US and Japan, UK fuel cell development work has accelerated this year. One good example is UK company, Ceres Power, which is working with British Gas to produce what it calls the world's first, mass-market, household boiler powered by fuel cells. The company has also signed a second agreement with global industrial gases giant BOC to develop fuel cell technology that operates on a range of cylinder gases.

British Gas says it has chosen to back the Ceres Power-developed fuel cell as it can run on natural gas, which makes the technology immediately accessible to the 14.5 million UK households with a gas central heating system. The unique Ceres fuel cells could also, potentially, provide the bridge to a hydrogen economy as they can also run on this 'fuel of the future'.

The partnership of a high technology company and leading energy supplier is expected to accelerate the final product development, field testing and market roll-out of the appliances, say the partners.

The Ceres Power fuel cell is about the size of a CD case but wafer thin. It consists of three separate layers – a cathode, anode and electrolyte – which, combined, are only half the thickness of a human hair. The cells stack together to make highly efficient, powerful and silent generators. A cube of stacked fuel cells would replace the burner unit in a domestic boiler providing heating and hot water, but also generating electricity for the household. Initial estimates show that a 150 mm stack would

generate around 1 kW of electricity.

Ceres Power CEO Peter Bance said: "The insight that British Gas can provide into what householders want will be invaluable in helping us tailor our product for mass-market application. Fuel cells could become as ubiquitous in powered devices as Intel's microchips are in computers. In future a 'Powered by Ceres' logo could be seen on many products including home boilers, industrial generators and hospital back-up systems."

Meanwhile, BOC is moving another step forward with Ceres Power on fuel cell technology that generates electricity from cylinder gases. Following an initial programme started last September and is now successfully completed, BOC and Ceres have entered into a second agreement to carry out pre-commercial testing and development work.

The original trials run for BOC assessed how fuels like LPG and propane could be used to produce electricity when it passes across the surface of the Ceres fuel cell. The two companies will now move beyond the initial fuel processing trials to explore specific market applications in preparation for the launch of a commercial product. The fuel cell could be used to provide silent, reliable power and useable heat for a range of off-grid applications from construction sites to telecoms base stations.

BOC Global Director Sustainable Energy, John Carolin said: "This second-phase contract with Ceres follows on from our original technical feasibility trials which showed real promise. The potential markets we have identified represent significant growth opportunities for our business around the world."

Contact Ceres Power at [www.cerespower.com](http://www.cerespower.com)

time to time to blend in some natural gas or LPG, but it is always possible to devise a system that utilises 100% of the available renewable methane.

There are also projects that run fuel cells off landfill-sourced methane. Indeed we ourselves are involved in a 3 MWe project of this type. Generally landfill methane is considerably less predictable and certainly less consistent than ADG and usually quite a lot of ancillary equipment is needed to clean up the gas stream before it gets to the power plant so it is not always good economics, except where other factors tip the balance – such as carbon reduction/trading or local regulatory pressure not to vent the methane or run internal combustion engines with it.

### Summary

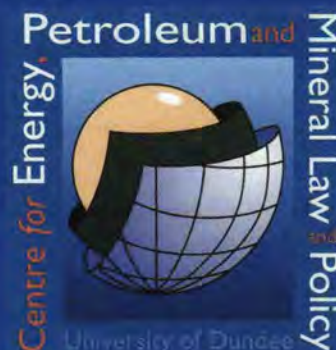
Fuel Cells are not an emerging technology as many European Governments continue, tiresomely, to refer to them. There are real fuel cell products out there now and Europe is getting left behind in the drive to develop them and also in the process of

understanding and adoption.

In the 1970s a Walkman cost over £100 and all it did was play tapes. The modern equivalent of that unit you can now buy for about £20. If you want to spend the whole £100 they will sell you a portable DVD player. Fuel cells are in the same position as the early Walkman, these are real products and the price will fall dramatically when enough people have bought them to enable the supply chain to extract cost.

I just hope that we in the UK and Europe do not sit back and watch others develop the market so that we end up purely as importers of this technology. For indigenous European companies to compete they need a domestic market first. Europe is already many billions of dollars behind the US and Japan, and Korea and China are also making very major investments in these technologies.

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# Big energy savings in store

The Retail Energy Environment Club (REEC) has two aims: to save money for members and meet increasingly stringent environmental obligations. With members including Sainsbury, Asda, Waitrose, John Lewis, Boots, WH Smith, Halifax and Alliance & Leicester, REEC participants account for around 4% of all UK electricity consumption and annual electricity bills can top £100 million per company. All face the same problem: how do they choose and apply the best solutions for saving energy?

A Sainsbury's spokesperson explained: "One of the reasons we are members is that we are completely bombarded by companies claiming to have miracle technologies which will save us millions. Some of their claims may be valid, but we need to find out which work and which don't, without wasting time and duplicating effort."

The REEC is structured as a co-operative club, with each member paying the same fee of £4,000 per year and each having one vote, regardless of size. Membership fees are put in a central pot and the group meets quarterly to review emerging energy and environmental technologies. It then decides which power issues it wants to pursue – from lighting and heating, to air conditioning and refrigeration.

The technical input for the REEC is supplied by EA Technology. We act as facilitator and organiser for the group, providing power engineering expertise, laboratories and testing facilities. Our job includes filtering all the technologies that are presented to members or appear on the market.

One of the greatest achievements of the REEC has been in the area of optimising voltage supplied to stores, which resulted in Tesco winning the ScottishPower Envirenergy Award in 2001 as well as cutting more than £1 million from its annual electricity bills subsequently.

*Retailing is one of Britain's most competitive industries. It's also one of the biggest consumers of energy, which is why many of its largest members are working together in the Retail Energy Environment Club (REEC) to use power more efficiently, reports Robert Davis of EA Technology Limited.*

The savings were achieved because, although the UK electricity supply is nominally 230 V, it often fluctuates as high as 255 V. Most modern electrical equipment is actually designed to run at an optimum voltage of 220 V and anything higher simply wastes power.

Undertaking voltage optimisation of equipment costs a few thousand pounds per building and has been shown to cut overall consumption by up to 15% on some types of machinery, such as motors. Typical whole-building savings are 5% per year, with the added benefit that electrical equipment such as lights last longer, because they are not overloaded. Payback on investment is normally a few weeks and the benefits are permanent.

Most REEC members have adopted voltage optimisation as standard, but the technique involves far more than 'turning down the power'. As part of a recent revision of its lighting systems, Sainsbury's asked the REEC to look at how different energy saving lighting equipment would work with voltages set at 220 V, taking into account factors including light levels and colours.

EA Technology filters out a lot of products because we know immediately that they will not work in principle – or in practice. If they pass that test, we can go to the laboratory stage, where we test manufacturers' claims. There we find that some work as promised, some have little or no effect and there are even a few that are more effective than claimed. Finally, we can carry out field trials in store, to show how well things work in real life conditions.

Improving the energy efficiency or reducing waste in existing equipment can be just as important as pursuing new technologies. This is especially the case in power-hungry operations, such as refrigeration, which can account for 40% of electricity usage in stores selling food.

Recent research commissioned by the REEC showed that neglecting to check refrigerant charge levels in heating and cooling systems can cause a massive increase in energy consumption, without anyone noticing – see Figure 1. If refrigerant levels fall by 50%, units will appear to work normally, but their efficiency will plummet by up to 40%. The first managers know about it will be a hefty increase in electricity costs. Curing the problem is a simple matter of fitting level monitors and alarms.

Reliability and safety issues are also on the REEC agenda, because failure of electrical equipment in any retail environment spells trouble. For food retailers relying on refrigeration, a failure lasting a few hours means 100% stock loss, so part of the evaluation process for any new equipment or technology is not only if it will work, but whether it is likely to break down.

With 150 reports and initiatives under its belt since 1998, the REEC has already made a significant and sustainable contribution to the bottom lines of its member companies, through cost savings. As an example of its environmental effectiveness, Sainsbury's is in no doubt that it has helped meet its corporate environmental target of cutting energy use by 10% between 2001 and 2005.

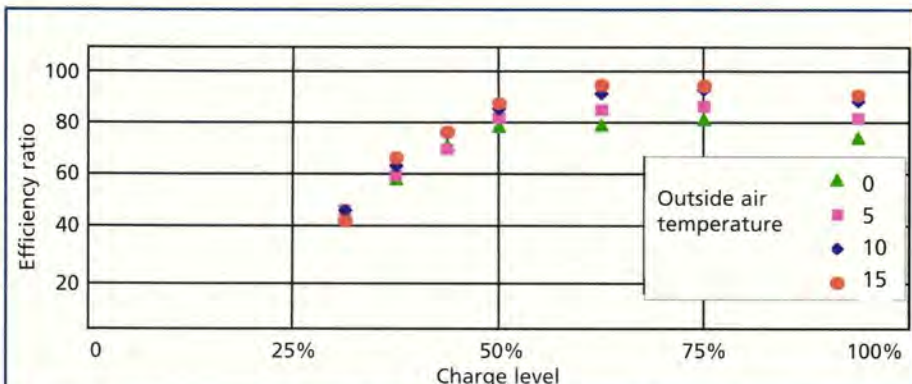


Figure 1. As refrigerant levels fall to below 50%, efficiency starts to fall rapidly – even though heating/cooling units may appear to work normally.

Robert Davis is the Managing Director of EA Technology Limited. Contact him via [eatechnology.com](mailto:eatechnology.com)



# Free cooling by decoupled thermal energy storage for buildings

There is a group of renaissance villas in Costozza, Italy that are served by a remarkable air conditioning system. Each dwelling is connected by a shaft to a series of caves that run beneath the mountains. The caves remain cool throughout the summer months by virtue of their thermal couple to the earth and their lack of exposure to solar gains. As the breeze blows against the hillside it drives air through the tunnel system which cools the air before it is delivered to the internal rooms through marble floor grilles. Simple but effective passive cooling and it is the inspiration for our thermal storage cooling systems.

There are similar examples in nature. The Barossa termite has perfected building its 800 storey high structures (relative to their body size) with fully integrated passive temperature control that maintains the temperature in the queen's chamber at the heart of the nest to within 1°C throughout the year. The main mechanisms for this precise temperature control are the heat exchange with the surrounding ground, with air being drawn through a huge subterranean chamber, supplemented in the most extreme conditions by evaporative cooling, achieved by the termites traipsing for many tens of metres down tunnels to the water table to collect minute quantities of water to put into the 'system'.

These may seem a far cry from the needs of a contemporary building but the basic physical principles are readily transferable, in particular the opportunities that exist for heat exchange with the ground through earth ducts and with large heat stores (sometimes called labyrinths). These technologies are still a rarity in the UK despite having been proven in other parts of the world. They can be classed as 'decoupled' thermal storage systems (as opposed to 'room coupled' systems), because the thermal mass is not thermally coupled to the space that it is serving – indeed it may be quite remote.

The technique of exposing internal concrete surfaces within buildings to exploit their thermal storage capacity to control internal temperature fluctuations has become commonplace over the last decade. This is room coupled thermal mass. The idea is that by ventilating the buildings through the night the mass of the building can be cooled down and the 'coolth' held in storage to absorb heat gains the following day. The most significant issue is that there is a limit to the amount of cooling that can be stored in this way and buildings using this tech-

*Buildings generate some 50% of the carbon dioxide produced in the UK. As the construction industry continues to develop its response to Kyoto and legislation incrementally forces changes to standards there is an imperative to seek new strategies for reducing energy demands in new buildings. Atelier ten has pioneered a 'new' approach to thermal energy storage for preconditioning ventilation air into buildings using ground coupled heat exchange through labyrinths and earth ducts since the mid 1990s. The approach is not really new though, writes Patrick Bellew.*

nique can be prone to overheating. This is because the spaces containing the heat storage cannot be cooled below comfort temperatures overnight or they will require heating in the morning; this limits their capacity.

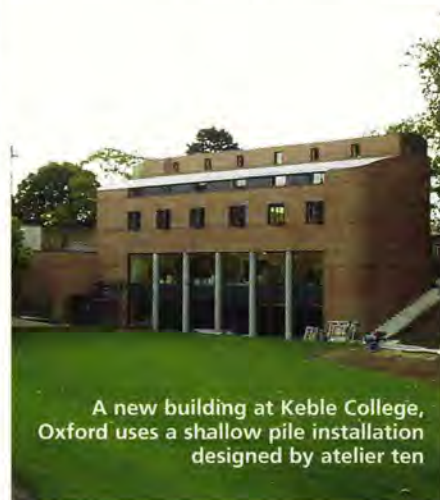
The energy required to heat or cool the outdoor air before bringing it into contact with the occupants of buildings also represents a significant energy load. In a naturally ventilated building on a hot summers day the incoming hot air from outside will absorb a large proportion of any stored coolth within the room and will tend to exacerbate overheating problems. This is why many of the much trumpeted naturally ventilated low energy buildings suffer from overheating and, as the effects of global warming start to bite, how long will it be before they are retrofitted with split-system air conditioners?

### Remote thermal storage

Since 1996 we have been developing ideas for remote thermal storage, in the form of labyrinths and earth ducts in an effort to exploit the passive heating and cooling effect available from the ground.

The basic idea is simply that the air is exposed to a large surface area of concrete on its way into the building by passing at low velocity down a tunnel of between 80 m and 300 m in length. In the case of a labyrinth the walls of the tunnel have been cooled by night time air; in the case of an earth duct the cooling effect is a combination of the same night cooling effect and the innate thermal mass of the ground.

The first labyrinth that we competed was at the Earth Centre in Doncaster and it served to completely eliminate the need for any cooling from this building.



A new building at Keble College, Oxford uses a shallow pile installation designed by atelier ten

The labyrinth was formed in the structure beneath the gallery floor which was to have been a deep raft to found the building on the poor ground which was a feature of the site. The labyrinth was formed by a series of in-situ concrete and blockwork crosswalls and was big enough to be walked through. The system included a degree of relatively coarse control in the form of simple dampers within the labyrinth that could channel air either directly into the room or via the labyrinth cells. The air moves through the low resistance system at very low velocity so that the energy to drive the circulation fans is minimised. A 500 m<sup>2</sup> PV array generates more than enough electrical power to run the ventilation system through the year, making this effectively a carbon neutral system. Unfortunately the Earth Centre closed last year due to an indifferent public response.

Soon after the Earth Centre had been



completed we went on to build a much larger labyrinth to condition air serving a huge atrium-like street at Federation Square in Melbourne. The labyrinth is quite simply made from rippled concrete walls forming long air paths for the air to flow down. The air is always cool at night in Melbourne and the heat of the day can be flushed out of the concrete, along with some of the moisture, so that the mass is cool the following day. The flow of air can be controlled through the various chambers to provide some responsiveness to external conditions. In addition to the thermal storage, evaporation cooling is achieved using stored rainwater on the hottest days, just like the termites after their trek to the water table.

The labyrinth here also eliminated the need for cooling in this space, which has been kept at comfortable temperatures even when it is 40°C outside. The annual energy consumption for the fans is one-tenth that which would have been required for the conventional overhead cooling system. After three full summers of operation the scheme has been great success. When the cooling is not needed in the autumn the air is diverted to the adjacent galleries of the museum to reduce their energy demand. In the winter the labyrinth also provides some heat energy storage to reduce the temperature minima experienced by the heating plant and therefore reduce heat energy input.

### Buried pipes

The labyrinths work well for some situations but do have the disadvantage that it is necessary to effectively construct all of the thermal mass, in the form of concrete. We started to experiment with the idea of buried pipes to bring air into rooms in the ventilation for internal spaces in schools, first at Notley Green Primary School (with AHMM) and then at Tower House School (with Glas Architects). Further research led to a realisation that this type of earth storage system is very common in German and other northern European office buildings where the trend is very much to avoid air conditioning. We located dozens of schemes in Germany in particular, for clients such as Audi and Mercedes-Benz where the earth ducts were the principal source of air temperature control.

These may be concrete or steel pipes buried beneath the ground, which run anything up to 100 m long to pre-condition the incoming air.

We have developed this idea for the UK and construction is about to start of Phase I of a Business Park in Luton which uses this technique to supply air to small office units. The Butterfield development for Easter Properties has been designed by Hamilton Associates and will be the first such scheme to our knowledge in the UK. Each building is supplied with external air

drawn through an earth duct which runs for 80 m beneath the ground at a depth of 1.2 m to a protected screened air intake in the landscape. Air is supplied into the office areas through a displacement system via a plenum floor.

It is intended to be extremely simple and the arrangement has the big advantage over natural ventilation that controlled night cooling can be achieved without having to automatically open and close the windows. The costs for the whole system are less than for a simple fan coil unit system, the temperatures in the office spaces can be kept at or below 26°C under normal loadings and the carbon dioxide emissions are half that of a naturally ventilated building and 20% of that for an air-conditioned building.

**Figure 1** indicates the assessed summertime temperatures of the Melbourne project. In a comparison of the annual energy consumption with other forms of comfort conditioning, including natural ventilation, we believe it out-performs both in terms of both summertime temperatures and energy use. We have recently developed a larger scale proposition for a competition project in Leeds that seems to offer some hope for application on larger schemes. It extended the idea to an eight-storey building and looked to be feasible and effective, if a little more expensive than conventional ventilation.

### A 'renewable' resource

The most significant thing in the context of new London (GLA), UK wide and European energy legislation is that earth cooling may be viewed as a renewable resource. This will surely catch the attention of developers and designers as they start to wrestle with the 10% renewable energy component required by the new GLA guidelines and by the new Part L of the Building Regulations requirements that will come into effect from January

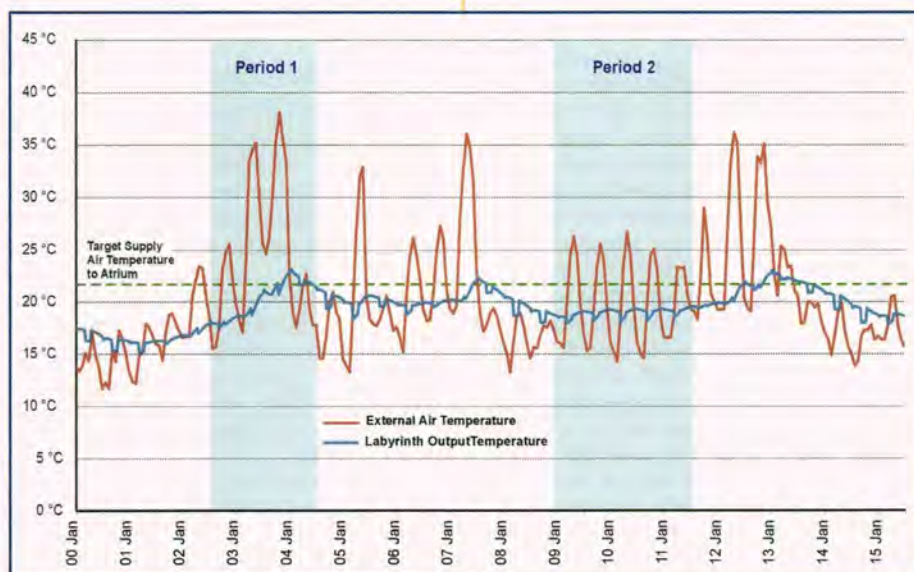
2006. It is a less expensive and architecturally limiting way of achieving the energy targets than many of the other alternatives.

These new regulations will almost certainly lead to the increase in use of one other environmental technology – ground source or geothermal heat pumps. These come on a variety of permutations but with one thing in common, they use the ground as a heat sink in the summer and as a heat source in winter. This can be achieved either by deep piles (up to 250 m) with a closed loop pipe circuit, by multiple shallower piles or by an open loop circuit connecting to the water table and extracting ground water for use as a heat source or heat sink. There are 900 such pile installations in the UK, including a shallow pile installation that atelier ten designed for a new building at Keble College in Oxford with Rick Mather Architects that is illustrated here.

There are 30,000 new installations of this type per year in Sweden and 900,000 exist in the USA so it is not exactly an untried technology but it is very under-exploited in the UK. The system is well suited to brownfield applications and is likely to find increasing application in London and the UK in the coming years as the new Building Regulations start to bite.

So for many years the potential of the earth as an energy resource for buildings has been largely ignored. Is now the time for us to wake up to the potential that it offers as a way of moderating peak conditions and reducing both peak requirements and overall building energy demand?

*Patrick Bellew is a founding Director of building environmental engineering consultants atelier ten and teaches environmental design at Yale University School of Architecture. Contact him on e: [www.atelierten.com](http://www.atelierten.com)*



**Figure 1. Labyrinth performance: summer**



## Warmth for the Millennium – innovative projects to tackle fuel poverty in Scotland

Over a five year period, a number of projects were funded, none of which could have happened otherwise. For several, WFTM provided the catalyst for much larger projects. It also led to the formation of some basic but innovative partnerships, particularly between health and housing professionals. Energy Action Scotland also expected that these examples of best practice and innovation would help shape future grant programmes and inspire those working to eradicate fuel poverty.

The overall aim of WFTM was to provide the funding for a range of projects to be delivered locally across Scotland. This was to be achieved through a comprehensive range of measures including insulation, heating systems and energy advice. Importantly, the measures were aimed particularly at fuel poor households which were, at that time, outside the scope of any other grant scheme.

WFTM supported a number of innovative and high cost projects which demonstrated that much can be done to tackle houses with the worst cases of fuel poverty and which are classed as hard to heat. Energy Action Scotland believes that these projects could easily be replicated and suggests that all of the technologies could be incorporated into mainstream grant programmes such as the Energy Efficiency Commitment (EEC) for energy suppliers and the Scottish Executive's Warm Deal.

During the first phase of WFTM, Energy Action Scotland became aware that not only innovative projects but very basic ones needed funding. Common examples included the large number of right to buy householders who were, for a variety of reasons, outside the scope of the current grant programmes. Often they lived in quarter cottage, flatted or terraced properties and their inability to pay for energy efficiency works prevented these from being delivered to their neighbours. For example, one owner occupier in ex-council housing living in a bottom flat of a six-flatted property could not afford the balance between a Standards of Performance (pre-EEC) energy efficiency grant and the total cost of a cavity wall insulation job. Their inability to pay meant that no other flats could benefit from the works due to the technical nature of the installation. Often the shortfall required by such a householder was as little as £50. EAS therefore focused the rest of the fund towards projects for fuel poor households that were blocking major energy efficiency projects for other fuel poor households.

Many new initiatives have since been created to tackle cold, damp homes –

*Moving into a new century, and indeed a new millennium, was for many fuel poor households in Scotland no different from living in the last century and the last millennium – that is, a living misery in cold, damp and expensive to heat homes. Fuel poverty, the inability to afford adequate warmth, was still very much an issue for thousands and while many prepared for millennium parties, the fuel poor in Scotland made plans to keep warm during another winter. Fuel poverty charity, Energy Action Scotland, wanted to help these fuel-poor households and, with energy company ScottishPower providing the funding, created the Warmth for the Millennium (WFTM) project fund which aimed to take 2,000 Scottish households out of fuel poverty.*

notably the Scottish Executive's Central Heating Programme. Energy Action Scotland is now using the findings of WFTM to promote best practice, joint working and innovation and to inform discussion on the future of grant programmes. With the Scottish Executive programmes coming to an end in their current form in March 2006, the timing of the WFTM report is significant.

The WFTM projects have shown that by enabling front line staff to develop and deliver fuel poverty programmes, much can be achieved. However, in tackling fuel poverty, there is no 'one-size-fits-all' solution. Instead what is often required is a more complex combination of funding, basic measures and innovation. ●

### Fife Council – Health and Energy Link Programme

Fife Council applied for WFTM funding to help deliver the Health and Energy Link Programme (HELP) which was targeted at vulnerable elderly and disabled residents at risk of developing health problems due to cold, damp housing conditions. This innovative project was delivered through 'trusted intermediaries' who were asked to identify vulnerable households. Two intermediary groups were involved: local health care staff, who conduct routine health checks of 75 year olds, and Care and Repair Officers who have existing clients for other home improvement work.

The project assisted thirteen households, removing them from fuel poverty by fitting or repairing heating systems and providing an insulation package. This project preceded the Scottish Executive

Central Heating Programme and provided many of the components of the current programme. The initial funding from WFTM was used by the council to secure a further £36,000.

Lead project contact, Osato Osaghae, Fife Council Housing Energy Management Service said: "Fife Council was able to use the Warmth for the Millennium fund to run our first Health and Energy Link Programme (HELP). This programme made a huge difference to our clients' lives. They have reported back how they can now heat and use all their rooms and how they are no longer struggling to keep warm with a coal fire. The difference to our clients is immeasurable. Our experience of HELP was so positive that we have repeated the project each year since, and have recently finished our HELP IV programme. The HELP project was also closely examined by the Executive before setting up the Scottish Executive's Central Heating Programme. Therefore the influence and benefits of this project have spread well beyond the bounds of Fife."

### Perthshire Housing Association – Solar Energy Project

Perthshire Housing Association's WFTM project aimed to trial and monitor solar energy products and assess their viability with a view to incorporating them as a standard for new building housing and within specification for improvements of existing stock. At the same time it aimed to combat fuel poverty by providing affordable warmth to households.

Perthshire Housing Association (PHA)



fitted innovative Solair warm slates to two flatted closes. These closes of flatted properties (six flats per close) had tenants with high levels of unemployment, high benefit uptake and who were experiencing general social exclusion. The common stairs suffered from cold stairwells and condensation, and the cold bedroom walls adjacent to these consequently also suffered from condensation. Providing warm slates to closes helped combat condensation in tenants' homes and reduce fuel bills. Because of the success of the project, PHA has now amended its building specifications to include solar heating for closes in all new build homes.

PHA also installed Solair warm slates and Solartwin water heating panels to seven electrically-heated houses, situated in areas without access to mains gas. This provided additional heat and hot water, increased comfort and reduced fuel bills for residents.

Liaison with tenants was maintained throughout the project, keeping them fully informed of the progress of the project, its implications and effects on them and also seeking feedback. Post installation, the feedback from clients continued to be very positive, with one tenant informing PHA that at the start of May she did not use electricity to heat her water for an entire week – all the more remarkable as she has six children and gets through five loads of washing a day.

The Warmth for the Millennium award helped the Association win additional funding in excess of £390,000 from the DTI to install 25 photovoltaic roofs in hard to heat properties.

### South Ayrshire Council

South Ayrshire Council carried out cavity wall insulation to 98 owner occupier homes which had been purchased from the council under the right to buy legislation. The identified homes were preventing the council from undertaking a cavity wall programme to its own homes and thus preventing council householders from benefiting from reduced fuel bills and increased comfort levels. The 98 homes funded by the WFTM project allowed a further 127 council homes to benefit from cavity wall insulation at the same time. Therefore in total 225 homes benefited from WFTM funding.

The results from the 98 owner occupier homes were:

- an average NHER increase of 1.35, taking the average score from 6.2 to 7.5;
- an average SAP increase of 11 taking the average score from 58 to 60; and
- an average annual saving in fuel costs of £58 per home.

In a second WFTM project by the council, another 99 homes across South Ayrshire were assisted, raising the average NHER score from 6.1 to 7.7. The average SAP rose from 59 to 73, providing an average annual saving of £90 per house.



### Stirling Council – Stark Street Improvement

Stirling Council provided innovative external cladding and insulation measures to take households living in a type of non-traditional construction house out of fuel poverty. The project tackled six non-traditional Cruden type houses.

The buildings were brought to the attention of the Home Energy Officer and, following a systematic appraisal, were shown to have very poor energy ratings, being of non-traditional build and in an extremely exposed, rural location.

Non-traditional and solid wall properties like these cannot have cavity wall insulation installed, which is the main energy saving measure of most current grant programmes.

No programme other than WFTM was available at the time to tackle fuel poverty in these hard to heat homes and this remains the case today. This is an excellent demonstration project, particularly as the Scottish Executive is looking at how to address this property type in the future.

The Warmth for the Millennium grant was used to secure a total of £90,000.

Average improvements were a decrease in annual energy use per home of 70 GJ, a decrease in annual fuel costs of £749 and a decrease in carbon dioxide emissions of 12.7 tonnes per year. Achieving such a substantial reduction in fuel costs ensured that these households were lifted comfortably out of fuel poverty, with weekly fuel bills of less than £6.

Ron Mould, Home Energy Officer, Stirling Council commented: "Finding households in fuel poverty is not that difficult. Finding the resources to significantly change these people's lives is not so easy. Stirling Council was able to focus the money onto a group of houses in a rural location with poor thermal qualities. The investment, supported by the Warmth for the Millennium fund, made an immediate difference to these families, but we believe that it is also to the long term benefit of the children in these households."

### Tighean Innse Gall

Tighean Innse Gall (TIG), the local Housing Agency for the Western Isles, received WFTM funding to assist Island householders improve the insulation levels of their property and help bring them out of fuel poverty.

The Western Isles have the highest fuel poverty figure in Scotland and, together with the high cost of materials being ferried to the islands, the cost of travel between islands and the distances between clients makes the cost of delivering energy efficiency measures fairly significant.

Through previous project work, TIG identified a client group outside the eligible client group for the Scottish Executive grant schemes, who were in the greatest fuel poverty: people over 60 or disabled, with old heating systems and in receipt of very small occupational pensions or

incomes. Many lived in detached houses in exposed rural areas with limited access to economical fuel supplies. They do not have access to mains gas. While their homes are heated by a combination of coal, electric and oil, due to poor system efficiency and a high level of 'Below Tolerable Standard' housing, they are often unable to adequately heat their homes. The houses often have un-insulated solid walls, floors and ceilings.

The funding allowed for an additional 31 homes in the Western Isles to receive a package of loft insulation, draughtproofing, energy advice and low energy light bulbs. The work raised the average NHER score of these homes from 2.8 to 4.0, while the average SAP was raised from 39 to 52. ●

Contact Energy Action Scotland on e: [www.eas.org.uk](http://www.eas.org.uk)



# Taking Warm Front to the hardest to reach

*Eaga Partnership is an employee-owned social enterprise, founded in 1990 for a social purpose – to deliver the first Home Energy Efficiency Scheme (HEES), the predecessor to the current Defra-funded Warm Front programme. The organisation now does much more, all from a core base of addressing fuel poverty in the UK.*

### Warm Front – measures available

A Warm Front grant of £2,700 or £4,000 (if oil central heating has been recommended) can provide a package of insulation and heating tailored to each property, drawn from the measures listed below.

#### Insulation measures:

- loft insulation
- draught proofing
- cavity-wall insulation
- hot water tank insulation

#### Heating systems:

- central heating
- gas room heaters with thermostat controls
- Electric storage heaters
- converting a solid-fuel open fire to a modern glass-fronted fire
- time controls for electric space heaters and water heaters
- heating repairs and replacements

#### Other measures:

- energy advice
- two low-energy light bulbs
- hot water tank jacket.

Eaga has grown since then and is said to be the largest independent organisation in the UK, delivering social and economic exclusion services to over 5 million vulnerable homes. The company works on behalf of central government, the devolved nation governments in Scotland, Wales and Northern Ireland, social housing providers and for utilities as part of their EEC commitments.

The organisation manages the Warm Front scheme on behalf of Defra; the Warm Deal and Central Heating Programme for Communities Scotland; the Warm Homes scheme for the Department of Social Development in Northern Ireland; and the Home Energy Efficiency Scheme in Wales for the Welsh Assembly Government.

Despite the differences in the operation and approach of particular schemes, for Eaga, there is one common theme – a business focused on delivering services that have a positive impact on society. This includes increasing home energy efficiency, promoting and delivering high-tech and cost-effective renewable energy, addressing poor housing and its consequences, improving the income of socially excluded people through our 'Benefit Entitlement Check' service.

This unique service was pioneered in 1997 by Eaga in order to actively help those customers who were ineligible for energy efficiency grants because they were not on the correct benefit. Our work in this area has been recognised by the Trade and Industry Select Committee as making a real difference to customers' lives by allowing them access to valuable options that would otherwise be denied. Around 20% of the applicants who come through the Benefit Entitlement Check are identified as not being in receipt of the benefits to which they are entitled. The average weekly increase in benefit is around £19, although some applicants have received weekly increases of £160 and in several instances a rebate accounting for thousands of pounds has been obtained.

Over the last 12 months, Eaga Partnership has completed over 28,000 Benefit Entitlement Checks, taking the total amount of money raised in additional income for vulnerable people to £5 million. Again, our success in helping thousands of vulnerable people is a reflection of our customer-focused approach.

This customer focus is what drives and motivates staff on a day to day basis and is a large part of the reason that in the prestigious *Sunday Times* 'Top 100

Companies to Work for' index this year we were ranked in the top 40 for the second year running. A fantastic achievement in itself, but what was really impressive was the fact that our employees rated us second in the whole of the UK for 'making the world a better place', (we came second to a hospice).

### The Warm Front programme

As from 1 June, this commitment has been focused on delivering all four areas of the second stage of Warm Front. Previously Eaga had managed the Warm Front contract in three out of four areas. The Warm Front scheme has also developed quite dramatically. We are delighted that Defra has made some very positive changes to Warm Front. Under the second stage of Warm Front, eligible clients not on the gas grid will now receive oil-fired central heating, and central heating is no longer restricted to those aged 60 and over and is now offered as a bespoke package for client's homes. These are just some of the positive changes that will make sure we lift more vulnerable people out of fuel poverty.

It is also worth noting that, prior to the advent of devolution, the first Home Energy Efficiency Scheme covered the whole UK, and funding stood at £23 million per annum and the maximum grant available was £315. Today Warm Front, the successor to HEES, only covers England but funding is over ten times that original figure and the new grant maximum is £2,700 (or £4,000 for oil fired central heating). This increase in funding and the change referred to earlier, is reflected in the devolved nations schemes. This is a very real measure of how far up the political agenda fuel poverty and energy efficiency have moved during the last 15 years.

However, whilst there is an increased awareness, challenges remain, primarily in targeting those who are hardest to reach – those in rural communities, the pensioners who often believe that programmes such as Warm Front are too good to be true and therefore don't apply, for reasons of caution or in some cases embarrassment that they are in this situation. The reality is that the more successful Warm Front has become over the years, the harder it has become to get help to people who remain in fuel poverty.

This is why we have doubled our investment in our networking operation to ensure we reach the hardest to reach clients by working with ground level organisations to create a 'baton of trust' that reaches people in black, minority,





Eaga cavity filling



Eaga loft insulation

ethnic, rural and elderly communities. We are now focused on getting help to those most in need – not just those who may be eligible. Our community focus is very much part of our social enterprise ethos and, in addition to community organisations we work with a wide variety of stakeholders, from our contractors who go into clients' homes, to local authorities, Energy Efficiency Advice Centres, caring agencies, healthcare professionals and charities. We have also set up partnerships with Primary Care Trusts to work together to treat patients with cold-related illnesses.

One example of this was arranging for all residents and patients aged over 60, to receive a letter and referral form from Warm Front, along with their invitation for a free flu-jab, in West Sussex. We have also arranged training for front-line health professionals so that they are able to prescribe energy efficiency measures when treating patients presenting fuel poverty symptoms.

### Reaching the 'hard to reach'

However, as a social enterprise, our approach to reaching 'hard to reach' clients does not stop when we help these clients. Eaga Partnership founded a Charitable Trust in 1993 whose purpose is to carry out research into issues relating to fuel poverty. The Trust funds projects that are innovative and challenging. We don't just rely on benefit eligibility as a means of assessing fuel poverty; our research has examined such issues as: what does fuel poverty mean if you are living rurally or if you have literacy problems? Undoubtedly our research has a wide and positive impact on the fuel poverty debate and the current level of interest in rural fuel poverty is a measure of this impact, demonstrating that the Charitable Trust research can make a real difference and have a long-term impact.

The Trust's new focus on the wider issues of social exclusion and access

includes research into whether poor literacy and numeracy is a barrier to communication in the fuel poor sector. Which then brings us back to the need for programmes such as Warm Front. We know that living in poor housing can mean householders are more likely to experience mental health problems and, in particular, damp conditions are known to cause depression in women. A cold home can also lead to social exclusion, particularly in older people who live alone.

Social exclusion and access to support are also reflected in the work of one of our subsidiary companies, Trinity Development, that specialises in advising organisations on dealing with communities which traditionally face barriers, such as the black and minority ethnic communities, women, and the disabled. Trinity Development has been involved in encouraging black and minority ethnic communities to become active participants in their wider community.

### Growth and development

As well as helping the hardest-to-reach we also aim to drive up quality standards. The volumes of work over the next few years of Warm Front will test the industry's capacity to deliver high quality and consistent service for all of our clients. But that is a challenge we intend to overcome. To help us do this we have recently acquired Millfold Group, an insulation company, and Lionheart, a central heating company, to improve the services we provide to Warm Front clients. These acquisitions will help us to deliver during future periods of high demand, improve delivery timelines and act as an installer of last resort.

In addition, Eaga's commitment to the environment, to the social excluded and to the need for energy efficiency does not stop at the UK. Rapid growth has seen offices set up throughout the UK and more recently in Ireland, India and Vancouver and Toronto, in Canada and we now have more than 1,400 employees

### Improvements under Warm Front

According to Eaga, the number of households assisted under Warm Front since scheme start in June 2000 is over 1 million.

Under Warm Front, during the scheme year 2003/4 the following was achieved:

- There was an average household SAP (Standard Assessment Procedure) improvement of 17, from 42 to 59. This represents the highest SAP gain since Warm Front started in Eaga-managed areas.
- Homes with a SAP rating of 20 or less saw their SAP rating rise by an average of 43 points. This resulted in an estimated saving in the cost of energy of £515 per household each year.
- There was an average household reduction in carbon dioxide emissions from 7.3 tonnes per year to 5.7 tonnes per year, an improvement of 1.6 tonnes per home per annum. This means a total annual saving of over 230,000 tonnes of carbon dioxide per annum for those homes improved, for each and every year for the next 20 years (the average life expectancy of measures installed).
- On average, each household has the potential to save £178 in energy running costs at current prices every year. This equates to a four year pay-back on the £710 average grant investment. Based on the number of homes receiving measures the potential total saving in energy bills is over £25 million each and every year for the next 20 years.
- There was an average reduction from 101 GJ to 85 GJ per household – a total potential energy saving of 2.4 million GJ each and every year for the next 20 years.

worldwide. Part of this rapid expansion will come through the development of new businesses such as Canada based Homeworks, our home energy saving company; Iguana, our new central heating company and solar heating company, Zen Eaga Solar.

Yet whatever opportunities lie across the Atlantic, Eaga's core business will remain addressing the issue of fuel poverty in the UK and, by doing that we can improve the health of many families as well as improving the environment. We look forward to working to deliver these energy efficiency schemes across England, Wales, Scotland and Northern Ireland, and to achieving the target of ending fuel poverty in vulnerable households in the UK by 2010. ●

*More information on Eaga Partnership and its work can be found at [www.eaga.co.uk](http://www.eaga.co.uk)*



## SCADA system for Melbourne office development

One of the most prestigious commercial developments in the heart of Melbourne, the twin-towered Southgate Complex, has upgraded its building automation and environment control system to Mitsubishi Electric's MX4 SCADA system, and is reaping benefits including reduced energy and maintenance costs.

Building Services Manager Jerry Donovan decided to put his faith in the industrial pedigree of the Mitsubishi system, citing the robustness and the open architecture that would allow simple connection to already-installed equipment, regardless of its make.

The new MX4 system monitors and controls supply and return air handlers, chillers, boilers, domestic hot water systems, fan coil units, and back up generators. A prodigious amount of data is collected and is instantaneously assembled into easy to use graphical screen displays that are available to view in a central control room and at several other strategic points around the complex.

"With 80 floors and countless tenants it was unrealistic to think that we could specify a single manufacturer for all the different equipment that we need to control," he says, "so open architecture was a must. We also needed a system that could cope with a huge and ever-expanding I/O count without falling over."

"We had 70% occupancy before the project was started and 100% afterwards," recalls Donovan, "yet our energy bill dropped from \$1,200,000 to \$900,000. I still look at these figures in disbelief."

More robust industrial equipment, programmable logic controllers (PLCs), are used to interface the new MX4 to existing building services equipment, while BACnet controllers provide localised control for individual tenants and/or physical areas with the complex. Plans are now in hand to integrate an automated low energy lighting system throughout both towers, the retail units and the car park.

Contact Mitsubishi Electric via  
[www.industrial.meuk.co.uk](http://www.industrial.meuk.co.uk)



Melbourne's Southgate Complex – fitted with a SCADA system from Mitsubishi Electric



Kent's Rivermead Infants School – fitted with an underfloor heating system

## Underfloor heating for Kent school project

Robbens Systems have supplied an underfloor heating system to a new Kent school that has been designed with the environment in mind, including a grass roof. Inside, the school provides a friendly, bright, airy environment – perfect for stimulating for the children making their first steps into the world of education.

The Robbens' underfloor heating system has made a major contribution to the project's overall efficiency – providing an estimated 10–15% of energy savings, compared to traditional heating methods, says Robbens. Maintenance costs are also dramatically reduced.

During installation, loops of Robbens'

multi-layer pipework were fixed in position on the floor insulation material with the loop ends connected to manifolds, which themselves are connected by flow and return services to the gas-fired boiler plant. After pressure testing, a sand and cement screed was poured to integrate the heating system into the floor structure and provide a smooth, even surface for the final floor finish.

The system covers a total of 1100 m<sup>2</sup> and has six manifolds, feeding the individual heating zones. Each zone has its own room thermostat to control the temperature of water flowing from the manifold into the concealed pipework loops.

Contact Robbens Systems on  
t: +44 (0)1424 851111.

## Automatic lighting controls for London apartments

Automatic lighting control from Ex-Or Ltd is being installed in Berkeley Homes' latest prestige apartment development in the heart of London. The 'LightSpot' presence detectors will cut energy costs and ensure regulatory compliance to the current Building Regulations. The Regulations say lighting controls should be used to avoid unnecessary lighting during periods when communal areas of residential buildings are unoccupied, says Ex-Or.

Lights in the landlord areas such as lobbies and communal halls at Salamanca Square, Berkeley Homes' development on Albert Embankment, will automatically switch on and off when required through the use of presence/movement detectors.

Lighting contractor Hills Electrical & Mechanical turned to Ex-Or for a controls solution. Ex-Or Southern Sales Manager Patrick Kelly said: "Passive infra red (PIR) control would not have been suitable in this situation because PIR controls detect



Interior of one of the Salamanca Square apartments

body heat and would not switch the lights on until people were in the corridor itself. However, the Ex-Or microwave and ultrasonic long range movement detectors scan for the movement of apartment doors as well as movement in the communal areas. This form of movement detection ensures lighting is switched on before people enter the area."

Hills Electrical is also installing LightSpot Long Range microwave movement detectors in the large underground car park at Salamanca Square.

Contact Ex-Or via [www.ex-or.com](http://www.ex-or.com)



## PV-powered ventilation system pushes warmer air into homes

**S**unwarm provides air heating, cooling, ventilation and hot water by harnessing the sun's energy, all via a ventilation network and a set of solar panels. Product development took over three years and brings together specialist knowledge in solar energy with the company's historic experience of the global ventilation market.

Across the whole positive input ventilation (PIV) industry, it is estimated that the systems installed in the UK over the last eight years have saved an estimated 75,000 tonnes of carbon dioxide and could go on to save 288,000 tonnes by 2010. The technology's history goes back over 30 years to when the North Eastern Gas board began looking for a low cost solution to eradicate the condensation dampness caused by sealed up chimneys and central heating systems. Following the initial conception of PIV, the NE Gas Board turned to Nuaire to take commercial advantage of the idea.

PIV refers to the act of pushing air into the home, rather than the traditional ventilation method that involves extracting air. A PIV system should run continuously at very low flow, where the consistent introduction of clean air, with lesser relative humidity, gently dilutes and replaces the vapour-laden air inside the home. This air is then gently expelled through the thousands of tiny leakage points that exist in virtually every property.

Back in the 1990s, energy saving developments were restricted to the introduction of DC motor technology that reduced the power used by the ventilation units. Since then the efficiency of PIV systems has increased substantially, consuming as little as 5–10 W for the average home, a dramatic reduction from 60 W thirty years ago. Recently the market place has pressed for even greater energy gains from PIV systems. Nuaire responded by placing the PIV unit in the loft thereby utilising the hotter air in the roof space (usually 2–3°C higher than outside) to temper the ventilating air and save energy.

Following these developments it was dis-

Part of a Sunwarm system installed in a loft space – the unit introduces clean, warm and drier air to gradually displace vapour laden air inside homes



*Improving the energy efficiency of buildings constitutes a key plank of the government's strategy to reach exacting carbon reduction targets but, currently the UK holds the dubious honour of boasting the most energy wasteful housing stock in Northern Europe. The 'Sunwarm' system addresses this situation by combining the disciplines of 'positive input ventilation' and solar energy to produce the most energy efficient home ventilation product available – according to the Nuaire Group.*

covered that the solar heat trapped beneath the slates or tiles and roofing felt was often much warmer than in the loft space itself. Nuaire found a way of exploiting this extra energy and raised the potential energy gain of PIV even further, to over 1,000 kWh per annum. More recently, the introduction of solar air collectors, which are mounted on the roof of the home, have allowed the ventilated air to be heated to even higher temperatures. When this heat is not needed in the home, it can be diverted automatically to the hot water system storage tank, realising total energy savings in excess of 4,000 kWh annually. Depending on the season and amount of water heating required, Sunwarm can provide up to 60% of hot water.

The solar collectors, which contain a unique absorber material to soak up the sun, are generally positioned facing the south, but anywhere from southwest to southeast will work well. The absorber material is a variation of a mineral fibre which is selectively coated to soak up the widest spectrum of solar rays, from ultra-violet through to infrared. The air, having absorbed all the energy generated from the sunlight, is then drawn into the ventilation system stored in the loft area, filtered and distributed through the insulated ductwork around the building and/or to the hot water tank.

Major problems associated with photovoltaics and photothermals stem from inefficiency (even the very best solar cells can function at a maximum of 15% efficiency) and an inability to store energy. In contrast, by using methods of both energy generation and conservation, Sunwarm can save around 50% of the energy and the carbon emissions involved in heating a home and its hot water in a 3 to 4 bedroom property. Further radical improvements in efficiency follow from the Sunwarm's capability to use 'low grade' sunshine to warm the building.

To determine the efficiency of the system, a data-logging package allows homeowners to monitor the temperature and status of an installed Sunwarm. The energy monitoring facility (NICM) provides information relating to every temperature measurement within the system, from sensors inside the solar air collectors, loft space, ventilation outlets, hot water tank and house.

Sunwarm has been recognised for its energy saving qualities which have earned the Nuaire Group, the Queen's Award for Innovation and qualified the system under the government's Clear Skies and SCHRI grant schemes.

Contact Nuaire Holdings Ltd on e: [www.nuaire.co.uk](http://www.nuaire.co.uk)



## In search of lower energy prices – have you considered on-site wind?

*Facing ever-increasing energy costs, more and more companies are seeking alternative means of obtaining electricity at a reasonable price. One of the most cost-effective approaches is to generate electricity at the point of use from renewable energy sources such as wind. Electricity generated in this manner is commonly known as on-site, industrial or merchant wind power and tends to be an attractive option to large companies that are high energy users. Kevin Cloutter tells us how it can be done.*

There are many things to consider during the development of an on-site wind project. This article looks at the drivers, the issues to be addressed and details the benefits that can be achieved, which include:

- energy cost savings
- additional revenue
- lower carbon dioxide emissions and
- improved corporate image

### Wind power market drivers

The UK Government has introduced the Climate Change Levy and the Renewables Obligation to encourage the use of renewable energy technology and improve energy efficiency. Ultimately, it is hoped the legislation will reduce emissions of greenhouse gases such as carbon dioxide and help the UK meet its commitments under the Kyoto Protocol.

The Climate Change Levy (CCL), which was introduced in 2001 and is currently set to run until 2012, aims to encourage energy users to be more energy efficient and in

turn reduce the overall UK energy demand. The CCL adds 0.43p/kWh to the price of electricity that is sold to industry, commerce and the public sector. However, by implementing, for example, energy efficiency measures, organisations can receive an 80% exemption from the levy. In addition, energy derived from eligible renewable sources is exempt from the CCL and receives a Levy Exemption Certificate (LEC).

The Renewables Obligation (RO) encourages investment in power generation from renewable energy sources by obliging electricity suppliers to obtain a percentage of their electricity from renewables. The RO is currently set at 5.5%, but this will increase year on year to 10% by 2010 and 15% by 2015.

For each MWh of electricity generated from renewable sources, generating companies receive a tradable Renewable Energy Certificate (ROC) from the regulator OFGEM. Electricity suppliers who don't own sufficient renewable power generation facilities can only acquire

Nissan Motors, Washington, Tyne & Wear – soon to be home to seven second-hand wind turbines



ROCs by purchasing them from the appropriate generating companies. Suppliers comply with the RO by presenting the required number of Renewables Obligation Certificates (ROCs) to OFGEM at the end of the obligation period.

Electricity suppliers who fail to source sufficient 'green energy' pay a fine known as the buyout price, which is set annually by OFGEM and is £31.39/MWh for the 2005/06 obligation period. Money raised from the buyouts is pooled and recycled to suppliers in proportion to the number of ROCs they present. The value of ROCs, including the recycle benefit, is currently around £45/MWh.

Aside from UK legislation, the other main driver for on-site wind power is that it can help those companies affected by the EU Emissions Trading Scheme (EU ETS) to comply with their obligations. Unlike traditional means of generating power (eg gas or coal-fired power stations) electricity derived from wind power is not accompanied by carbon dioxide emissions and, as such, can be a cost-effective method of reducing a company's greenhouse gas emissions.

### Financial and other benefits

As well as reduced electricity costs, companies that generate electricity from accredited renewable sources (eg wind) obtain financial benefits from LECs and ROCs. These benefits are designed to stimulate the market and excite development in wind power and other renewable energy technologies.

In addition, a wind turbine is a very visible indication to stakeholders that a company takes its environmental responsibilities very seriously and this will lead to an improved corporate image.

### Difficulties and risks

Obtaining planning permission is possibly the most challenging part of an on-site wind project. The good news is, to help implement the Government's vision of a low carbon economy, national and local

	Number of turbines	Capacity (MW)	Installed capacity (MW)	Status
Pirelli, Carlisle	1	3	3	Planning permission granted
Ford, Dagenham	2	1.8	3.6	Operational, 3rd turbine to be added
Michelin, Dundee	3	1.5	4.5	Planning permission granted
Sainsbury, East Kilbride	1	0.6	0.6	Operational
GSK, Barnard Castle	2	0.25	0.5	Operational
Prudential, Reading	1	2	2	Planning granted, to be built this year
Royal Seaforth Docks, Liverpool	6	0.6	3.6	Operational
Nissan, Sunderland	7	0.66	4.62	Planning permission granted
Voridian, Workington	2	2	4	Planning permission granted
Industrial Estate, Cambridgeshire	1	2	2	Planning permission granted
Corus, Teesside	18	2.5	45	Planning permission granted
Swansea Docks, Swansea	1	0.25	0.25	Planning permission granted

Table 1: Some UK on-site wind projects



planning policies support the use of renewable energy. It is also worth noting that projects planned for brownfield sites can often achieve planning permission more easily than those on greenfield sites. The risks associated with an on-site wind project can be significantly reduced through careful site selection and by investing in expert advice at an early stage.

### Site assessment

The critical steps in the development process of an on-site wind project are:

- the feasibility study;
- wind monitoring;
- planning;
- turbine procurement;
- financing;
- construction; and
- commissioning.

However, it is important to fully appreciate the issues to be addressed before engaging in the development process. For this reason, it is recommended that sites are screened prior to a feasibility study being carried out. This will ensure they pass the first development hurdles such as having sufficient development space, having a suitable wind resource and being an appropriate distance from residential properties.

The feasibility study should highlight any potential difficulties associated with planning, environmental, technical and financial matters at a very early stage. Depending on the issues raised, mitigation or effective consultation with statutory bodies and other stakeholders can often provide a satisfactory resolution.

### Developing an on-site wind project

There are essentially two mechanisms for developing an on-site wind project and the preferred route is largely dependent on the organisation.

In the first method the company that owns the land and will use the renewable electricity works with specialist consultants and finances the development stage. After planning permission has been granted, the capital cost of the project is financed off the balance sheet or through third-party financiers (ie a bank or renewable energy fund). The company will own the generating plant, and the turbine manufacturer will usually be responsible for maintenance. The electricity generated from the turbine is used on site and will replace electricity from the supply company. LECs and ROCs are administered through an agreement with a licenced electricity supplier.

The alternative method requires a developer to undertake the development, invest in the capital cost of the project and operate the plant. The company leases the land to the developer for the term of the project (usually 25 years) and also agrees to buy the power generated by the turbines, through a long-term power pur-

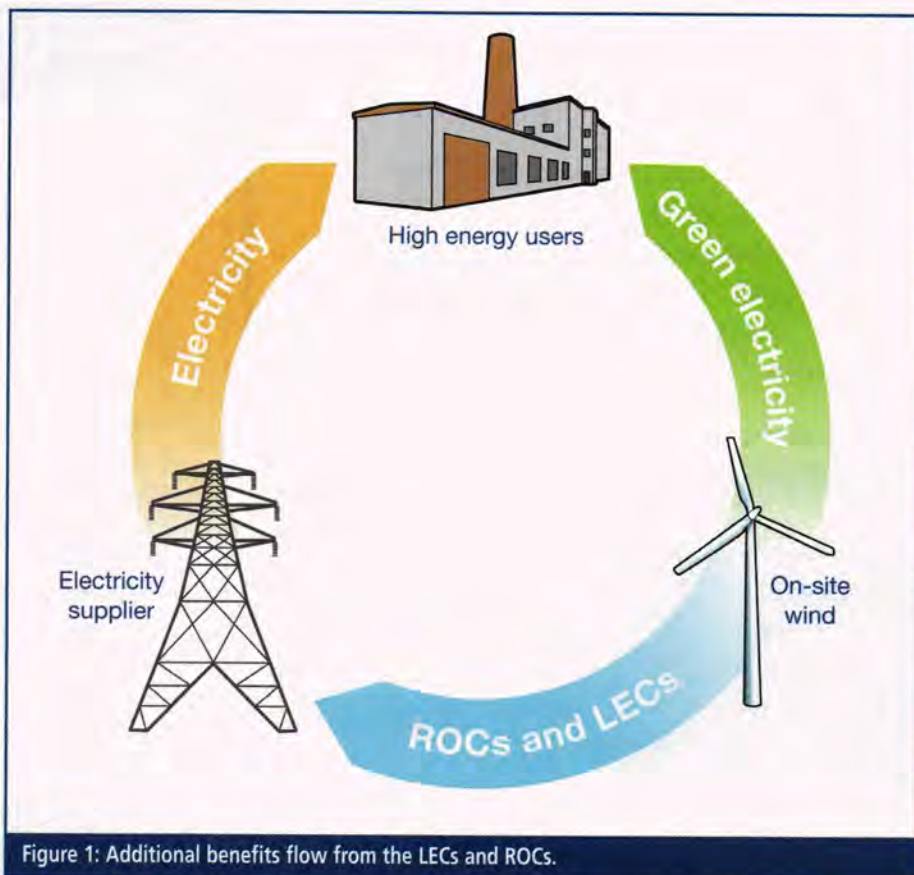


Figure 1: Additional benefits flow from the LECs and ROCs.

chase agreement. The developer is responsible for the administration of the LECs and ROCs, and retains these additional financial benefits.

Although there are advantages and disadvantages with both methods, the decision on which one to adopt will depend on the particular circumstances of the company concerned. For instance, in the first method the company is responsible for the development process, with the most obvious key milestone being securing planning permission. This can be aided with careful site selection, adherence to best practice guidelines and seeking expert advice.

Although the second scenario has a lower risk element, it also has a lower reward for the company that owns the site. The developer makes the long-term gain by being the generator, and the company misses out on the additional revenue wind turbines can provide, but benefits in terms of CCL and EU ETS issues.

### How much does it cost?

The cost of on-site wind turbines depends on the installed capacity of the turbines and other construction costs, although as a rule of thumb the costs tend to be in the region of £750/kW of installed capacity. Therefore, two 1.5 MW turbines would cost about £2.25 million. Annually, they would generate about 8 GWh of electricity and reduce carbon dioxide emissions by around 3,500 tonnes. In the current market, an investment of that nature would pay back in 3–5 years, depending on the site's wind resource and project costs.

### Second-hand turbines

If the cost of a new turbine is prohibitive, it is possible to buy second-hand units. There are successful on-site wind power developments in the UK built with such turbines. A new industry is evolving where brokers will put buyers and sellers in touch, will arrange teams to erect the units and will even provide a warranty. Second-hand turbines often come from Europe where small turbines are being replaced, before the end of their operating life, with larger units. These small turbines are generally only a few years old and the price varies according to size and age.

### Next steps

There are many factors to weigh up when considering whether to implement an on-site wind project. To avoid wasting a lot of time and money, or falling foul of planning regulations, it is essential to obtain professional, independent advice and this is where Future Energy Solutions (FES), part of AEA Technology, can help.

For over 30 years, FES (formerly ETSU) has been at the cutting edge of energy policy and technology development. The company's long history of working in the renewable energy sector has given it an unrivalled appreciation of the technical, commercial and institutional issues involved in implementing wind and other renewable energy technologies. ●

*FES provides a comprehensive wind-energy development service. Contact Kevin Cloutter, Wind Energy Consultant, on 0870 190 6706 or e: kevin.cloutter@aeat.co.uk*



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to 15.5°C base temperature

Region	Jun 2005	Jul 2005	Aug 2005
1 Thames Valley	29	14	20
2 South East England	48	21	30
3 South Coast	55	32	42
4 South West England	45	15	26
5 Severn Valley	34	17	29
6 Midlands	44	27	29
7 West Pennines	69	38	46
8 North West England	58	50	45
9 Borders	81	55	54
10 North East England	66	38	45
11 East Pennines	55	28	33
12 East Anglia	61	30	44
13 West Scotland	67	50	59
14 East Scotland	74	54	57
15 North East Scotland	96	63	63
16 Wales	57	31	33
17 Northern Ireland	61	40	46
18 North West Scotland	112	83	67

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Special Interest Group:

## Energy Efficiency in Buildings

New online service launched:

The Energy Institute has just launched a Special Interest Group (SIG) internet microsite dedicated to Energy Efficiency in Buildings, providing EI members with reference documents, news, events listings and an online forum for debate on the issue.

It can be accessed at [www.energyinst.org.uk/sig/eeb](http://www.energyinst.org.uk/sig/eeb) (EI members log on by entering their full membership number and their surname in capital letters).

The Energy Efficiency in Buildings microsite is the first of a series of SIGs which will be launched over the next few months. The next SIG will cover Energy Policy (including Future Fuels).

For more information contact Deborah Wilson on t: +44 (0)20 7467 7115 or e: [info@energyinst.org.uk](mailto:info@energyinst.org.uk)

[www.energyinst.org.uk](http://www.energyinst.org.uk)



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Closing date: 28<sup>th</sup> October 2005.

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