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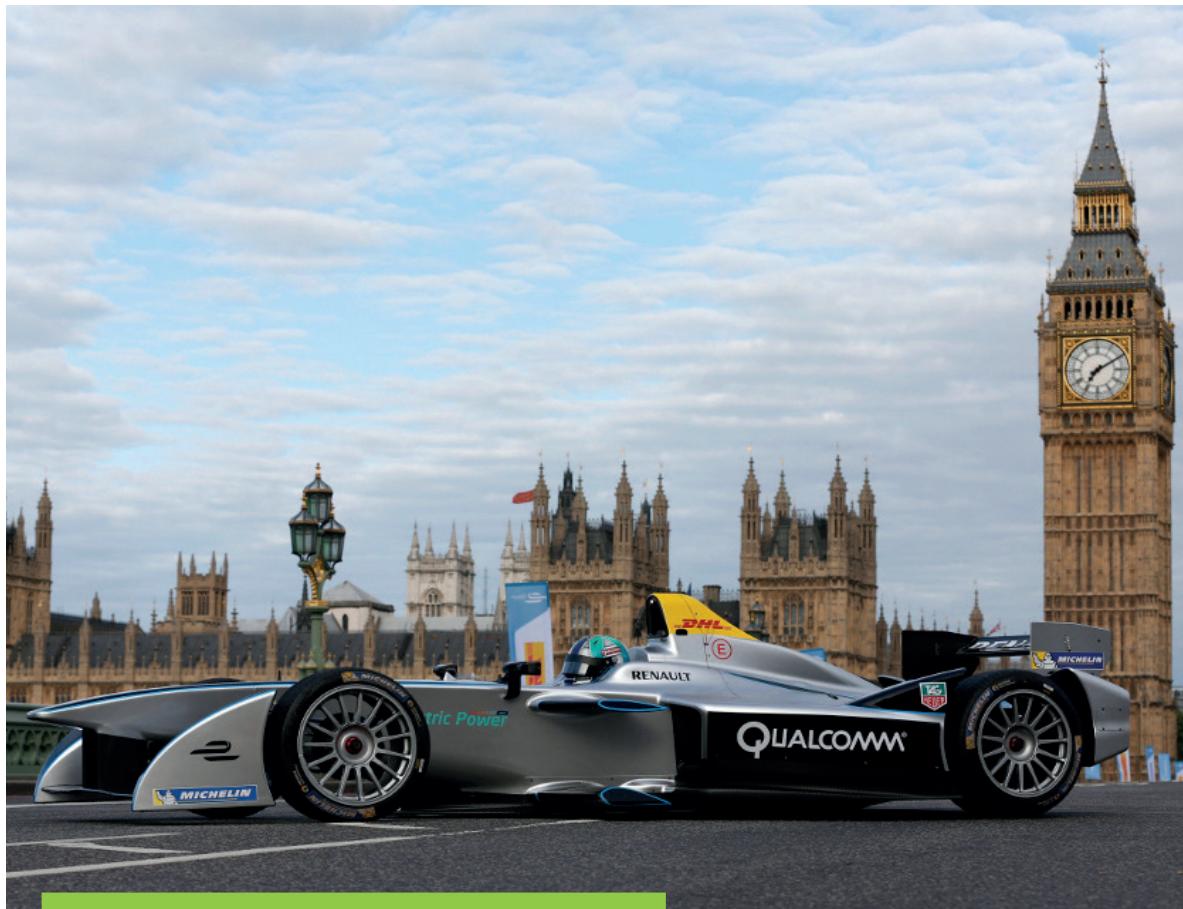
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June 2015



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There's a lot about air quality in towns and cities, low carbon transport and electric and fuel cell electric vehicles in this issue, in a series of articles that make up our energy in transport feature.

We try to answer some fundamental questions: how important are low carbon transport options to Britain's efforts both to cutting overall carbon emissions and to improving some rather poor urban air quality? We also include an article on how electric charging and alternative fuelling stations are being developed within EU countries.

On energy purchasing and management, the government's Energy Saving Opportunity Scheme (ESOS) is top of most energy managers' in-trays at the moment, with the first reporting deadline in December this year. We include articles on ESOS within a European context, why business energy users need to consider switching energy suppliers, and the interplay between voltage optimisation and electricity storage.

Three further articles cover the need to reform the EU Emissions Trading Scheme, the re-emergence of direct current as a force within buildings, and a ground-breaking 'smart town' development in Japan.

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FROM THE EDITOR

At the world's largest offshore wind farm



**Steve Hodgson,
Editor**

The announcement by E.ON that it is to press ahead with building the 400 MW Rampion Offshore Wind Farm 13 km off the Sussex coast in the English Channel came too late to be included in the news pages of this issue. It's a highly significant announcement in that Rampion is the first project to go ahead under the Crown Estate's Round 3 seabed leasing programme, under which Britain's offshore wind industry could expand to a size unprecedented anywhere else in the world. Also significantly, development of Rampion has been helped by the Green Investment Bank acquiring a £236mn stake in the £1.3bn project.

Round 3 is by far the biggest tranche offered by the Crown Estate, which manages the UK seabed up to 12 miles offshore. It includes the huge – 13 GW – Dogger Bank project in the North Sea within a total scope of 24 GW of capacity.

The UK already has just over 4 GW of operational offshore wind generation capacity, with a further 2 GW either under construction or at least with a positive investment decision. Another 5 GW of projects have secured a Contract for Difference or have support under the Renewable Obligation in place, and a further 7 GW of capacity have received planning consent. That's a lot of generating capacity – 18,000 MW – but of course it may not all be built.

The proposed 116-turbine Rampion project will now lead the way into Round 3; work to build an onshore substation should begin this month.

Already providing large quantities of green electricity is the UK's (and the world's) largest operational offshore wind farm, the 630 MW London Array. So what does a large, offshore, non-fossil power station occupying 100 km² of shallow estuary, look like?

On a sunny day last month when I visited the installation, calm conditions meant that the 175 turbines were all stationary, but the Array nevertheless generated 2.2 TWh of electricity in 2014. The 3.6 MW turbines are 147 m high, to the tip of the blade at its highest point – taller than the London Eye – although it's hard to take-in the height even from an adjacent boat. Turbines are aligned in rows, between half and a kilometre apart to prevent turbines being in the 'wind shadow' of another. Two major substations also sit out of the water between the rows and an occasional pleasure yacht passes by.

The water is not deep – 25 metres maximum – as the wind farm is deliberately located between sandbanks and away from deeper shipping lanes. At some low-tides, the sea bed is apparently exposed, making access to some turbines a challenge.

The Array has several near neighbours within the Greater

Thames zone – we were able to see both the Thanet and Gunfleet Sands farms wind farms during the 20 kilometre commute – comfortable on the day I made it – from the onshore base at Ramsgate Harbour in Kent. Invisible to visitors are the 187 inter-array cables that take power to the offshore substations, and the 200 km of buried 150 kV export cables that take power to an onshore substation near Graveney.

Completed late in 2012, the wind farm is operated by a consortium of E.ON, DONG Energy and Masdar, with Canadian pension fund Caisse de dépôt et placement du Québec taking a 25% stake last year.

The London Array already leads the world; the proposed Rampion offshore wind farm and the six farms that may eventually make up the world-beating Dogger Bank development could take Britain's offshore wind industry to yet another level. The new government seems reluctant to support construction of more *onshore* wind farms, but it's surely impossible not be proud of Britain's world-leading position in offshore wind.

Indeed, new Secretary of State for Energy and Climate Change, Amber Rudd, said of the Rampion development: 'this huge investment is a vote of confidence in the UK, creating local jobs, bringing business opportunities and providing clean, home-grown energy.'

The views and opinions expressed in this article are strictly those of the editor only and are not necessarily given or endorsed by or on behalf of the Energy Institute.

In this month's Petroleum Review:

- Crisis prompts Ukrainian gas reform
- Bumpy ride ahead for drilling and OFS sector
- New era of opportunity for UK nuclear
- Turning point for EU carbon trading

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Tesla moves into stationary battery market

Electric car manufacturer unveils range of batteries for homes, businesses and utilities

Initial speculation dissipated into few surprises and much fanfare as US car manufacturer Tesla finally unveiled its stationary battery systems in an Apple-esque product launch in California at the start of May. Tesla Energy was born – a suite of batteries of different shapes and sizes for homes, businesses and utilities.

With Tesla Energy, Tesla is repositioning itself as an energy innovation company, rather than a mere automotive enterprise. It has grand aims for its batteries – a melodramatic press release describes Tesla Energy as a means of allowing society to use more renewable energy and move the electricity grid away from fossil fuels.

The batteries – one technology in a suite of potential methods to store electricity – are designed to allow users to manage power demand, provide back-up power and help keep the grid stable. While Tesla said it was working on a grid level with utilities to help store energy on a large scale, it was the home-scale ‘Powerwall’ battery that got the most attention.

The Powerwall, a wall-mounted lithium-ion battery, allows users to store electricity for load shifting, back-up power and self

consumption of solar power generation. Its sleek curved design contains a battery pack, a liquid thermal control system and software to allow interaction with a roof-mounted solar PV system. Starting at \$3,000, it comes in 7 kWh and 10 kWh sizes. Early reports suggest that initial orders for the batteries mean they could be sold out to mid-2016.

Tesla CEO Elon Musk said the company’s goal is: ‘to fundamentally change the way the world uses energy... we’re talking at the terawatt scale. The goal is complete transformation of the entire energy infrastructure of the world.’

The larger batteries will comprise 100 kWh blocks that can be grouped in packs ranging from 500 kWh to more than 10 MWh. Bloomberg New Energy Finance pointed out that the \$500 to \$700 per kWh price point for the batteries is less than half that seen today for residential power storage in Japan, Australia and Germany.

One of the reasons the batteries can be offered at a relatively low price is that Musk is building a huge ‘Gigafactory’ to make them *en masse*. The solar powered factory, for stationary and mobile batteries, is being built in Nevada and is

expected to begin cell production in 2017. When it reaches full capacity in 2020 it will have an annual production capacity of 35 GWh worth of batteries.

Some have suggested that Tesla will need to do more to reduce battery costs in the future. ‘Cheap cells made in the Gigafactory are only part of the puzzle,’ said Dean Frankel from Lux Research. ‘Power electronics, installation, and widespread availability of financing remain open questions. The quicker Tesla can build partnerships, make acquisitions, and invest further to address these issues, the better its chance of hitting its hugely ambitious goals.’

An article in *Fortune* suggested that the Gigafactory could be obsolete before it’s even built, due to advances in aluminium air battery technologies – which are said to be significantly cheaper than lithium ion.

And, some commentators pointed out that a home battery system is of more use to the US market, and particularly California, where time of use tariffs and solar power are more relevant than in the UK. The Powerwall is scheduled for UK availability by the end of the year.

The batteries are designed to allow users to manage power demand, provide back up power and help keep the grid stable

Solar

Solar association calls for free PV trade between China and Europe

The European Photovoltaic Industry Association (EPIA) has changed its position on the ‘solar dumping’ situation of cheaper Chinese solar technology flooding the European market, calling for undistorted free trade to return as soon as possible.

EPIA President Oliver Schaefer outlined the organisation’s new position at a PV conference in Shanghai, saying: ‘EPIA is a strong supporter of free and fair trade and we would like to see trade relations between Europe and China, on solar modules and cells, return to normal undistorted, fair trade as soon as possible, when the duties and

respective price undertaking expire in 2015.’

The association, which was previously in favour of duties on Chinese cells and modules, has reversed its views as it thinks that cheaper solar equipment will increase job creation across the entire solar supply and value chain – especially in the installation sector – in a struggling European Market. It estimates that half of the European solar sector’s 265,000 jobs in 2011 have now disappeared, and that European duties on Chinese solar products are a likely factor in the slowdown in annual growth of

installations in Europe.

Since December 2013, anti-dumping and countervailing duties have been applied in Europe on crystalline silicon modules and cells from China. The duties and a minimum import price are due to expire in December this year.

Meanwhile in China itself, 5 GW of solar power was connected to the grid in the first quarter of this year, according to the country’s National Energy Administration. Around 4.4 GW of this was in the form of large, utility-scale plants. China now has 33 GW of solar power and aims to add a total of 18 GW this year.



Push for energy cleantech only way world can meet climate goals – IEA

Report says rapid technology development, alongside political commitment, is essential to address emissions

A concerted push for clean energy innovation is the only way the world can keep global emissions to a safe level, the International Energy Agency (IEA) said as it released its flagship energy technology report: *Energy Technology Perspectives 2015 (ETP 2015)*.

The report says that clean energy progress is falling well short of the levels needed to limit the global increase in temperatures to 2°C. It also takes a dim view of the ability of the UN climate negotiating process, due to take place in Paris later this year, to produce an outcome commensurable with a safe climate. In this setting, new breakthrough technologies to reduce emissions are even more important, it says.

It is not all heavy reading – the report also highlights some notable success stories. The dramatic fall in the cost of solar panels, and the continual increase in vehicle fuel efficiency are highlighted, alongside Canada's Boundary Dam

carbon capture and storage project.

'The stakes are high for the energy sector, but it is also no stranger to profound technological change,' said IEA Executive Director Maria van der Hoeven. 'An incredible chain of innovations has been at the vanguard of social and economic transformation for over a century, and it is exciting to see the progress being made by solar panels and fuel economy improvements for passenger cars today, to name but two.'

'But we cannot be complacent. We are setting ourselves environmental and energy access targets that rely on better technologies. Today's annual government spending on energy research and development is estimated to be \$17bn. Tripling this level, as we recommend, requires governments and the private sector to work closely together and shift their focus to low carbon technologies.'

ETP 2015 analyses long-term trends in the energy sector, centred on the technologies and the level of

deployment needed for a more sustainable, secure, and affordable energy system. It highlights the key role governments have to play in creating initial market opportunities to send a signal to innovators and drive investment. This has already been achieved to some extent with the drop in costs of solar and wind through the help of government subsidies.

The report says that around 30% of direct industrial carbon emissions reductions by 2050 hinge on processes that are in development or demonstration today. It also says that building and maintaining strong innovation capacity in emerging economies will be key to successful deployment of sustainable energy technologies, where they may have the largest impacts.

'The shale gas and shale oil boom of the last few years was virtually unthinkable at the dawn of this century,' said van der Hoeven. 'If we only stick to the beaten path of today, we will miss the game-changers of tomorrow.'

Around 30% of direct industrial carbon emissions reductions by 2050 hinge on processes that are in development or demonstration today

Lighting

EU halogen phase-out postponed by two years to 2018

European Member States have agreed to the European Commission's proposal to postpone the phase out of inefficient 'D'-class halogen lamps by two years, to September 2018. The Commission said that the postponement of the phase-out would give more time for the cost of LED lighting technologies to drop.

In advance of the decision, a public review process concluded that September 2016 would be too early for LEDs to fully replace halogen lamps – a date originally agreed in 2009 to tap into the savings potential of LEDs, which use around five times less energy than halogen lamps.

The Commission said that the financial savings from the postponement is in line with its 'Energy Union' priority of improving Europe's energy efficiency with the final goal of ensuring secure, sustainable, competitive and affordable energy.

The phase-out from 2018 does not affect directional halogen lamps, such as popular spotlights, and halogen lamps often used in desk lamps and floodlights.

According to the Commission, switching from an average halogen lamp to an LED will already save around €115 over the LED's lifetime of up to 20 years, and pay back costs within a year. The Commission says the switch to energy-efficient lamps in 2018 will bring yearly energy savings equal to the annual electricity consumption of Portugal (48 TWh of electricity).

European news organisation *Euractiv* reported that the decision is the first time that the EU has rolled back an agreed product efficiency measure, and that the postponement was a result of heavy industry lobbying from halogen manufacturers.



Floating solar power plants for Japan

A 1.7 MW floating solar power plant at Nishihira Pond, Kato City, Hyogo Prefecture, Japan. The plant, and another 1.2 MW floating plant at Higashihira Pond in Kato City, are expected to generate around 3.3 GWh per year – enough for 920 typical Japanese households.

The plants were inaugurated by Kyocera TCL Solar, a joint venture established by Kyocera and Century Tokyo Leasing Corporation.

Photo: Kyocera



Backloading barely dented EU emission allowance surplus in 2014

Additional offset credits and low EU emissions mean surplus in emission permits remains largely untouched

Despite measures undertaken to hold emission allowances back from the EU Emissions Trading Scheme (ETS) last year, to reduce the surplus in allowances and boost the carbon price, an increase in carbon offset credits purchased from overseas in 2014 meant that the overall allowance surplus was barely reduced. It still remains at around 2bn tonnes of carbon dioxide.

Analysis from carbon campaigning organisation Sandbag shows that 256mn tonnes worth of offsets, purchased by companies fearful of upcoming legislation that could eventually make them inadmissible, cancelled out most of the 400mn emissions allowances that were taken out of the scheme in an emergency 'backloading' measure in 2014.

As a result, even with the 400mn backloaded allowances, the 256mn offsets purchased, combined with a large drop in actual emissions from ETS participants, meant that the overall emissions surplus currently in the ETS has only dropped by 10mn allowances – and still sits at a total

of 2,088mn tonnes of carbon dioxide. This is significantly higher than the initial impact assessment for backloading, which forecast a drop down to a surplus of 1,570mn tonnes after 2014.

'The failure of the backloading decision to tackle the over-supply crippling Europe's carbon market should serve as a stark warning against timid new fixes to the scheme,' said Damien Morris, Head of Policy at Sandbag. 'Latest emissions data supports the need for a much more ambitious programme of reforms.'

Sandbag criticised the ETS for failing to keep up with the observed drops in emissions from the scheme. The cap of the ETS drops by 38mn allowances each year, while in 2014 emissions fell by twice that amount. For a cap-and-trade scheme to be effective, the caps have to be felt by participants.

The 'huge surplus' in the market remains 'stubbornly high', says Sandbag.

Meanwhile, policymakers agreed to implement measures voted for by the European Parliament to implement a 'market

stability reserve' (MSR) to more permanently hold back allowances (see the April issue of *Energy World*). Trialogue negotiations between the Parliament, and the European Commission and Council, ended with an agreement to reform the market and implement the MSR in 2019 – two years ahead of the Commission's original proposal.

Backloaded emissions from 2014 will not re-enter the market in 2019, as was originally proposed, and will be transferred into the MSR. Sandbag estimates that the agreement could clear the 2.1bn in surplus allowances described above by 2020.

'The start date of 2019 shows that Member States are prepared to compromise,' said Ivan Pineda, Director of Public Affairs at the European Wind Energy Association. 'But we have to acknowledge that Member States and the Parliament could have been far more ambitious in the shake-up of the carbon market and that much more comprehensive reform is needed in order for this instrument to provide a meaningful signal to investors.'

The overall emissions surplus currently in the ETS has only dropped by 10mn – and still sits at a total of 2,088mn tonnes of carbon dioxide

World's largest engine power plant for Jordan

The world's largest internal combustion engine power plant, located in Amman, Jordan.

The plant, IPP3, is powered by 38 Wärtsilä 50DF multi-fuel engines with a combined capacity of 573 MW, and has been accepted into the Guinness book of records due to its size. It is owned by AAEPC (Amman Asia Electric Power Company) and Wärtsilä led the engineering, procurement and construction consortium delivering the project.

IPP3 will be used for covering sharp daily peaks of electricity demand in Jordan. Its modular design means it can be used to follow quick changes in demand and renewable output. The tri-fuel plant can run on heavy fuel oil, light fuel oil and natural gas, currently running on the former.

Photo: Wärtsilä





US could stop importing energy by 2020 – EIA

Indigenous crude oil and gas production, renewables and energy efficiency means US is becoming more self-sufficient

US net energy imports will decline and could ultimately end altogether, due to continuing growth in indigenous crude oil and natural gas production, as well as the increasing use of renewables and a modest growth in energy demand.

This is the headline conclusion from the US Energy Information Administration's *Annual Energy Outlook 2015*, which presents projections for US energy markets through to 2040 based on various scenarios.

In the central 'reference case' scenario of the report, net energy imports end before 2030, and in a high oil price scenario, before 2020. Imports only persist in the low oil price and high economic growth scenarios.

The report predicts continued strong growth in US production of unconventional crude oil from tight formations. In terms of natural gas, in all scenarios in the report the US transitions from being a net importer to a net exporter by 2017. US natural gas net export growth then continues after 2017, with annual net exports in 2040 ranging from 3tn cubic feet (tcf) in the 'low oil price' case to 13 tcf in the 'high oil' and 'gas resource' cases.

In all scenarios in the report the US transitions from being a net importer of natural gas to a net exporter by 2017

The report also notes that regional variations in US oil and natural gas production will force shifts in flows of the commodities between US regions, so pipelines and supporting infrastructure may have to be realigned. In most cases, oil production shows the strongest growth in the Dakotas/Rocky Mountains region, followed by the Southwest region. The strongest growth of natural gas production occurs in the East region, followed by the Gulf Coast onshore and the Dakotas/Rocky Mountains regions.

The reference scenario sees energy demand grow at 0.3% per year to 2040 – far below the predicted economic growth rate of 2.4% per year – due to energy efficient technologies. It sees renewable energies meeting much of the growth in electricity demand, due to cost reductions and supporting policies.

Finally, the report sees carbon emissions from energy 'stabilise', and remain below the 2005 level through to 2040 – with a central prediction of 5bn tonnes in 2040. Carbon emissions per unit of GDP decline by 2.3% per year from 2013 to 2040.

'Advanced technologies are reshaping the US energy economy,'

said EIA Administrator Adam Sieminski. 'With continued growth in oil and natural gas production, growth in the use of renewables, and the application of demand-side efficiencies, the projections show the potential to eliminate net US energy imports in the 2020 to 2030 timeframe. The US has been a net importer of energy since the 1950s. In cases with the highest supply and lowest demand outlooks, the US becomes a significant net exporter of energy.'

- US greenhouse gas emissions increased by 2% in 2013, but this is an upward blip in an overall trend of a 9% drop in emissions since 2005. The trends are outlined in the US Environmental Protection Agency's *20th Inventory of US Greenhouse Gas Emissions and Sinks*. In 2013, the US emitted 6,700mn tonnes of carbon dioxide equivalent – of which power plants accounted for 31%, transport 27% and industry 21%. The increase from 2012 to 2013 was due to increased energy consumption and a greater use of coal to generate power.

Wind

Germany to build 20 offshore wind farms

The European Commission has found that German government plans to support the building of 20 offshore wind farms, making up a total of 7 GW of capacity, are in line with EU state aid rules.

Three of the proposed farms will be located in the Baltic Sea, with the other 17 in the North Sea. Although the European Commission has already approved Germany's EEG Act for supporting renewables, which will subsidise the wind farms, as not breaking state aid rules; due to their size, financial compensation and competitive effect, the wind farms were investigated on a case-by-case basis.

Germany notified the Commission of the plans for the wind farms in October last year.

Subsidy for the farms will come in the form of a premium on the market price for electricity. The Commission concluded that the wind farms would further EU energy and environmental objectives without unduly distorting competition in the Single Market.

The wind farms range from 252 MW to 688 MW in size. Total investment costs amount to €29bn. All of the projects are planned to start producing electricity by the end of 2019, and will contribute around 13% to Germany's planned 2020 renewable capacity.

The Commission's investigation found that the rates of return investors would achieve thanks to the subsidy were limited to what is necessary to implement each project

and is in line with rates previously approved for similar projects. It also took into consideration that the projects will enable new electricity providers to enter the German generation market, having a positive effect on competition.

Meanwhile, E.ON's Amrumbank West offshore wind farm, which is located in the German North Sea, has started to produce power. The first of its eighty 3.6 MW turbines has started spinning, with the wind farm expected to reach full power later this year. The farm's service centre on Helgoland island, from which the operation and maintenance of the wind farm is monitored and managed, has also been completed.

 **VIEWPOINT**

Can Formula E electrify mainstream motoring?



Neil Wallis is Head of Communications at the Low Carbon Vehicle Partnership (LowCVP), www.lowcvp.org.uk

Just a few years ago, the term 'electric vehicle' conjured up images of a milk float. But perceptions are changing fast and likely to be shifted further with motor racing now going electric as the first FIA Formula E series visits London at the end of this month.

Battersea Park will host the final weekend of racing in the inaugural Formula E series on 27–28 June, bringing motor racing, vehicle electrification and environmental issues into sharp focus in the heart of Britain's capital city. London is an appropriate venue for the series finale; most of the racing teams and technology suppliers are based in the UK and city environments like London are well-suited to electric vehicle adoption, where recent uptake has indeed been encouragingly brisk.

The electrification of vehicles has emerged as one of the most prominent objectives of governments, in the UK and elsewhere, as they seek to meet commitments to cut greenhouse gas emissions. The UK's Committee on Climate Change's analysis for its Fourth Carbon Budget, for example, suggested that it would be broadly appropriate to aim for EVs to

represent 60% of new car sales by 2030. Several other countries have announced similarly challenging aspirations, prompting motor manufacturers and the automotive supply chains to invest heavily in

The views and opinions expressed in this article are strictly those of the author only and are not necessarily given or endorsed by or on behalf of the Energy Institute.

R&D and innovation, introducing a growing range of new electrified products to the market.

From motorsports to mainstream

Technology is a big part of the challenge in the electrification revolution and one in which its proponents say Formula E has an important part to play. As seen in other motorsport series, technical solutions in Formula E stimulated by the intense competition between teams, are promised to 'trickle down' to mainstream models, improving performance and cutting costs.

This first year's cars are based around technology developed by a small group of manufacturers – including Spark Racing Technologies, McLaren Electronic Systems, Williams Advanced Engineering, Dallara and Renault – and more of the leading manufacturers are expected to join the competition in future. From next season, teams will be able to develop their own distinct cars with bespoke technology, and there are hopes that the competition will prompt a race to create even more powerful batteries that will ultimately end up in mainstream road vehicles.

There are already encouraging signs that technology being developed for electric car racing could begin to make an impact in the mainstream. Race series sponsor Qualcomm, for example, sees Formula E as an opportunity not just to showcase technologies but to evaluate and improve wireless connectivity and electric vehicle technology across the globe, especially in the host cities. The company is showcasing Wireless Electric Vehicle Charging (WEVC) technology which it believes will supplant wired charging.

New energy sources

To help overcome the 'well-to-wheel' criticism that electricity used to charge electric vehicles comes from fossil-based sources, Formula E is working with a British company, Aquafuel Research,

which was commissioned to build a pair of mobile generators running on a fuel that it says is virtually emission free – glycerine.

The generators are based on standard production diesel engines – a Cummins KTA50 – that have been adapted with Aquafuel's patented technology. The glycerine itself is a by-product of the biodiesel production process. Traditionally its commercial uses have been mainly in cosmetics but with the new biodiesel supply outstripping traditional demands, this is an alternative application for the product.

The initiative is a result of a research project with (LowCVP member) Greenergy and the partners have been delighted by the results: they found the fuel has improved lubricity and cleaner burning properties and it is also more efficient than diesel in the same engine.

Electricity is only one of the options, of course, for decarbonising road transport fuel, and even here in Formula E we see the need for development of low carbon liquid fuels as a core enabler. It is this complex energy choice for transport which led the LowCVP, in collaboration with the Department for Transport, to convene the Transport Energy Task Force. The Task Force recently concluded that transport energy can and should contribute to major reductions in greenhouse gas emissions and that, for the foreseeable future, increasingly sustainable biofuels have a significant role to play along with other low carbon fuels including methane and LPG as well as progressively decarbonised electricity.

The glamour of Formula E, though, should certainly help to make 'new energy' vehicles sexy, hopefully shifting attitudes towards their adoption as well as helping to transform technology. ●

These and related themes will be discussed at the LowCVP's Annual Conference on June 24 in Westminster. More details are available at www.lowcvp.org.uk/events/conference



Wind industry 'brings benefits to UK economy'

Each megawatt of onshore wind brings £2mn to UK economy, much of which benefits local communities

Britain's onshore wind industry generated £906mn in gross value added (GVA) revenue to the UK economy in 2014, according to a report released by trade association RenewableUK, revealing the increasing contribution that the onshore wind industry and its supply chain makes to the UK economy.

The report, undertaken by BiGGAR Economics for RenewableUK, shows that the economic benefits of developing onshore wind are strongly felt in the UK, with each megawatt of onshore wind installed bringing in more than £2mn to the UK over its lifetime, and 69% of the industry's total spend remaining in the UK (or 69% 'UK content').

RenewableUK was responding to suggestions that onshore wind projects are under threat from the new government.

The report also reveals that, on average, 27% of the economic benefits of onshore wind are enjoyed in the local authority area around each project, reflecting the efforts of many developers to engage in initiatives to maximise and promote local supply chain and employment opportunities. The local level of content has increased in each stage of wind farm development between 2011 and 2014, reflecting developers' commitment to ensure benefits are spent locally.

The largest percentage of local spend comes at the operations and maintenance stage, with 42% of the value of contracts now being spent in the local area. On a wider

level, almost half of the total spend is retained in the region in which a wind farm is located (48%), with this highest at the development stage (59%) and operations and maintenance (58%). It is lowest during the construction stage (36%); however, this typically lasts for less than two years.

Even when initial expenditure does occur overseas, some of it ultimately returns to the UK when British companies are involved in the supply chain – for example, supplying components to turbine manufacturers based outside the UK – adds the report.

And costs of wind power continue to come down. Global wind and solar company Mainstream Renewable Power has said that its proposed 448 MW Neart na Gaoithe offshore wind farm in Scotland will use two new technologies which will decrease costs, reduce construction and operational risk and ultimately provide the cheapest electricity ever produced by a UK offshore wind farm. The technologies, which were launched in March following extensive design, de-risking and testing work, include the new Offshore Transmission Module (OTM) by Siemens Energy Management Division; and High Wind's Boom Lock system to be deployed by GeoSea for wind turbine component installation at sea.

Neart na Gaoithe was one of only two offshore wind farms awarded Contract for Difference support by the government in February. It received planning

consent in October 2014 and is expected to be generating electricity and fully commissioned by 2020.

The new OTM by Siemens will remove the need for heavy offshore substation platforms and associated specialist installation vessels. The innovative design approach means that two wind turbine foundations can be used to support the OTM modules, which include the essential transmission equipment.

Meanwhile, the Boom Lock system will allow the safe installation of all wind turbine components in wind speeds up to 15 m/s. The system is mounted on an offshore crane and is designed to control the movement of the crane hook and the payload in such a way that installation time can be drastically reduced.

- Ireland's ESB has entered into a development partnership with Coriolis Energy, a wind energy company, to develop up to 400 MW of new wind farms across nine projects. The agreement strengthens ESB's commitment to the expansion of its onshore wind portfolio in the UK market, says the company, and will potentially translate into a capital investment of approximately £600mn. The majority of projects within the portfolio are located in Scotland and the first project is planned to be operational by 2019.

27% of the economic benefits of onshore wind are enjoyed in the local authority area around each project

Port becomes carbon neutral

The Port of Milford Haven says it has become carbon neutral, thanks to its investment in renewable energy and energy efficiency projects. In spring 2014, the Port commissioned its 20,000 panel solar array at Liddeston Ridge, adding to its 26 roof-mounted arrays across the Port's property portfolio. Combined, the projects are now creating enough electricity to offset 102% of 2014's operational emissions, says the Port.





Supreme Court orders government to take 'immediate action' on air pollution

Ruling follows battle from environmental lawyer group arguing that the government failed to meet the European Air Quality Directive

The UK Supreme Court has quashed the government's so far ineffective plans to cut illegal levels of air pollution – much of which comes from road vehicles in cities – in Britain and ordered it to deliver new plans by the end of the year. The ruling is the culmination of a five-year legal battle fought by environmental lawyer group ClientEarth for what it calls the right of British people to breathe clean air.

The ruling will eventually save thousands of lives a year by forcing the government to urgently clean up pollution from diesel vehicles, the main source of the illegal levels of nitrogen dioxide found in many of the UK's towns and cities, according to ClientEarth.

The ruling means that the government must start work on a comprehensive plan to meet pollution limits as soon as possible. Among the measures that it could consider are low emission zones, congestion charging and other economic incentives.

The case concerns the UK government's obligations under European Directive 2008/50/EC

– the Air Quality Directive – to reduce levels of nitrogen dioxide in outdoor air. Formed by combustion at high temperatures, the main sources of nitrogen dioxide are road traffic and domestic heating. The Directive sets limits to levels of various pollutants, including nitrogen dioxide, and sets corresponding time limits for compliance.

The UK government had a five-year period from January 2010 to achieve limits of the gas, but failed to meet those limits, particularly in London, and suggested they would not be met until 2025. The Court ruled that there had been a breach of the Directive and that the government must submit new air quality plans by the end of 2015.

The Supreme Court Justices were unanimous in their decision, saying: 'the new government... should be left in no doubt as to the need for immediate action to address this issue.'

ClientEarth Lawyer Alan Andrews said: 'Air pollution kills tens of thousands of people in this country every year. We brought our

The UK government had a five-year period from January 2010 to achieve limits of nitrogen dioxide, but failed to meet those limits, particularly in London

case because we have a right to breathe clean air and today the Supreme Court has upheld that right. This ruling will benefit everyone's health but particularly children, older people and those with existing health conditions like asthma and heart and lung conditions.' The organisation is calling for action to clean up the worst polluting diesel vehicles, including through a national network of low emission zones.

The ruling was also an opportunity for promoters of alternatively fuelled vehicles to highlight their fuels or technologies. Chief Executive Officer of liquefied gas fuel supplier Gasrec, Rob Wood, said: 'hopefully this will be a wake-up call for the government and the wider transport industry – which is responsible for the bulk of nitrogen emissions – that the development and adoption of natural gas fuelled vehicles should be greatly speeded up.'

Strategies to reduce the volume of urban road traffic represent another part of the solution.

Historic mill returns to hydropower

An 18th century cotton mill on the banks of the River Bollin in Cheshire has taken inspiration from its past to produce its own cleaner energy again. A new hydroelectric scheme installed at Quarry Bank near Wilmslow has been switched on as the National Trust takes another step forward to achieve its ambition of generating 50% of its energy from renewable sources by 2020.

Founded in 1784, Quarry Bank originally harnessed the power of the Bollin to drive the huge water wheel which would in turn power mill looms. The 1801 weir on the river remains a key feature in Quarry Bank's landscape to this day.

More than two centuries later, the National Trust, working with the Environment Agency, has taken the water power scheme in a new direction. Instead of servicing long-silenced mill looms, the Bollin now powers a Kaplan turbine installed 30 m downstream from the weir. The turbine generates over 55% of Quarry Bank's on-site energy requirements.





Tidal energy

Atlantis to acquire Marine Current Turbines

Tidal power company Atlantis is to acquire the share capital of the Bristol-based tidal business, Marine Current Turbines, (MCT) from Siemens in an all share deal, subject to certain conditions being satisfied.

Siemens decided to exit the marine energy industry earlier this year by selling MCT, one of the most important pioneers of tidal energy technology – see *Energy World* January 2015. The company operates the world's first commercial-

scale (1.2 MW) tidal turbine at Strangford Narrows in Northern Ireland.

If the deal goes ahead, Atlantis would be acquiring an iconic British tidal turbine business, including extensive seabed rights, existing projects, staff and intellectual property. It would also represent consolidation of two leading tidal technologies companies and create one of the largest portfolios of tidal current power projects in the UK, says Atlantis.



Root vegetables and ESOS

Oxfordshire-based energy management company Enistic is handling ESOS (Energy saving Opportunity Scheme) compliance for a major UK carrot and parsnip grower, Alan Bartlett and Sons. The company will take on the Lead Assessor role, monitor energy use and target energy savings opportunities for the evidence pack which will be submitted to the Environment Agency before 5 December this year.

Alan Bartlett and Sons specialises in the large-scale supply of carrots and parsnips to UK supermarkets, farming around 1,200 ha of carrots and parsnips in East Anglia and on the Moray Coast in Scotland. The business has two sites, one in Chatteris Cambridgeshire and one in Forres Scotland.

As well as upgrading all factory lighting to the latest LEDs the company has also invested over £1mn on one of the UK's largest privately-owned, roof-mounted solar PV systems on the roof space at the Chatteris HQ. The 1.2 MW system produces around 20% of the total annual electricity consumption. Director Toby Bartlett said: 'If, at the end of the ESOS journey, and with Enistic's help, we can see ways of reducing our carbon footprint further and making more savings this will be very much welcomed by our business.'

For more on ESOS see page 22.



Amber Rudd new Secretary of State for Energy and Climate Change

Amber Rudd, MP for Hastings and Rye is the new Secretary of State for Energy and Climate Change. She was a junior minister for climate change in the last government. She has a background in finance and spent time in the Treasury prior to joining the Department of Energy and Climate Change (DECC).

While in her previous post at DECC she spoke at Heat 2014, organised by the Energy Institute and the Association for Decentralised Energy.

Hydropower

New pumped storage scheme for Snowdonia?

Britain's first new grid-scale electricity storage facility for more than 30 years has taken a step closer to completion, following an agreement with landowner, the Crown Estate, to lease 13 hectares of land in North Wales to developer Snowdonia Pumped Hydro (SPH).

The proposed £160mn Glyn Rhonwy facility will be located near Llanberis and have the potential to produce nearly 100 MW of electricity using pumped hydro technology. Water will be pumped to a reservoir on the upper slope of Cefn-Du at times of low electricity demand, then be released back through turbines to a lower reservoir to re-generate the electricity at times of high demand.

The facility will play an important role in balancing supply and demand on the

UK's electricity grid as the percentage of renewables such as wind and solar power continue to grow.

It is anticipated that the facility will be operational by 2019. The facility is expected to be operating for 125 years, during which time Gwynedd Council will receive annual rates payments of approximately £600,000 a year, and an independent trust will manage community contributions from the facility, including an initial grant of £325,000 and annual payments of £15,000.

The 600 MWh facility is expected to achieve carbon payback within six to nine months, according to SPH, which adds that more than 99% of the world's existing grid-scale electricity storage is pumped hydro, due to its low cost and proven technology.



More solar farms for eastern and southern England

Projects up and running in Norfolk, Essex, Cambridgeshire, Gloucestershire, Sussex and Kent

The first, 32 MW, phase of the Scottow Moor solar farm, located on the former RAF Coltishall airbase 16 kilometres north-east of Norwich, is up and running, having been built in just seven weeks – one of the fastest large scheme builds in the UK and Europe, according to its developer.

Phase one comprises more than 130,000 ground-mounted solar panels on either side of the runway, and new underground connections to the local electricity network. Scottow Moor Solar used the services of Enerparc to lead on the main construction works and ESM Power to deal with the electrical connections. Proposals for the second phase of the project, approximately 18 MW in generating capacity, are to be brought forward in the autumn under the government's Contract for Difference subsidy scheme.

The solar scheme will generate income for the County Council, which owns the site, of over £10mn over 25 years, once both phases are complete.

Meanwhile, utility-scale solar specialist Push Energy says it has developed 142 MW of solar farms since March 2013, including six solar farms in East Anglia totalling 92 MW. The completed projects include three sites in Essex, one in

North Hertfordshire and two in south Cambridgeshire.

The sites were all completed and energised before the end of the financial year when the government stopped support for solar farms over 5 MW under its Renewable Obligation scheme.

The company says it is about to start construction on the next 30 MW of projects at sites in East Anglia and the Midlands; it also has a further 120 MW pipeline currently under development in these regions.

Last, the Korean-based manufacturer of solar modules, Hanwha Q CELLS, has announced that four solar farms with a total of 64 MW of its PV modules were completed by voga solar in March. The projects are located in Gloucestershire, Telford and Wrekin, Sussex and Kent.

Sites were completed and energised before the end of the financial year when the government stopped support for solar farms over 5 MW under its Renewable Obligation scheme



Gosfield solar farm in Essex, one of six developed by Push Energy in East Anglia

66 anotherlook



Marc Height weighs up how big tidal turbines should be

Tidal stream energy converters, or tidal turbines, differ from their wave counterparts in that they largely follow a horizontal axis design. They look like wind turbines, underwater.

As well as convergence towards this design, there seems also to be a convergence to the size of a typical tidal turbine, with somewhere around the 1 MW mark deemed to be commercial scale.

In the future, what will, or should, happen to the size of these machines? A debate at this year's All Energy conference sought to explore just this. Arguing for larger devices was Professor Peter Fraenkel, Director of Fraenkel Wright and co-founder of Marine Current Turbines (MCT); and in the small corner, Cameron Johnstone, CEO of Nautricity put forward the case for scaling down.

Fraenkel's argument was that a certain amount of costs are sunk into a tidal project, regardless of size – for foundations, cabling, grid connection and so on. These fixed costs are intrinsic and so, once they are spent, the obvious thing to do is to increase a turbine's swept rotor area to increase revenue. The larger turbine cost will increasingly become relatively small compared to the fixed costs. The wind industry has been doing just this.

This is not to say that rotor size should continue to increase indefinitely. Issues around torque actually dictate that 1 MW, or up to 20 m diameter blade length, is an upper limit. The key is for multi-rotor systems, says Fraenkel (this is why MCT's SeaGen device has two rotors).

On the other hand, Johnstone argued that reducing the capital that goes into tidal systems is the way forward, and you can't do this by scaling up. Instead, efforts should be focused on simplifying the subsea power train, by taking weight out, and using more compact, lighter technology. Continuing to put 1,000 tonne machines in the water can't make commercial sense, argued Johnstone, and lighter, smaller machines would reduce installation, as well as operations and maintenance costs.

Despite personally feeling that Fraenkel put forward a better argument, the audience went with Johnstone, with the majority voting that small is the way to go.

Time will tell where the industry moves from its nascent stage. One thing's for sure though: considering the small number of machines in the water – there's not much data on cost-effectiveness to go on yet.

**Marc Height
Deputy Editor**

The views and opinions expressed in this article are strictly those of the deputy editor only and are not necessarily given or endorsed by or on behalf of the Energy Institute

EI AGM and Cadman Lecture

Following the EI's call for nominations in April for EI members to join the EI Council as elected members, the successful candidates will be officially appointed at the EI's Annual General Meeting (AGM) later this month to which all members are invited to attend.

The EI Council is composed of volunteers representing all aspects of energy and works on the strategic direction of the EI. In addition to three vacancies for elected members, a further place is available for one young member representative, open to any EI member under the age of 35 and employed in the energy industry. These positions, along with the

new Presidency, will be elected upon at the EI AGM on 23 June at Prince Philip House in London. The AGM will be followed by the presentation of the EI's prestigious Cadman Award to Malcolm Brinded CBE FEI.

Malcolm will deliver the Cadman Lecture, entitled *Energy: Global challenges and game-changers*. In his lecture, which EI members are invited to attend, Malcolm will talk about the conflicts we face in resolving global challenges, such as the threat of rapid urbanisation, fuel poverty, and the impact that the demand for cheaper, more abundant energy has on climate

change. He will also talk about some of the most exciting game-changers: new technologies that are revolutionising how we source energy, and innovative ways of better planning and developing cities and their transportation systems, highlighting that, as the world seeks solutions which meet both climate and development goals, a greater understanding of both the challenges and opportunities is needed.

For queries regarding the AGM and/or to confirm your attendance, please contact Helen Sullivan, Assistant to the Chief Executive, at e: agm@energyinst.org

Spaces at the Cadman Lecture are limited; to book your place, please register at www.energyinst.org/cadman



Malcolm Brinded CBE FEI

A nice problem to have with awards

In the latest blog from Ian Merchant FEI, EI President, he reflects on the judging process of last year's EI Awards. He says: 'Last year I was really impressed with the calibre of many of the nominees and was struck by the obvious evidence of professionalism and achievement. However, given that there is a lot of really great stuff happening and lots of talented and committed people working in the industry, I would like to see a lot more entrants in 2015.'

'Let's celebrate the excellent projects and individuals out there who are doing such important work to change behaviour and improve processes, and use the awards to showcase what can be done to inspire others to raise their game too. My plea is that we make the job of this year's EI Awards judging

panel much more difficult by swamping them with loads of examples of the good things that are happening in our industry. This would be a nice problem to have.'

This will be the sixteenth year the awards competition has been running. The EI calls for all projects of excellence and/or individuals that satisfy the criteria of any one of the nine following categories: Communication; Community Initiative; Energy Champion; Energy Excellence; Environment; Innovation; Safety; Technology; and Young Energy Professional of the Year. Unlike many other industry awards, this competition is free to enter. This reflects the EI's commitment to encourage the largest collection of entries possible, to profile the very best projects, and to

celebrate the huge and valuable contribution the energy sector makes to society.

The exposure associated with winning or even being shortlisted for the EI Awards can be very worthwhile, with previous winners reporting an increased profile and wider interest among investors associated with this competition.

Visit our website at www.energyinst.org/ei-awards to find testimonials from previous winners, a short video from last year's ceremony, along with details of the judging criteria, and tips and hints for writing a successful entry. Talk with your colleagues today, identify potential projects and make sure you enter this year. The deadline for submissions is 29 June 2015.

G9 publishes second data report

In April, the G9 Offshore Wind Health and Safety Association (G9), supported by the EI, published new HSE statistics for the offshore wind sector. This second annual incident data report provides the latest figures on reported incidents in 2014. The overall Lost Time Injury Frequency (LTIF) shows a decrease of 34% compared to the previous year, while the Total Recordable Injury Rate (TRIR) has increased by 3%. The publication gives a comprehensive insight into the health and safety performance of the G9 members from 45 sites spread across the UK and Northern Europe.

Since the first data report was published in 2014, the G9 has expanded the amount and type of data collected to include hours worked, dropped

objects, medivacs and emergency response, and also high potential (HiPo) incidents. The hours worked data has also been used to calculate LTIF and TRIR, which can be used to benchmark offshore wind industry performance with other sectors.

The publication of this report followed a successful 'Safer by Design' workshop held in Norway in March, on the subject of emergency escape from a turbine nacelle in the event of a fire. The workshop was attended by a range of industry representatives with engineering and HSE backgrounds; presentations were given from a number of experts within the industry on fire control and mitigation, equipment and PPE to facilitate escape from the nacelle, and escape training

and competency requirements.

In addition to the presentations, there were separate breakout sessions where groups undertook a short design-led review before reporting back on key discussion points and conclusions in a final plenary session. The outputs of these breakout sessions are available online.

The G9 brings together nine of the world's largest renewable energy developers to form a group that places health and safety at the forefront of all offshore wind activity and developments. For more information, please visit www.g9offshorewind.com



EI sets up energy efficiency advice service for businesses

The EI has set up a free advice service to provide a 20 minute consultation for businesses, enabling them to ask questions about ESOS, energy auditing and the benefits of seeking professional advice on energy efficiency. The service is fulfilled by members of the Register of Professional Energy Consultants (RPEC) – a regulated directory of experts who are all chartered, are bound to a strict Code of Conduct and have a proven track record in energy consultancy.

Companies can register their interest via email, telephone or online and a consultant will respond

within five working days. The discussion will focus primarily on opportunities for energy savings for business, complying with ESOS legislation and the auditing process together with the benefits of engaging with professional advisors.

The EI is at the forefront of developing knowledge resources, training courses and qualifications for energy managers, harnessing its members' expertise for the benefit of organisations across the UK. To see our complete portfolio of energy management resources please visit www.energyinst.org/energy-efficiency



IN YOUR AREA

Idris Jones memorial lecture and luncheon

The 41st annual Idris Jones Lecture was held in February in Cardiff. This year's lecture examined the plans for the Swansea Bay Tidal Lagoon, focusing on the technology it will employ, the civil engineering challenges it will navigate and the new energy market it will open. Tidal Lagoon Power is preparing to start construction of the world's first tidal lagoon power plant in Swansea Bay this year. The 320MW installed capacity project will establish a blueprint for the rapid roll-out of a fleet of full-scale tidal lagoons that could between them provide 8% of the UK's electricity. The lecture was given by Ton Fijen, a well-qualified engineer who has been working in the fields of marine and coastal engineering for more than 30 years. Before joining Tidal Lagoon Power, Ton was based in South Africa as a Consulting Engineer and Director of WSP Africa Coastal Engineers. Following the lecture, the EI South Western and South Wales branch's annual student paper presentation award was presented to Tibin Joseph GradEI for his paper on DC Grid Connections.

Visit to Eastcroft energy from waste facility

A group of 20 members of the EI East Midlands branch visited the Eastcroft Energy from Waste facility in Nottingham. The facility is part of the Nottingham District Heating Scheme which produces heat and power for local users by burning up to 200,000 tonnes of waste. Following the Eastcroft tour, the group walked across to the Enviroenergy CHP plant for another fascinating visit. This facility receives steam from Eastcroft and converts this to electricity for distribution to the grid and heat for district heating in around 4,600 local homes and offices.

Providing technical support on safety management issues

In recent months, EI Middle East has worked with the EI Technical team to provide a series of presentations and training on various safety management issues. This has included an introduction to the EI's High Level Process Safety Management Framework, and the Hearts and Minds safety culture programme at the Global HSE Conference, GCC Process Safety Management Forum and Tank World Expo events in Dubai. The EI has been supporting local companies, such as the Emirates National Oil Company, by providing training courses across Dubai and Abu Dhabi. Safety in Oil and Gas is one of three special interest areas for EI Middle East, as well as renewables (encompassing solar energy) and energy management. To make the most of these visits, Dr Mark Scanlon, Technical Team Manager for Safety, alongside Maria Blakley, Managing Director – EI Middle East, also dropped in on the American University of Sharjah to talk to chemical engineering students about standards and codes of good practice.

For more detailed reports from the EI branches network and further information about forthcoming activities and events in your area, please visit www.energyinst.org/branches

IN BRIEF

New dates for the EI's Level 3: Advanced Energy Manager course

The EI's Advanced Energy Manager training programme for 2015 has now started, with a course currently running and a repeat session scheduled for the latter part of the year. This 12-day qualification is ideal for energy managers with three or more years of experience, who are looking to develop their knowledge and skills and are possibly considering pursuing Chartered Energy Manager status. The autumn session will begin on 21 September, with the exam assessment scheduled for 7 March 2016. A 10% early-bird discount is available for this course until 21 July.

Access to EI library and online resources

As part of the EI's refurbishment programme, the EI Library is likely to be closed to visitors for the second half of 2015. However, the EI Knowledge team will still be available to answer queries, and the eLibrary (www.energyinst.org/eLibrary) will also be accessible, containing a wealth of information on all areas of the energy sector. This includes three fully-searchable databases – Knovel, Ebsco Environment Complete and Ebsco e-books – providing access to publications online. Members can also carry out research through the dedicated EI Knowledge Service – a central resource of information, featuring publications, statistics, news, events and contacts. Visit knowledge.energyinst.org to find out more.

Acre partners EI to help energy professionals find work

Specialist recruitment agency, Acre, is partnering with the EI to provide a

continuous career support service, from qualification to top jobs. Since 2003, Acre has been the market pioneer of sustainability recruitment and, over this period, has placed many of the world's leading professionals within the energy management and carbon space. It is the first port of call for many global clients looking to expand their sustainability and energy teams and is well positioned within the market to assist our members in finding roles. Find out more at www.acre.com

Insurance services for members

EI members who work as contractors may have insurance needs that are specific to the energy industry. We have teamed up with freelance insurance experts Kingsbridge Professional Solutions to offer a comprehensive, inexpensive and compliant insurance package, which includes all the key insurances contractors need; notably professional indemnity, public liability and employers' liability. For more information or to obtain a quotation, visit ei.kpsol.co.uk or contact Kingsbridge directly on t: +44 (0)1242 808740 or e: enquiries@kpsol.co.uk

Sadly we have been notified of the deaths of the following members:

	Born
Mr D D Chambers CEng MEI	1931
Mr B W Cliffe CEng MEI	1922
Professor W Davey FEI	1917
Mr R M Doig CEng MEI	1937
Mr J E Hoare CEng MEI	1922
Mr R C A Mackworth MEI	1924
Mr M L Markham CEng MEI	1940
Mr C A Marshall CEng MEI	1951
Mr R Smith CEng FEI	1921
Dr N A White CEng FEI	1922

POLICY

Low carbon transport agenda ‘helps the UK economy and cuts motoring costs’

The drive for low carbon road transport is – and will continue to be – good for motorists, the economy, jobs, growth and exports as well as essential to protect against climate change, according to a report: *Fuelling Britain’s Future*, by Cambridge Econometrics. The report found that, by 2030, fuelling the average new low carbon car could be £600 cheaper than for the average car today. The national cost of running and replacing cars in the UK could be between £5–7bn lower.

Eight specialist companies, each a dynamic innovator in low carbon road transport, were showcased at the launch of the report, held in the House of Commons in March, as practical manifestations of the findings of its findings – see box below. The event was hosted by the

Low Carbon Vehicle Partnership (LowCVP) in collaboration with the European Climate Foundation.

The researchers found that a continuing focus on cutting carbon from road transport could lead to carbon dioxide emissions from the UK car and van fleet being cut by 47% by 2030, and as much as 80% by 2050.

The report says that improvements in the efficiency of internal combustion vehicles are already saving motorists hundreds of pounds each year. Advances in engine efficiency, lighter construction materials, more efficient tyres and the gradual introduction of electric propulsion will reduce running costs even further.

Cambridge Econometrics’ report echoes the findings of the LowCVP’s retrospective study

published last year: *Investing in the Low Carbon Journey*, which found that the last ten years of a consistent policy focus on cutting carbon has helped to stimulate a renaissance in the automotive sector, while also improving fuel efficiency at the most rapid and sustained rate ever.

The new report says that the cost of motoring will fall in Britain as a result of efforts to tackle carbon emissions and clean up urban air pollution. In 2014, the average motorist spent £1,190 on fuel. By 2030, fuelling the average new low carbon car could be £600 cheaper per year to run than for the average car today. The average electric car could deliver even bigger savings in annual energy costs, worth around £960.

These technically-advanced vehicles will be more costly to buy

Innovation in fuels, components and operation

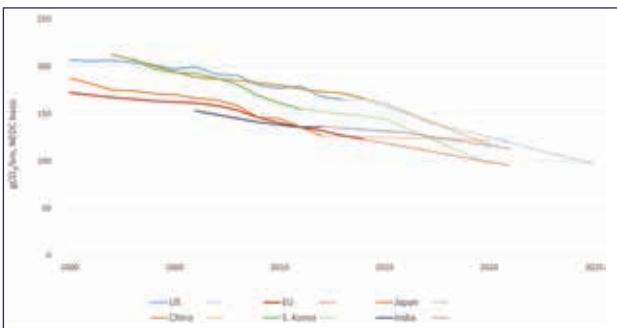
Small and medium-sized British companies provide examples of developments in low carbon fuels, vehicle and component technology and operational innovation. The following examples illustrate the breadth of the LowCVP showcase, demonstrating how low carbon solutions exist across traditional industry boundaries.

- *Celtic Renewables* is commercialising the production of biobutanol as an advanced biofuel from the residues of the £4bn Scottish malt whisky industry.
- *Controlled Power Technologies* brings powertrain, power electronics and control software expertise together to develop and commercialise emissions reduction technologies now being sought by vehicle manufacturers.
- *GnewtCargo* provides a final mile delivery service in London

which uses electric vehicles and advanced logistics to minimise emissions in the capital.

- *Mercury Fuel Systems* offers dual fuel LPG/diesel systems for heavy commercial vehicles which cut fuel costs as well as carbon emissions.
- *Meteor Power* is developing the first downsized low carbon, hybrid engine for use in high performance motorcycles and lightweight sports cars.
- *Protean Electric* specialises in the design, development and manufacture of in-wheel and compact electric motor and drive technology for the automotive and cleantech markets.
- *Revolve Technologies* is an engineering and service provider to the automotive R&D sector specialising in developing low carbon
- technology solutions for electric vehicles (EVs), hybrids and hydrogen applications.
- *Tevva Motors* is developing for production the first commercially viable range-extended electric urban delivery truck. Tevva’s innovative solution is applicable to both newbuilds as well as the retrofit of older vehicles.

Speaking at the launch event, LowCVP Managing Director Andy Eastlake said: ‘Innovators like these demonstrate the vitality of the automotive and fuels sector and highlight the prospects for future growth. The UK is, and needs to remain, the best place to invest in the innovative low carbon technologies of the future. We will continue to do all we can to ensure that every low carbon opportunity is explored and supported.’



Historically, Japan and the EU have led vehicle emission performance. For the EU this is expected to continue, but Japan has recently set a standard for 2020 of just 122 g/km which is considerably less stringent than in the EU. South Korea, by comparison, has set fuel standards for 2020 that are in line with the EU. Canada and the US have recently introduced measures to reduce vehicle emissions between 2011 and 2016 by around 4% per annum. In 2012, the US agreed a 2025 standard of 107 g/km (93 g/km for cars alone). As a result, the emissions performance in various vehicle markets is expected to converge towards 2025.

Source: International Council on Clean Transportation (ICCT) and reproduced in the Fuelling Britain's Future report

at the outset, but the initial investment will be outweighed by energy savings within a few years, leaving households significantly better off. Even if oil prices were to remain at today's unusually low level, energy savings would rapidly

outweigh the cost of low carbon technologies, says the report.

From a national perspective, by 2030, the total cost of renewing and fuelling the UK car fleet would be £7bn lower for low carbon vehicles than if the fleet were to continue running on today's technology, or £5bn cheaper in a low oil price scenario. The car and van fleet would also be increasingly powered by domestically produced clean energy sources, reducing Britain's dependence on oil imports from overseas and helping protect households and businesses from volatile oil prices.

Meanwhile, carbon dioxide emissions from the car and van fleet could be cut by 47% by 2030, and as much as 80% in 2050, adds the report. Reductions of air pollutants, such as nitrogen oxides and particulates, would help lower the incidence of respiratory diseases. The health benefits associated with these air-quality improvements are estimated to be worth £1bn to £1.2bn to the UK economy.

Of course, this transition would not be without its challenges:

investments would need to be made in new infrastructure; Britain's automotive workforce would need to gain new skills to remain competitive; and there would be job losses in the refining of fossil fuels. But overall, Britain would reduce its dependence on imported oil; the economy would become more resilient; the climate would be better protected; and the air in our cities would be cleaner.

The reduction in oil demand, if matched across the other major oil-consuming countries, could itself cause a reduction in the oil price. In doing so, the economies of oil-importing countries could be boosted further. For the UK, the case is mixed, as it is both an oil producer and importer. As the UK now imports more oil than it produces, however, it is reasonable to expect that by contributing to lower oil prices the shift to low carbon technologies could lead to further economic benefits,

concludes the report. ●

www.camecon.com
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Transport energy has a major role to play in delivering greenhouse gas reductions

Transport energy can and should contribute to major reductions in greenhouse gas emissions and, for the foreseeable future, sustainable biofuels have a significant role to play, along with other low carbon fuels including methane, LPG and electricity. So concludes the final report of the Transport Energy Task Force: *Options for transport energy policy to 2030*.

The Department for Transport (DfT) and the Low Carbon Vehicle Partnership (LowCVP) established the Transport Energy Task Force as a mechanism for stakeholders to help the government to formulate options for policy regarding transport energy. The Task Force was asked to consider how the EU 2020 greenhouse gas emissions reduction and renewable transport fuel targets should be reflected in UK policy and determine how low carbon fuels can help reduce greenhouse gas emissions from UK transport in the period to 2030 and beyond.

Transport is a major source of greenhouse gases, emitting around a quarter of domestic carbon dioxide and other greenhouse gas emissions. Reducing greenhouse gases from transport would help the UK achieve its long-term goal of reducing greenhouse gas emissions by at least 80% compared to 1990 levels by 2050, says the report. While vehicle efficiency and demand management are vitally important measures, transport energy can and should make a significant contribution to

greenhouse gas savings, particularly in the longer term.

And, while electrification of transport is a cornerstone of current policy to reduce carbon emissions from transport, liquid and gaseous fuels will remain dominant in combustion engines and there is an opportunity for the foreseeable future for sustainable biofuels to play a substantial role towards the achievement of deep carbon reductions in transport by 2030 and beyond.

The Task Force agreed that the goals for UK transport energy policy should focus on securing the greatest possible cost-effective greenhouse gas emission reductions from transport energy, and providing greater certainty and clarity about the sustainability of all fuels. This will require a collaborative environment to foster innovation and investment in sustainable biofuels in the UK. To deliver this, the UK should make clear policy objectives and trajectories to 2030, introduce improved sustainability criteria, encourage investment in advanced renewable fuels and create a market which is supportive of domestic investment in new biofuels.

Compliance with the Renewable Energy and Fuel Quality Directive targets for 2020 will be challenging and not necessarily consistent with the longer-term greenhouse gas and sustainability aspirations, but a number of options are available to the UK. The Task Force believes the pathway

to delivery of greenhouse gas emission reductions in 2020 should minimise commercial, sustainability and market acceptance risks and uncertainty.

The deployment strategy for replacement fuels and blends must ensure that fuel supply remains fit for purpose for use with available vehicles and infrastructure, and conform to established international fuel specifications.

There were varying views on the best ways forward, and some members disagreed on whether the 2020 targets were achievable or desirable. However, if the UK government wishes to meet the EU 2020 transport targets, two mass market measures would probably be necessary to achieve them. These are: displacing petrol with higher bioethanol levels, and displacing diesel with high levels of waste and residue-derived biodiesel.

Longer term, there is significant growth potential for the UK in advanced fuels. The UK is currently well placed to move both gasoline and diesel biofuels towards more advanced and sustainable supplies based upon the knowledge and investments of domestic producers. The report calls for support to develop this expertise and investment through the adoption of a target for sustainable advanced biofuels, and complementary fiscal and capital support. ●

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CHARGING INFRASTRUCTURE

Brussels demands alternative transport service networks

European Union (EU) member states are developing national policies that the EU has required to ensure that they have an adequate number of alternative transport recharging and refuelling stations by 2020. This is deemed necessary to boost demand for vehicles running on alternative fuels in Europe.

The number of electrical (battery and plug-in) and hybrid vehicles in Europe remains low for most countries: according to *European Vehicle Market Statistics* from the International Council for Clean Transportation for 2014, 13% of vehicles in Norway comprise these e-vehicles, and 11% in the Netherlands. These are easily the most impressive figures highlighted by the compendium – others were France 3.4%, Sweden 2.3%, the UK 1.5%, Germany 1.1%, Austria 1% and Denmark 0.9%.

So Directive 2014/94/EU on 'the deployment of alternative fuels infrastructure', which entered into force in November 2014, could play an important role (including in non-EU country Norway, which is covered by this law under the European Economic Area agreement). Under its terms, EU countries now have until November 2016 to transpose the directive into national legislation and inform the European Commission about how they will build refuelling and recharging networks.

While the European Commission had set targets for each country in its initial proposal of the directive, announced in January 2013, national governments refused to have these imposed on them, insisting that each country set targets individually. The final version of the directive states that the action plans the Commission expects from each member states by 2016 will have to include national targets and objectives for the deployment of alternative fuels infrastructure.

The national plans also must contain an assessment of the current state and future development of the market for

How can markets for alternative fuel vehicles develop, unless drivers reliably know that a recharging or refuelling stations is nearby? The EU has set targets for member states, reports Carmen Paun in Brussels, and Keith Nuthall.

alternative fuels in the transport sector, including the potential of their simultaneous and combined use. National governments are also expected to explain what measures they are planning to take to reach the national targets and objectives they set.

These action plans should ensure that 'an appropriate number of recharging stations accessible to the public are put in place by 31 December 2020' – a qualitative demand that gives the Commission some leverage to ensure targets are sufficiently ambitious.

Room to roam

Member states should give electric vehicles room to roam at least in urban, suburban and other densely populated areas, according to the directive. The number of these recharging points for each country should be established by taking into consideration, among other factors, the number of electric vehicles estimated to be registered by the end of 2020.

The EU wants national governments to ensure that the operators of these recharging points are free to purchase electricity from any supplier in the EU. Moreover, the supplier could be different from the one providing electricity to the household or the premise where the recharging point is located, the directive added.

It also sets December 2025 as the milestone for making hydrogen refuelling points accessible to the public in those EU countries which include them in their national action plans. These would power up hydrogen automobiles, including those which run on fuel cells.

Even given these timelines, the disappearance of pre-established targets from the final directive led

advocates of green transport, such as the civil society organisation Transport & Environment, to claim that the legislation was just 'dead text' and would fail to create the momentum for the uptake of electric, fuel cells and hybrid vehicles.

But the ongoing conflict with Russia and the EU's push for an 'energy union' of integrated energy regulation and the appreciation that alternatives to fossil fuel imports from Russia and other unstable regions are necessary seems to have blown some fresh steam into the EU's plan to deploy alternative fuels infrastructure.

Given the 'shocking figure' of €1bn per day that the EU spends on fossil fuel imports, the Commission wants to develop a strategy for the electrification of transport that goes beyond installing recharging stations for electric vehicles, said Greg Archer, Head of Transport & Environment's Clean Vehicles Team. He now expects the Commission to present a concrete plan on what Europe needs to do to support transport electrification. 'It would have a focus on electric vehicles, but also look at electric bikes, the electrification of the rail network and so on,' he told *Energy World*.

While he considered the directive on the deployment of alternative fuels infrastructure weak, Archer said that its introduction of a standard for the electric vehicles charging plugs is a positive first step on the EU's way to increasing the number of these vehicles on its roads.

But increasing interoperability of recharging networks will be needed soon, he warned. 'At the moment, you would have to register with many recharging companies across countries,' Archer said. A better scheme would be to allow people to register with

A large uptake in electric vehicles on European roads would not only decrease greenhouse gas emissions and help the EU move away from fossil fuel imports, but also help balance the grid by contributing to the integration of renewable energy sources into the grid



Electric car charging in Amsterdam

Photo: hans engbers, Shutterstock.com

one company and have access to many recharging points across Europe, he added.

A large uptake in electric vehicles on European roads would not only decrease greenhouse gas emissions and help the EU move away from fossil fuel imports, but also help balance the grid by contributing to the integration of renewable energy sources into the grid, according to Archer.

However, this would require encouraging people to charge their electric vehicles overnight, when there is excess capacity from renewables, he explained. 'If they are charged overnight, the development of electric vehicles provides a fantastic possibility to make use of the volume of renewables generated over night, for which at the moment there is no significant demand,' he said.

It has been estimated that if charging did happen during the day and every automobile in the EU was an electric one, electricity demand would rise by 25%, he explained.

If things are done cleverly and electric vehicles are charged overnight, electric vehicles can become a good forward storage for renewable electricity at peak hours, Mr Archer added. 'What we need to see is electric vehicles introduced with smart grids, and in doing this you can determine when it is charged,' he explained.

Additional demand

EU electricity industry association Eurelectric agrees with much of this assessment. A March report concluded that additional electricity demand due to electric vehicle charging is possible: 'Even a hypothetical 100% electrified fleet will add 802 TWh or a 24% increase in total electricity demand provided that those vehicles were charged outside peak hours.'

With 90% of charging expected to occur at home, or parking near homes and offices, low-voltage distribution grids in residential or commercial areas are likely to be impacted first.

Europe's automotive powerhouse Germany is certainly making plans to push ahead with its response to the directive, with a spokesperson for Germany's Federal Ministry of Transport and Federal Infrastructure saying: 'The process was started immediately.'

The German government has a target of ensuring there are at least 1mn electric cars in Germany by 2020, significantly higher than current low levels. 'In recent years, the federal government has provided more than €2.2bn in research funding for the promotion of electric mobility,' said the official. If it succeeds, then there could be some significant increases in demand for electricity, but probably not until 2020, said the official. That said, the reinforcement of local power supplies in some areas might be needed in the meantime.

A raft of legislative reforms and amendments would be needed to comply with the directive, although there would be a 'national strategic framework' promoting refuelling and recharging networks. This would initially involve the roll-out of a minimum level of all alternative transport refuelling and recharging services enabling industry and motorists to try them out. But looking ahead, the ministry said it would closely monitor the development of demand for the different kinds of alternative vehicles, from hydrogen to electrical and others, and roll-out recharging/refuelling networks to suit.

Denmark ahead

Elsewhere in Europe, Denmark has been particularly proactive in developing alternative transport recharging and refuelling networks in a bid to create an e-car market. An official at its transport ministry stressed that as regards implementing the directive regarding electrical charging, 'Denmark is quite far in having a national net of charging points covering the Danish road system.'

Indeed, the country already has contracts in place for 23 motorway charging stations – 13 locations are already operating and the other 10 are scheduled to be online this summer. These are and will be run by electric car recharging specialist Clever A/S and Germany-based energy company E.ON.

These contracts will expire after 10 years and the total revenue expected to be generated by these 23 stations is estimated at Danish Krone 65mn (\$9.3mn). The Danish Highway Agency said a third tender process for six to eight new stations is planned, including gas and hydrogen filling stations as well as electrical charging points.

The tenders earmarked potential location for refuelling and recharging points, leaving it to operators to choose which locations to bid for. All investments are to be private, except the public cost of posting new traffic signs indicating the stations. Tender participants had to demonstrate their ability to develop and operate charging stations and were chosen by service levels and tolls they would pay Denmark's road directorate.

The transport ministry official stressed that charging points would in general be built and operated by private companies. 'It is the opinion of the government, that fundamentally the market is the most effective, including cost effective, way to develop the infrastructure for alternative fuels,' she said.

As a result, the government has financed and supported development and demonstration projects on electric vehicle charging and other alternative fuel technologies in the transport sector, to help pump prime the market. Secondly, the government has helped the installation of charging points by giving operators free access to land by highways for a number of years and running a public tender to choose contractors.

Concrete targets

As for the European Automobile Manufacturers Association (ACEA), it has become tentative about the potential impact of the directive since member states removed the Commission's concrete targets: 'The member states themselves agreed to make their own national plans by the end of 2016. Therefore, it is premature to assess the impact of the directive agreed last year,' said Communications Manager Charles de Lusignan, who said governments still could potentially outperform targets set in the Commission's original proposals.

He noted that France, Germany and Britain already have their own national plans for e-mobility. However, even these countries have to update their plans and ensure they cover all alternative fuels infrastructure to serve all powertrains, including LPG, CNG, hydrogen, LNG, and more. ●

FUEL CELL ELECTRIC VEHICLES

Poor air quality – a clean power solution is needed

Global urbanisation and industrial growth is causing pollution to reach dangerous levels in both developing and developed countries. Transport and industrial consumption of fossil fuels are the main factors behind this, driven by growing demand from consumers as global wealth increases. Road transport is one of the main contributors to air pollution; legislation is helping to reduce emissions but there are limits to what can be achieved and it is making vehicle manufacturers' products more complex and expensive.

Intelligent Energy, an energy technology group that develops hydrogen fuel cell power systems, believes a cleaner alternative must be introduced and is working with a number of vehicle manufacturers to achieve this.

The scale of the challenge

Road transport is one of the main contributors to air pollution (28% of emissions in the UK are the result of road transport according to a 2014 report by the Society of Motor Manufacturers and Traders). Last year, MPs declared that air pollution is an 'invisible killer' and a public health imperative. The concern over air pollution is so great that the Commons Environmental Audit Committee remarked that schools, hospitals and care homes should not be built near main roads to cut the tens of thousands of premature deaths being caused by air pollution.

According to a report last year from the World Health Organisation (WHO), exposure to polluted air accounted for 7mn premature deaths in 2012 alone. While a global problem, South-East Asia and Western Pacific Regions bore the largest burden, resulting in a total of 5.9mn deaths.

In large, growing economies, such as India, air quality is understandably suffering. The country's transport sector accounts for 70% of the country's multibillion litre diesel consumption and associated particulates released into the air. In China, cities such as Beijing, where

Poor urban air quality is a serious problem and road traffic one of the main causes. Here, James Batchelor from Intelligent Energy discusses how fuel cell electric vehicles – from cars to buses and large trucks – could be a major part of the solution.



Intelligent Energy fuel cell taxi in London

air quality index (AQI) readings commonly exceed levels that the WHO considers unsafe, have at times been declared 'almost uninhabitable.'

But this is not a problem confined to developing nations; in April 2014 the EU was taking action against 17 of its 28 member states due to serious air quality problems. Even London's prestigious Oxford Street was revealed to have air quality below EU standards, according to the *London Evening Standard*. The paper reported claims by academics from King's College London and campaign group Clean Air, that in January – just four days into 2015 – the location had exceeded the EU legal limit for nitrogen dioxide levels for the whole year. (Levels of nitrogen dioxide cannot be above 200 micrograms per cubic m³ of air for more than 18 hours in total, per year.)

Reducing the impact of air pollution
Air quality has been high on London's agenda for some time,

with a large number of older diesel-fuelled vehicles (buses, taxis, delivery vehicles) on its roads; the city is looking closely at the requirement to implement local measures to improve air quality. Governments around the world should review their own cities and take best practice and ideas from those already implemented successfully elsewhere. In London, these include the following initiatives:

- implementing the Congestion Charge Zone in 2003;
- establishing the world's first Low Emission Zone in 2008;
- retiring the remaining 900 oldest Euro III buses in the Transport for London (TfL) fleet, and replacing them with super-clean Euro VI buses at a cost of £18mn;
- accelerating the rollout of hybrid buses, with 1,700 to be on the road by 2016, including 600 of the iconic New Routemaster buses, which are

Hydrogen fuel cell electric vehicles (FCEVs) which cleanly and efficiently deliver similar range, performance and refuelling experience to internal combustion engine powered cars, promise to be a real game-changer

- one of the cleanest and greenest buses of their type – this will be equivalent to around 20% of TfL's bus fleet;
- trialling new fleets of zero-emission fuel cell buses and taxis;
 - installing more than 1,400 publicly accessible electric vehicle charging points.
 - introducing a new £20mn Mayor's Air Quality Fund to support the London boroughs in tackling local air quality hotspots;
 - the Mayor has proposed a new Ultra Low Emission Zone for central London in 2020, subject to a feasibility study, which would mean a step change for the uptake of low-emission vehicles in the city; and
 - Boris Johnson, the Mayor of London, has gone so far as to mandate that all new taxis must be zero-emission capable by 2018.

While the above initiatives are commendable and will help reduce air pollution in the short term, a long-term solution requires government to work with vehicle manufacturers to educate and influence the consumer purchasing decision towards low or zero emissions vehicles. For its part, the industry must be ready to supply such a demand, once created.

Fuel cell electric vehicles

The straight removal of the internal combustion engine from our roads is an unrealistic target for the foreseeable future. However, there will be a marked shift to lower and zero emissions vehicles over the next five to ten years. Up to now, the ambition of weaning drivers off fossil fuels

Around the world, a number of national governments and industry players are now working together to build the fuelling infrastructure that will serve future and existing needs

has largely focused on hot-selling electric cars like Tesla's Model S. But hydrogen fuel cell electric vehicles (FCEVs) which cleanly and efficiently deliver similar range, performance and refuelling experience to internal combustion engine powered cars, promise to be a real game-changer.

FCEVs have progressed to a stage where it is now feasible that they could be – and in some

instances are being – successfully introduced as a direct replacement for today's diesel and petrol-powered vehicles. FCEVs are developed and ready for adoption by both consumers, who now have a greater choice of newly launched commercial models, and for government adoption for city based fleets.

For the consumer, leading automotive manufacturers such as

Zero-emission range-extended light commercial vehicles for fleets

Intelligent Energy is leading a UK industry consortium that is to develop a new class of zero-emission, light commercial vehicle (LCV).

The three-year project, utilising Intelligent Energy's fuel cell technology, is to develop validated systems and vehicle conversion expertise ready for volume manufacture. The goal is also to provide fleet operators with a solution that enables vehicle operation for extended periods whilst being emissions free at the tailpipe.

The consortium will receive a £6.3mn grant from the Advanced Propulsion Centre (APC) as part of the £12.7mn project. In addition to lead partner Intelligent Energy, the partners comprise Frost EV, Frost Electronics, Millbrook, CENEX, British Gas and DHL.

The collaborative project minimises technical and commercial risk by initially targeting captive and commercial fleet operators, providing a package that can be integrated into vehicles as an end-of-line fitment at an original equipment manufacturer, or through a new-vehicle conversion facility, or by retro-fitting at approved centres.

Jon Beasley, Director of Technology and Projects from the Advanced Propulsion Centre, located at the University of Warwick, said: 'Our aim is to position the UK as a global centre for low carbon propulsion systems development and production. This consortium of British companies is helping the APC to deliver its aim with this innovative project that uses hydrogen fuel cell technologies. It has the potential to deliver a viable zero-emission vehicle for fleet operators around the world.'

Fuel cell systems can be used to increase battery electric vehicle range while maintaining zero emissions. The light commercial

vehicle systems developed during this programme will offer operational advantages through increased access to restricted emission zones combined with faster refuelling times than battery pack recharging alternatives. The consortium will work in conjunction with a steering group including vehicle manufacturers, government agencies and major fleet operators.

Intelligent Energy's Motive Division Managing Director, James Batchelor, added: 'To complement Intelligent Energy's proven business model based on licensing our technology to vehicle makers, we also recognise the potential to secure the early market introduction of our fuel cell systems with the goal to provide range-extended capability to fleet operators of battery electric vehicles. Indeed, fleet operators are already engaged with the battery EV market to comply with current and future legislation and achieve corporate environmental sustainability goals. They are pushing for increased range and faster refuelling times to allow greater fleet flexibility and reduce costs.'

'Many have indicated that without this range extender technology, perhaps just 10% of total LCV fleets are likely to be switched to battery EV propulsion. Using cost-effective fuel cell technology, that estimate rises in the short term to about 30%', added Batchelor.

He concluded: 'By the end of the project, vehicles will be delivered using Intelligent Energy's fuel cell technology built to automotive standards, ready for extensive fleet use. The relationships formed as a result of this programme will help to develop a mature supply chain and commercial framework, in turn supporting the expansion of hydrogen infrastructure, with the expectation that this will lead to the availability of fuel cells at scale.'



Intelligent Energy fuel cell stacks

Toyota, Honda and Hyundai have announced their intentions to make FCEVs available to global markets. This has already begun, for example, with Toyota's Mirai FCEV, which is already available to consumers in Japan and expected to hit US and European roads later this year.

Intelligent Energy worked with the Mayor's Office and Transport for London to introduce a fleet of fuel-cell powered London taxis for the London 2012 Olympics, transporting the Mayor's VIP guests around the Olympic sites. The fuel cell taxis remain running in London as part of a wider European programme (HyTEC). These 'Cleaner Air for London' taxis have proven they can perform the duties required of a Black Cab, carry the same number of passengers, and do so while producing zero pollution at the tailpipe.

Consumer convenience and better air quality

Hydrogen as a fuel has clear advantages according to Toyota, which said: 'hydrogen has great potential as an alternative fuel. It can be produced from a wide variety of primary energy sources, including solar and wind power; it is easy to store and transport; and

when compressed, it has a higher energy density than batteries.'

FCEVs offer zero tailpipe emission motoring without compromising performance or range. In fact, the hydrogen cars entering the market today can have triple the range of most battery electric cars and can be refuelled in a few minutes (rather than recharged over several hours), making them comparable in that respect to traditional combustion-engined vehicles.

Fuel cell technology can be scaled-up to fuel buses, long-haul trucks and other large vehicles that most current battery packs would struggle to power. In relation to this, Intelligent Energy is leading a UK industry consortium that is to develop a new class of zero emission, light commercial vehicle (LCV). By integrating fuel cell technology into battery electric vehicles (BEVs), the consortium will deliver the capability to provide low carbon LCVs with significantly improved range and rapid refuelling – see box on page 19.

Infrastructure challenges

While there is a strong business and environmental case for FCEVs, the lack of refuelling options and necessary infrastructure needed has the potential to inhibit mass

adoption. Around the world, a number of national governments and industry players are now working together to build the fuelling infrastructure that will serve future and existing needs.

Programmes such as H2 Mobility in Germany, UK H2Mobility and H2USA, as well as work underway in France, Scandinavia, South Korea and Japan are bringing industry and governments together to help make FCEVs a commercial reality.

A cornerstone to minimising emissions

As the world sits up and takes notice of the health implications of air quality, and increasingly recognises the contribution of emissions from road transport to the problem, the need for alternative, cleaner automotive power sources has become increasingly apparent. Fuel cells represent a highly efficient and scalable technology capable of powering everything from our cars and motorbikes to our vans, trucks and taxis while minimising the detrimental impact on the air we breathe. ●

James Batchelor is Managing Director of Automotive Division, Intelligent Energy, www.intelligent-energy.com

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VOLTAGE OPTIMISATION

Optimising energy storage

On-site electricity storage, working alongside voltage optimisation, could solve problems for both consumers and suppliers, as Dr Alex Mardapittas describes.

Most commercial buildings still rely on national grids to provide electricity, but huge anticipated increases in global demand will require grids to develop and expand their networks, passing the cost on to users. The added strain on the grid is also likely to reduce the reliability of supply. These problems, coupled with the intermittent nature of renewable generation, emphasises the need for a new approach to electricity supply and usage.

Energy storage is increasingly recognised as one of the best solutions to address these challenges, allowing energy to be stored locally at times of low demand so that it can be used at a time most beneficial to the user.

Reduce, store, save

A new system is combining the concept of energy storage with the benefits of voltage optimisation for the first time. The system, Powerstar Virtue, works by reducing energy consumption by an average of 12–15% through its patented, electronically regulated voltage optimisation technology, and then harnessing the resulting induced negative power feedback to charge a storage medium.

As the availability of power is easy to predict the system can, in effect, act as a virtual power station, offering users greater flexibility and control over their own electricity usage. This means that a well thought out energy strategy can be implemented to maximise savings and ensure a constant and reliable energy supply.

Designed, sourced and manufactured in the UK, Powerstar Virtue can act as a full facility uninterrupted power supply for up to two hours and, thanks to its modular design, further storage modules can be added as site requirements grow.

An additional advantage of using the system is that it eliminates the need for inverters on renewable installations, which can further help towards reducing

Correcting the imbalance between energy supplied through the grid and the voltage required by electrical equipment not only reduces energy consumption, but also prolongs the life of machinery by reducing excess energy which manifests itself as unwanted heat and vibration



The Powerstar Virtue system

costs and improving return on investment. Sites can also benefit from reduced harmonics, voltage phase balancing and improved power factor, along with reduced maintenance costs.

The patented design of these systems delivers savings by matching the incoming electricity supply to the requirements of on-site electrical equipment and returning any excess back to the grid. It achieves this by generating induced negative power feedback, which flows towards the grid and is subtracted from the incoming power.

Around 70–80% of the total energy savings are through the induced negative power feedback, with the remaining 20–30% gained from improvement in equipment efficiencies due to appliances operating at a voltage more suited to their operating requirements.

In addition, making savings on LED lighting is especially challenging and Powerstar is the only known voltage optimisation system proven to achieve this. The system has also demonstrated that savings of 6–10% can be achieved when modern variable speed drives are connected.

A recent installation of a 250 kVA system at one of Europe's leading brewers of Carlsberg at a facility in Cyprus delivered a reduction in energy consumption of 17% and a return on investment in only 12 months.

Exercise in precision

Correcting the imbalance between the energy supplied through the grid, often as high as 242 V, and the voltage required by electrical equipment, designed to operate efficiently at 220 V, not only reduces energy consumption but also prolongs the life of machinery by reducing excess energy which manifests itself as unwanted heat and vibration.

These benefits were of interest to Newburgh Precision, one of the UK's premiere contract manufacturers of precision machined and fabricated engineering components and

assemblies, which was seeking to implement an effective energy strategy in the company's new facility in Rotherham.

A full site survey was carried out to establish the best voltage optimisation solution for Newburgh, leading to guaranteed energy savings of 7% using a Powerstar 1,000 kVA solution. The actual energy savings have exceeded expectations, resulting in a 156 MWh per annum – 10% of total site energy consumption, representing annual financial savings of £14,000. This will represent a three-year return on Newburgh's investment.

Dave Burrows, Plant Provision Manager at Newburgh said: 'Along with the positive environmental impacts, we have seen a reduction in motor drive failures, giving us greater efficiency and providing further savings on top of those promised.'

The future is energy storage

Storing energy savings for use at a time when tariffs are high is an obvious progression. Storage is also crucial if a significant percentage of energy is to come from renewable sources.

Storage will also reduce the need to build more infrastructure to cope with demand, and it offers enormous cost savings. Imperial College London's Energy Futures Lab has estimated that energy storage technologies could generate savings of £10bn a year by 2050 in the UK alone.

Reasons of economy lay behind the development of our vast national grid but the growth of small-scale renewables and revolutionary energy storage technologies means that power can be generated and stored more locally to give greater control, greater flexibility and maximum savings. ●

Dr Alex Mardapittas is creator of the Powerstar voltage optimisation system, www.powerstar.com

ENERGY AUDITS

Europe-wide businesses face more than just ESOS

The UK is one of the countries ahead of the game in transposing Article 8 of the European Energy Efficiency Directive into concrete policy – in the form of ESOS. But companies that have operations across the continent will struggle to know how to comply with Article 8, with only six months to the deadline, as *Marc Height* finds out.

The Energy Savings Opportunity Scheme (ESOS) is the latest in a line of energy efficiency initiatives targeted at UK businesses. Aimed at similar sized organisations that were affected by the Carbon Reduction Commitment Energy Efficiency Scheme, ESOS is a different beast altogether. The UK's interpretation of part of a European Directive, the aim of ESOS is for organisations to get a handle on their energy use through auditing – but there is no requirement for them to act on this information.

ESOS is aimed at organisations that are 'large', defined in this case as over 250 employees, or with an annual turnover of £39mn and a balance sheet of £33.5mn. Organisations that qualify for the scheme will have to appoint a Lead Assessor (who can be in-house or external) to manage the compliance criteria and sign off a report that needs to be submitted to the Environment Agency – the scheme's administrator – by December this year.

The report needs to contain evidence that at least 90% of an organisation's energy use, over

buildings, transport and industrial processes, has been audited; or, that the business as a whole has implemented an energy management framework in the form of ISO 50001. Previous auditing work carried out over the last four years in various forms can contribute to the report. The report also has to include recommendations to reduce the organisation's energy use.

Rather than go into more detail here, the Energy Institute (EI) has produced an array of information for those affected by ESOS in the form of briefings and FAQs, which



Dan Hubbard

Embarking on ESOS

How are energy management professionals looking to tackle ESOS? Dan Hubbard, Group Energy Manager and one of the EI's Chartered Energy Managers, tells *Energy World* about his approach to the scheme.

EW: How will you be managing ESOS and what are the sort of things will you be looking for?
 DH: As an internal ESOS Lead Assessor I will be managing compliance for a UK group of organisations. When considering the merits and challenges of the potential routes to compliance, we decided that the ESOS audit approach will provide the most realistic and robust method of achieving full compliance and highlighting opportunities for energy saving initiatives.

The audits will cover retail, logistics and manufacturing operations across all UK companies within our group; along with buildings this will also require detailed audit of transport operations (freight and company car fleet) along with manufacturing processes. Being a relative newcomer to this company,

this scheme provides me with an ideal opportunity to consider all opportunities from policy, behaviour change through to large-scale investment in energy efficient and renewable technologies, with the requirement to present those cases to our key decision makers.

Practically, I am project managing the scheme: coordinating the data collection and validation, evidence pack and audit schedule within our small in-house energy team whilst out-sourcing the site visits and physical audits to a team of appropriately qualified professionals.

EW: Will you be using ISO 50001 for any or all of the assessment?
 DH: No, there isn't any part of the UK group that is currently covered by ISO 50001 and we have taken the view that it would not

be achievable across such a large organisation within the timescale when evaluating all factors. This is however something that will be given serious consideration for phase two.

EW: What is the size of the organisation?

DH: There are over 350 sites in the UK group, comprised of a varied estate of retail stores across multiple brands; selling furniture and household goods. There are also a small number of manufacturing plants and distribution centres.

EW: What are the advantages of acting as a Lead Assessor in-house?

DH: Ultimately the responsibility for compliance is with the participating business and they will have to make their own decisions as to what may work best for them.

There is the concern that there will be a serious supply and demand issue with respect to the availability of a relatively small number of ESOS Lead Assessors compared to the large number of organisations captured by the scheme. Having

can be accessed at efficiency.energyinst.org/esos

The wider context

ESOS is the UK's interpretation of Article 8 of the European Energy Efficiency Directive (EED), which focuses on energy audits and energy management systems. The EED as a whole is much larger, with a total of 30 Articles bolstering the Directive.

The overall aim of the EED, established in 2012, is to help the European Union reach its 20% energy efficiency target by 2020. The Directive targets all stages of the energy chain, from production to final consumption.

EED progress across European Member States is certainly not uniform. Towards the end of March, EU news website *Euractiv* reported that around two thirds of EU countries could face legal action from the European Commission for failing to translate the EED into national law. The deadline for transposing the Directive was June 2014.

The *Euractiv* article reported that 16 nations had not fully transposed the Directive, and three had made no progress at all. The European Commission has started proceedings against Greece and Portugal for delays in implementing the EED, warning of

financial sanctions. At the time of writing, Hungary is facing a daily fine until it transposes.

Italy, Malta, Cyprus and Sweden had met the June 2014 deadline. The UK followed shortly after.

If this is the bigger picture, then things get more complicated when looking at Article 8 specifically.

A headache for pan-European businesses

Pan-European organisations are going to find it difficult to navigate Article 8 compliance criteria across different Member States – and especially so at this point in the process when information can be hard to come by.

What might come as a surprise for affected businesses, and not a pleasant one, is that each Member State will have its own compliance system for Article 8. There is no European-wide process.

For example, UK Lead Assessors cannot work in other countries to sign off documentation unless they are locally registered (with Ireland being a potential exception). So, auditors may have to qualify in different Member States, or, businesses may require different auditors in each country. But at this stage fine details are unclear.

While the UK has various approved registers for 'Lead Assessors', Cyprus, for example, has

specified a national Energy Auditors Register. To be on the register, auditors have to attend up to 150 hours worth of seminars – followed by an examination. In Germany, auditors do not have to be part of an accredited body but have to have relevant experience in energy consulting.

More difficult still for organisations that are looking to plan for all this now, are the countries where it is not clear, or no information exists, on what is needed to comply with Article 8. According to analysis from sustainability consultancy Ricardo-AEA, no information is available for Greece, Hungary, Latvia, Lithuania, Luxembourg, Portugal or Slovenia. Other countries have limited information available but have not progressed fully. Austria, Denmark, Germany, the Netherlands and the UK are the only countries where the audit requirements for large enterprises are known.

Of the energy areas covered by audits, in a pan-European context transport energy looks like one particularly difficult area to negotiate. Ian Behling, Principal Consultant, Energy and Climate Change at Ricardo-AEA, says: 'For a logistics company in the UK, for example, all fuels for flights starting or ending in the UK are

an in-house Assessor removes that concern.

It could be argued that taking this in-house provides the opportunity and flexibility to tailor the scheme to the business within the boundaries of compliance; the likelihood is that the in-house assessor may already have access to the relevant data and understand the business, buildings and processes. This should save time in for the initial assessment, however managing or in some cases conducting the compliance programme could require significant time and resources.

With little more than six months to the deadline, if business have not already got an in-house Assessor they will mostly have to employ an external Lead Assessor. The challenge will be finding the right individuals that are qualified and available to provide expert advice specific to the business and its processes. The EI's RPEC register of ESOS Lead Assessors provides a very good guide.

For a lot of participants there may be a significant knowledge

gap where energy is concerned, and they will have to rely on external professionals. However this does not absolve the senior figures of the responsibility of reviewing and signing off the evidence pack. It is therefore crucial that the business and the external Lead Assessor are able to build a productive working relationship to achieve compliance or there real risk that both parties could be left vulnerable to compliance issues.

EW: Are you confident you have all the information you need to make the compliance deadline?

DH: Yes, I am confident that we have all the necessary information to enable us to meet the deadlines – there are already good systems in place for tracking electricity, gas and transport fuel consumption. I think businesses that have been part of the Carbon Reduction Commitment Energy Efficiency Scheme should be relatively well placed to collate their data with respect to electricity and gas.

Transport fuel may be a different challenge altogether, depending on the relevant business activity and

the presence and reliability of usage data.

EW: Will you be looking to act on any opportunities presented by ESOS?

DH: Absolutely. Already there has been significant investment in energy efficient technology throughout the group, particularly through the recent retail store refurbishment programme. However, in my view as a group we are only at the start of our energy awareness and reduction journey. There are numerous opportunities to save energy and the associated costs; it is my intention to use the ESOS compliance to work as the vehicle to properly assess what we have and what can be done in order to formally present it to our board members.

Although timescales are tight, I see this as the ideal opportunity as someone new in to the business to accelerate and bring together a large amount of work I have done or planned to do in my role as Group Energy Manager. ●

What might come as a surprise for affected businesses, and not a pleasant one, is that each Member State will have its own compliance system for Article 8. There is no European-wide process.

covered by ESOS, but some of this may also need reporting in other EU interpretations of Article 8. So some of this energy will be double reported – but clearly you can only make the savings once.'

As companies don't have the full picture yet, this understandably makes it difficult to start to plan for Article 8 strategically and in a logical fashion. As Christine St John Cox, Knowledge Leader at Ricardo-AEA says: 'It's hard to plan for what you don't know, and you don't know what you don't know.'

In this sense, St John Cox recommends that companies keep an eye on Member State progress, gather participation data and start to think about the quality of their energy data – and think about the sort of budget that will be needed to be set aside. Ricardo-AEA is also offering an intelligence service for organisations that face the current Article 8 predicament.

How is the UK getting on?

Back in the UK, companies are becoming more aware about ESOS. But despite that, according to Martin Fry FEI, Chairman of ESTA and the Chair of the BSI Energy Management Standards Committee, many organisations have not yet engaged with the scheme. And time pressures are creeping in. According to Fry, implementing ISO 50001 from scratch will take at least a year, and in terms of audits, considering the low number undertaken already there could be a surge in demand later in the year. The question is: are there enough professionals there to do them?

Although not exactly clear, there are somewhere between 400–500 qualified Lead Assessors in the UK. The EI has around 200 on both its registers. Around 10,000 organisations are thought to fall under ESOS criteria. Some larger organisations providing ESOS services have used these figures to try and spur businesses into using their services sooner rather than later, to avoid any potential bottlenecks.

For the time being it doesn't look like many businesses have taken early action, with rumours of around 15 submitting compliance with the Environment Agency. 'We haven't seen many examples of firms that have registered compliance,' said Susan Clarke, an Energy Industry Analyst at energy and sustainability analysis firm Verdantix. 'We know that a number of firms trying to sell ESOS audit services have put quotes with companies but have

had very few orders of work yet – there hasn't been a great deal of action.'

Compliance versus opportunity

The thing about ESOS is that there is no obligation to do anything about saving energy once the audit is completed, save for doing another audit in four years' time.

While some think that identifying areas for saving will prompt organisations to act, others are more sceptical. Verdantix is clear that to get the most out of ESOS, and to obtain a positive return on investment from complying, businesses should follow up on the audit recommendations and implement energy efficiency measures – to focus on the 'opportunities' in ESOS, as its name suggests. But yet Verdantix forecasts the bulk of organisations will do the opposite and undertake the minimum to comply, treating ESOS as a 'tick box' exercise.

'Based on conversations with ESOS providers and corporates affected by the scheme we see the majority – *circa* 80% of firms – just looking to go for the cheapest audit available,' said Clarke. This simple compliance approach will cost somewhere between £5,000 and £50,000 depending on the size of the company, but won't offer any savings further down the line.

And the competence of the Assessor carrying out a company's audit is paramount. 'There is a shortage of experienced Lead Assessors, so firms should look out for ones accredited by a professional institution, who validate qualifications and experience through a demanding application and interview procedure,' said John Carden CEng Chartered Energy Manager FEI.

Carden continued: 'The experienced Lead Assessor will be able to identify and make detailed recommendations for reducing energy usage throughout the organisation being assessed. Selection of a Lead Assessor experienced in the firm's business sector, through interview and submission of a detailed proposal, is the key element for organisations starting out on the ESOS compliance process.'

There could be another issue – are the penalties of non-compliance severe enough to force businesses to act? 'There are questions there around whether firms are going to be motivated enough to meet these deadlines,' said Clarke. 'To do audits properly across large multi-site projects, the cost of the audit may be getting

near the cost of the actual penalty for non-compliance [a maximum of £90,000]. You could ask whether the penalty is severe enough to drive action.'

A similar scheme in Hong Kong a few years ago for commercial buildings to get energy audited had high levels of non-compliance, with government having to force businesses to act.

Despite concerns that there might be a surge of ESOS work in the autumn, accompanied with a potential bottleneck in Lead Assessor supply, the UK is at least ahead of other countries when it comes to its energy auditing framework for Article 8. But clearly, for companies to make the most of ESOS, they need to act on the advice that they get, and focus on the opportunities made available from this opportunity scheme. ●

ESOS Toolkit and more from the EI

The latest in a line of services from the EI to help organisations make the most of ESOS is its ESOS Toolkit. The toolkit is designed for those undertaking audits to help with compliance and cost-effective action to reduce energy use.

The toolkit, which can be used by in-house or consultancy-based Lead Assessors and others involved in ESOS work, contains tools to help collate information on total energy consumption, audit completion, life cycle cost and commercial considerations.

For more information and to access the ESOS Toolkit, visit www.energyinst.org/esos-toolkit

The EI's Register of Professional Energy Consultants and register of Chartered Energy Managers are both approved as meeting the required standards to act as ESOS Lead Assessors. For more information, to view the registers and to contact the professionals, visit efficiency.energyinst.org

Finally, the EI also provides training for ESOS. More information is available at www.energyinst.org/esos-training

SUPPLIERS

Switching the focus on utilities

You would have been hard pressed to miss the recent government campaign to encourage consumers to switch energy providers. The 'Power to Switch' campaign from the Department of Energy and Climate Change (DECC) was designed to highlight the fact that many households could save up to £200 by switching energy suppliers. The ads dramatised the benefits of switching in a simple, clear and engaging way.

After only four weeks DECC reported that 130,000 homes took up the call to switch energy and save, with the average dual fuel switch saving consumers £312 per year. That's more than £38mn in total.

While the campaign focused on raising awareness of savings to be gained by householders shopping around for the best energy deals, those figures should be a wakeup call for businesses too.

If those savings can be achieved within the domestic arena then what could a similar approach do for the nation's businesses? Domestic savings can pale in comparison with the benefits that switching-savvy businesses can make, if they switch to save.

Yet, when it comes to energy there's still a blind spot about switching. Utilitywise has recently spent time talking to business owners to see what they think about utilities. The conversations show that nearly half (47%) of businesses have never switched suppliers or tariffs, with one in five saying they didn't know that switching was an option for them.

Three-quarters of SMEs – which equates to approximately 3.9mn businesses – believe they pay too much for their utilities, yet almost the same number understand there are savings to be made.

Identifying barriers

So why aren't business bosses reaping the rewards of shopping

around? And what does that mean for the industry? For most SMEs it's the familiar story of being too busy being in business: 46% fear costs and fees attached to transferring to a new supplier and a similar number were worried about having more paperwork to do. Incredibly, over a quarter (27%) of businesses even believe that switching will cause a disruption to their energy supply and that they may be left for a period of time with no gas or electricity.

These insights go a long way to explaining some of the barriers and long-standing myths that have prevented more business owners from tackling their utilities provision. Yet, it also hints at a bigger problem. If businesspeople don't understand their utility costs, nor how to potentially reduce these, then what does this mean for businesses implementing energy efficiency practices?

In reality, the cost of energy is only one part of the equation. After all, the best value energy is the energy you don't use. That means educating end users so that they think about energy management from procurement – getting the best deal for their business – through to management and controls. By having more information at their fingertips business users can be more intelligent energy consumers.

More to do

While the news about domestic customers switching to get better energy deals is positive in terms of building a competitive marketplace and helping consumers understand more about energy, there is clearly more to do. It is undeniably daunting and more complicated for commercial enterprises to navigate switching as they may have a number of sites,

The government has led a successful campaign encouraging households to switch energy suppliers, but what about organisations? Andrew Richardson explains what businesses can learn from consumers when it comes to energy switching.

meters and different contracts – this is where working with a trusted advisor can help.

There is clearly a latent customer desire to have this type of third party help and endorsement to get a handle on energy and usage: over half of businesses (52%) we talked to reported that a feeling of taking the power back into their hands would encourage them to switch energy suppliers, on top of a financial motivation. A saving of £100–200 per year would be enough to encourage over one third of businesses to switch, and over a quarter already believe they would save up to £300 if they were to switch in 2015.

Before getting advice, 28% of customers did not think switching would be worth the hassle, 23% did not have time to do it and 16% found it too confusing. Yet, 68% of the Utilitywise customer base believes switching helps to make the market more competitive and 72% thinks it makes suppliers work harder to meet the customer's needs.

If the DECC campaign has shown anything it is that with a strategy to address the barriers to switching, and a clear incentive for taking action, the public can be motivated to act. By applying the same principles to the commercial sector – taking into account the subtle differences and added complexities – businesses could be similarly inspired.

Whilst we, and others in the industry, continue to act as trusted advisors to business customers, perhaps the next government will take the success of the DECC campaign and switch the audience focus to SMEs? That would be another switch to celebrate. ●

If businesspeople don't understand their utility costs, nor how to potentially reduce these, then what does this mean for businesses implementing energy efficiency practices?

Andrew Richardson is Deputy CEO of Utilitywise, www.utilitywise.com

AUTOMATION

One step closer to energy efficiency

As any other industry megatrend, energy efficiency brings with it a complex, and sometimes bewildering body of legislation and directives. Continuous assessment of what has been achieved and what can still be done is essential, which is why ISO standards and energy efficiency directives are constantly under revision.

The most recent of these is the Energy Savings Opportunity Scheme, or ESOS, established by the Department of Energy and Climate Change (DECC) as a response to the requirement for all European Union member states to implement Article 8 of the Energy Efficiency Directive.

ESOS basics

ESOS is a mandatory energy assessment and energy saving identification scheme for large companies in the UK. To clarify, 250 employees or more, or an annual turnover exceeding £39mn and a balance sheet exceeding £33.5mn qualifies a company as 'large'. If this sounds like your company, you have an obligation to comply.

ESOS participants need to measure total energy consumption across buildings, transport and industrial processes. Energy auditing activity dating back over the last four years can be used to support compliance in the first phase of the scheme, provided it meets the minimum requirements of ESOS. Alternatively, if you have an ISO 50001 energy management system covering your entire energy usage, that is sufficient to constitute an ESOS assessment. The first assessment has to be completed by 5 December 2015 for your business to be considered compliant. A report of the assessment, with recommended energy efficiency actions, needs to be submitted to the Environment Agency which administers the scheme.

Each organisation must also appoint a Lead Assessor to carry out and oversee the ESOS submission. These assessors can be internal or external to the

company, as long as they are members of an approved professional body register.

Organisations that have already undertaken energy audits to ESOS standards can use existing records to support ESOS compliance. The point isn't to make organisations do things twice, but to build on existing energy practices that work.

ESOS has been estimated to eventually lead to £1.6bn net benefits to the UK – that's about the cost of running 1.2mn standard light bulbs for a year. This is a conservative estimate, calculated on an average of 0.7% saving on energy bills.

Additional benefits

If cost and environmental reasons aren't enough to convince companies of the benefits of auditing energy through the ESOS scheme, there are additional advantages that might.

ESOS can help companies improve overall product quality, particularly when it comes to perishable goods like food and beverage. By carefully planning and controlling the processing chain, food and beverage manufacturers avoid waste and product degradation.

ESOS compliance can also help balance the energy usage across very complex manufacturing processes – sometimes in order to facilitate heating and cooling cycles. Energy efficient breweries, for example, can recover waste heat from wort coolers into the liquor stream with the aim of heating the next brew. This is the type of process insight that ESOS audits can give companies.

Last, but certainly not least on a list of obvious benefits a company could reap from an ESOS audit is staff wellbeing. Appropriate lighting and temperature are

While in the home it's relatively easy to ensure lights are not left on unnecessarily and electrical devices don't spend endless hours on standby. For large businesses it's considerably more difficult. Jonathan Wilkins looks at how automation can help, in the context of ESOS.

extremely important, not only in an office environment, but also on the shop floor.

Furthermore, many accidents occur because of lack of equipment maintenance. For example, if a company doesn't replace thermal insulation on steam pipe work every time it degrades, this can result in spiralling energy costs and injuries caused by exposure to hot surfaces. Similarly, motors and drives left to fall into disrepair might have exposed drive belts or cooling fans, which are unsafe and make a lot of noise.

An ESOS audit will spot these issues and propose the right measures to eliminate health and safety risks and reduce energy costs. Although these might seem like insignificant changes, ESOS recommendations can result in continuous process improvement and in the long run can bring huge energy savings.

Towards automation

There are some shocking industry facts with regards to energy efficiency, or rather, inefficiency. According to European Automation figures around 65% of the UK's industrial energy consumption comes from electric motors alone. That's a massive 20% of the UK's total energy consumption.

Using a variable speed drive (VSD) on a motor can severely reduce energy consumption, in some cases by as much as 60%. It's therefore surprising that these humble devices are often neglected or even fitted improperly, rendering them useless.

Forgetting the financial costs of not implementing a VSD for a second, if just half of Britain's electric motors were reduced in speed by 10%, it would have the net effect of mitigating the carbon emissions of 9.8mn executive saloon cars every year.

Industrial automation helps companies achieve high productivity and energy savings, while also monitoring and recording the manufacturing process

Industrial automation helps companies achieve high productivity and energy savings, while also monitoring and recording the manufacturing process. Just like with ESOS, the first step is an in-depth analysis of existing systems and processes. Organisations should realistically evaluate what savings can be achieved by modernising existing systems and what investments need to be made.

Intelligent measurement technology, process automation and electric drives technology are only some of the solutions for skilful energy management. The road to energy efficiency starts with the basic principles of energy recovery and optimised processes and products.

When discussing the core technologies that can help the manufacturing sector become energy efficient, integrated communication is first on the list. This refers to creating components that can be connected in an open architecture – components able to gather real-time information and take instructions from intelligent control systems.

Second, advanced control methods like programmable logic controllers should monitor,

diagnose, increase system efficiency and solve problems. The data gathered and stored should then be analysed and used to make further enhancements to the system.

The technologies necessary for implementing intelligent industrial automation systems are already available and their capabilities are always improving. Accurate sensors and measurement devices, control and monitoring methods, Ethernet or other Internet-based industrial communication standards, as well as simple, safe user interfaces are already in operation on many shop floors.

So if you're a large company involved with ESOS, you might want to think about some cost and energy efficient tactics. It could benefit billions of people in the long run.

Jonathan Wilkins is Marketing Manager of European Automation, www.euautomation.com

The Energy Institute's Register of Professional Energy Consultants and register of Chartered Energy Managers are both approved as meeting the required standards to act as ESOS Lead Assessors. For more information on these and ESOS in general, and to view the registers, visit efficiency.energyinst.org

Industrial automation for industry

Whether it's on the premises – by revamping or purchasing new equipment – in the supply chain or in building maintenance, any energy saving technique will count towards reducing production costs and improving a company's carbon footprint and sustainability.

A popular offender is the electric motor. Statistics show that about a third of electricity produced globally is used by these energy-hungry devices. By purchasing efficient motors, such as IE3 and IE4 class units, and fitting older motors in variable speed applications with VSDs, energy savings can go up to 60% for each motor.

Increasing factory and process automation in the long run can then be looked at. Up to 80% of the savings a manufacturer can make come from improved

automation – and many of these savings are a result of reducing energy consumption.

By implementing intelligent automation solutions such as lighting or building controls, remote monitoring and self-diagnosis systems, energy consumption can be drastically reduced.

Plant floor equipment is gradually becoming more digitised and connected, able to perform high value asset and process monitoring and diagnostics. And this could all be available in real time across operations, facilities and even the supply chain.

The Internet-of-Things scenario is still a few years away, but manufacturers should keep an eye open for existing or upcoming technologies that can help them reduce energy consumption.

Is your company ready for ESOS? Ask the experts



RPEC

The Register of Professional Energy Consultants (RPEC) is the register of expert energy consultants, experienced professionals with a proven track record of helping businesses achieve real energy savings in a range of sectors and technologies.

Chartered Energy Managers

Chartered Energy Managers have met the high professional standards required to help businesses manage their energy effectively.

RPEC and Register of Chartered Energy Managers – ESOS approved

The Environment Agency has approved both RPEC and the Register of Chartered Energy Managers to act as ESOS Lead Assessors.

For more information, or to find an energy savings expert, visit:

www.energyinst.org/ESOS-Lead-Assessor

Reducing energy costs for your business
efficiency.energyinst.org

Reaching a turning point

Reform of the EU Emissions Trading Scheme has become a necessity for it to maintain relevance, writes Sarah Deblock, EU Policy Director, IETA.

Discussions to reform the EU's Emissions Trading System (EU ETS) have been ongoing for years. After a proposal to 'temporarily fix' the EU ETS by delaying the auction of some carbon allowances at a time of oversupply, another proposal to change the basic design of the system is now being considered, by introducing flexibility in the supply of EU allowances (EUAs) via the creation of a reserve.

This market stability reserve (MSR) aims to introduce greater flexibility in the EU ETS, and move away from a fixed supply that is non-responsive to changes in demand levels for allowances. The proposal is to move surplus carbon allowances into a reserve if it exceeds a certain threshold that is set in legislation, and return them to market when insufficient allowances are available. While this reserve may at first glance seem like a common-sense proposal, it has faced strong political challenges.

Necessary reform

The EU ETS was one of the first cap-and-trade systems targeting greenhouse gas (GHG) emissions ever created. It is easy to look back now and see its faults, but very few could have predicted the difficulties that the world's largest ETS would face. The over-allocation of free allowances in the first two phases contributed to the surplus that currently exists in the system. Moreover, the EU ETS was unable to adapt to changing circumstances when the economic crisis worsened in 2008, which led to an unexpected and sudden drop in demand.

Faced with some of these challenges, the surplus in the EU ETS grew. At the start of Phase III (2013–2020) the surplus had grown to more than 2bn allowances, which is equivalent to a year's emissions. As a result, the price of EUAs has collapsed to a level that

no longer drives the necessary carbon abatement levels and is not providing the incentive for mid-to long-term emission reductions, nor does it provide any reward for investments in low carbon technologies. Consequently, pressure for additional policies to be introduced has grown to meet both these objectives. Some European member states have introduced national measures to reduce emissions further or to add to the cost of pollution.

For example, the UK has introduced a minimum carbon floor price that UK-based operators have to pay in addition to the price of EUAs. Germany is considering imposing a threshold for old coal-fired power plants, whereby operators would have to buy extra EUAs for any emissions above the threshold, which are likely then to be cancelled. These national policies add costs to business and distort competition between operators in different EU member states.

Despite these examples of national policies, EU heads of state recently reaffirmed their support for the EU ETS to play a central role in cutting the bloc's emissions. With a strong EU ETS, the pressure to introduce additional policies will diminish. The focus is not so much on whether the EU ETS should be the central policy instrument of the EU, but how it should be reformed to ensure it drives the necessary emission reductions. Political negotiations on the MSR are coming to a close and a provisional compromise agreement was reached in early May. We could, therefore, expect a formal adoption some time around summer. The main points of negotiation were the start date of the MSR, for which an agreement was reached to begin in 2019 (two years earlier than the Commission's original proposal); and whether the unallocated allowances from Phase III of the EU ETS should return to market, as is

foreseen in the existing ETS Directive, or be placed in the reserve that was provisionally agreed early May. There is agreement amongst European institutions to place the 900mn backloaded allowances into the MSR rather than auction them in 2019–2020 as originally intended.

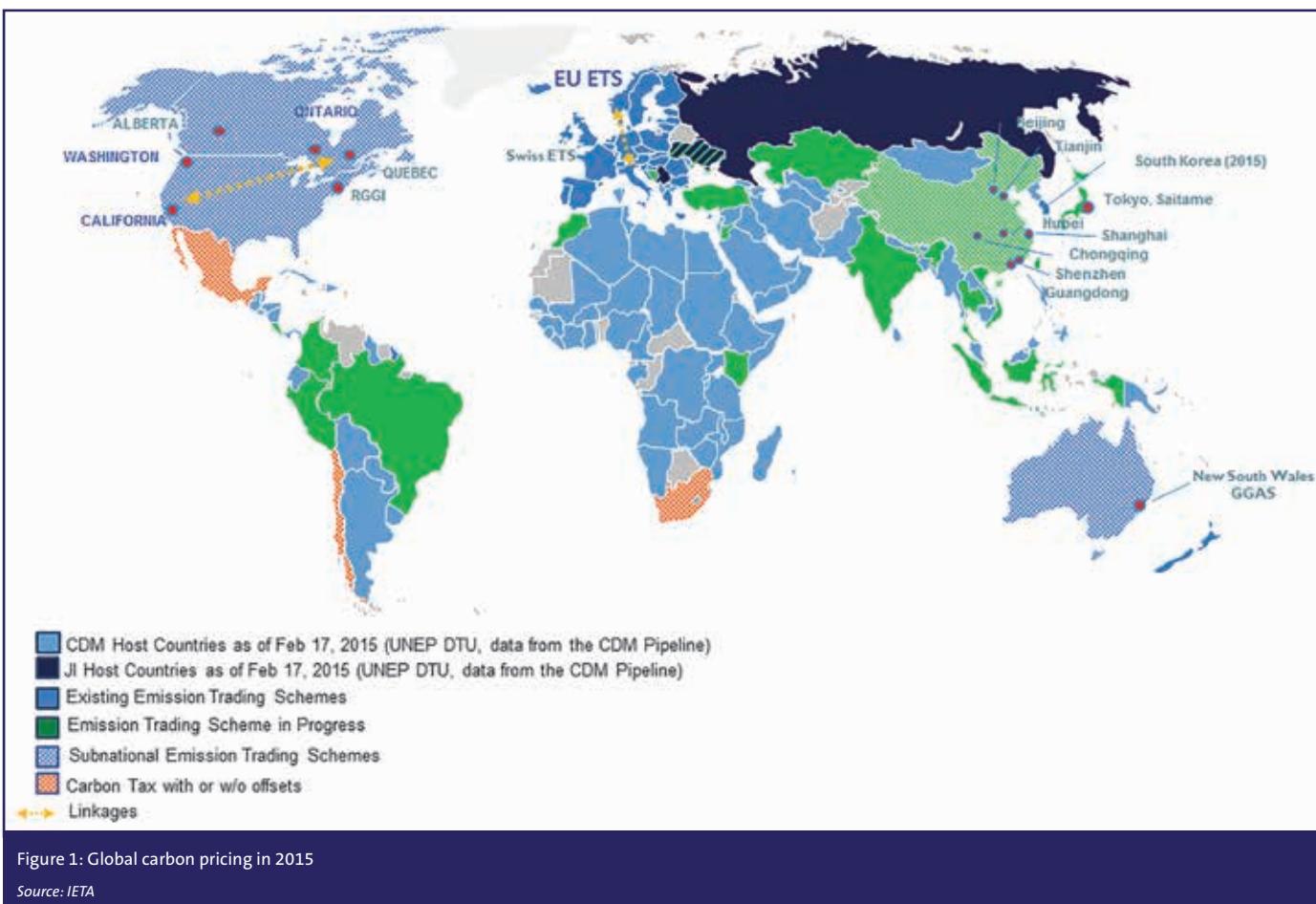
Post-2020 goals

The EU has set itself a long-term goal to reduce GHG emissions by 80–95% by 2050, compared to 1990 levels, as part of efforts by developed countries as a group to reduce their emissions by a similar degree. Its mid-term target is a reduction of at least 40% by 2030 compared to 1990, which will mean a 43% reduction for sectors covered by the ETS compared to 2005 levels. This 2030 target is in line with the lower-end range of the EU's 2050 ambition. Substantial effort to reduce emissions will be expected, and ensuring it is conducted in the most cost-effective manner is important for those sectors covered by the ETS that need to adapt their production processes to reduce their emissions over the medium to long-term.

The EU has been one of the parties encouraging project-based flexible mechanisms, such as the Clean Development Mechanism and the Joint Implementation, to be part of the UN climate change framework. There have been benefits from developing such market linkages between jurisdictions such as technology transfer, climate finance and independently verified emission reductions, which resulted in international credits that could be used in the EU ETS. However, the EU's most recent approach is to focus its emission reductions at the domestic level only after 2020, without the use of international credits.

The EU has a dual objective in the run-up to international climate change talks in Paris at the end of the year, which are expected to see a new agreement reached. The first is to reform its own system and tackle the structural surplus; and the other is to keep its options open, to allow cost-effective

The price of EUAs has collapsed to a level that no longer drives the necessary carbon abatement levels and is not providing the incentive for mid- to long-term emission reductions



abatement options to develop and linkages between other countries to emerge. Setting a minimum target to be met through domestic means does not prejudge the final outcome of the target that the EU will put forward, and it is possible that the 40% target could be increased and met with the use of international credits.

From a longer-term perspective, allowing international credits will be necessary to ensure the most cost-effective carbon abatement options develop. The current reform of the EU ETS can help address the current challenges, but it's also important to have in place policies for the longer-term objective that the EU is aiming for – towards a near full-decarbonisation of its economy, for which all flexible options need to be explored.

Market role

The EU's example highlights some of the challenges that an ETS can face. But efforts to reform the EU ETS are to ensure it is restored as the EU's central climate policy instrument, as there are significant benefits from relying on carbon markets – not least the fact that it achieves an environmental objective at the

least possible cost, unlike other pricing options such as a carbon tax. Emissions trading schemes and carbon pricing mechanisms are increasingly becoming the preferred instrument towards decarbonisation of the world's economies. According to the World Bank¹, 40 countries and more than 20 sub-national regions have put a price on carbon, and many more are scheduled to be introduced. Altogether, these actions will represent nearly half of the world's carbon dioxide emissions.

This strong momentum for developing carbon pricing approaches is particularly relevant in the run-up to Paris as climate negotiators work out a text that will set the basic framework to allow countries and regions around the world to reduce their emissions to the agreed level of 2°C. A bottom-up rise of carbon pricing policies means it is important for the Paris agreement to recognise the role of carbon markets, and set the basic rules that will allow these various policies to be compared and, more importantly, linked with each other. Ideally the Paris agreement will provide detailed guidance on how each party's carbon pricing policies can be used to meet their

national contributions. In practice, however, the Paris agreement is likely to be short and provide just the basic foundation that will enable future decisions to emerge at a later stage. As a minimum, it should therefore include clear provisions that mitigation-unit transfers can count towards a party's emission-reduction contribution.

An explicit recognition of the role of carbon markets in the Paris agreement is likely to encourage more jurisdictions to take action and enable the cheapest abatement options to develop globally. A market-based approach offers the flexibility that businesses need to cut emissions without harming the wider economy, but still sends the right price signal for low carbon investments.

If the world's governments are serious about limiting global warming to 2°C, the time to act is now – and markets will get us there faster and cheaper than other alternatives. ●

1. <http://www.worldbank.org/en/programs/pricing-carbon>

DIRECT CURRENT

DC electricity is becoming relevant again

Solar PV, fuel cells, LED lighting, mechanical ventilation systems, even electric vehicles – all generate or use direct, rather than alternating, current and the time has come to consider the use of DC distribution systems within buildings, writes Ian Billington.

The use of LEDs has risen exponentially in the last decade and has now become the standard source of lighting in new building and also in TV and other display screens. On the generation side, solar photovoltaic (PV) technology is being installed in ever increasing amounts and fuel cells are potentially becoming economically viable. This is confirmed by publication by the Institution of Engineering and Technology (IET) of a code of practice on direct current (DC) power distribution in buildings¹.

DC loads

With all digital electronics devices, from mobile phones to personal computers, also requiring DC power, the 'base' electrical load in most new homes is now mainly from DC sources. DC fan coil units (used for the distribution of space heating and cooling) are typically 50% more efficient than their alternating current (AC) versions, offer seamless change in fan speed, and operate on a 0–10 V DC supply. Mechanical ventilation with heat recovery (MVHR) units – used for ventilation on the majority of new build housing – also generally use DC fan motors with 0–10 V input. Another potential major DC load in the future is electrical vehicles.

Typical voltages and power draw for a range of typical applications are:

- mobile phones and tablets – 5 V;
- TV and PC Screens – 24V;
- PCs (typically 500–900 W rating, with 100–240 V AC in, 12 V DC out);
- motors (MVHR, fan coil unit) – typical 0–10 V; and
- electric vehicles – 330 V for i-MiEV, 360 V for BMWi3 and Zoe.

DC generation and storage

On the generation side, PV has been around for a considerable time generating DC power, but only during the day. Its output depends on the solar density, which results in a typical load factor (percentage of continuous rated output against actual output for a typical year) in the UK in the region of only 8%. This does not preclude the use of PV as a source of electricity generation, particularly with battery storage, but does impact on its economic viability. Fuel cells, which generate electricity output at DC, are potentially a future game changer.

There are a number of types of PV; these are arranged with the individual cells configured into arrays and then the arrays connected together to produce the output voltage at the point of connection, which can be up to 600 V (prior to inversion) for large PV sites with multiple arrays.

Fuel cells broadly fall into two camps; low and high temperature. High temperature cells (200°C–1,100°C) giving greater power output – typically 100 MW plus, and low temperature cells (20°C–100°C) have outputs of 100 kW or less. There are exceptions to these very broad groups. Low temperature fuel cells can be configured to give a set voltage output with a constant input to the fuel cell.

A number of storage options are available; the most common being 'chemical conversion' such as static batteries or fuel cells. Both being DC they can accept direct connection from PV arrays or store the gas input to the fuel cell (the gas acts as the storage medium).

Voltage conversion

The AC transmission and distribution network is in place with standards harmonised across Europe at 230 V (single phase) and 400 V (three phase). All electrical

equipment is currently designed to suit an AC network connection with DC loads connected mainly via a switched mode power supply unit, which takes the standard AC and converts this to the required voltage and at DC. These power supply units are often less than 80% efficient, although a number of bodies offer approval schemes to encourage (with labelling on devices) improved efficiency.

By removing the need to convert from AC to DC a number of stages in the voltage conversion process are removed, so increasing the conversion efficiency (from an efficient AC/DC voltage conversion of 85% to closer to 90% with DC/DC voltage conversion).

The removal of the need to change voltage (between the generated voltage and the required voltage of the DC load) is unlikely in the near future due generating voltages being significantly higher than most commercial or domestic DC load items, with the potential exception of electric car charging.

DC in the home

Given the efficiency gain in DC to DC step-up or step-down voltage conversion, where DC generation is located close to the served DC load, there is benefit in DC distribution between the two, as would clearly be the case with storage of DC-generated electricity with batteries.

At a domestic scale, Hoare Lea carried out a study in collaboration with Moixa Energy into the use of battery storage to supply DC lighting and 5 V DC USB outlets (for portable devices such as tablets and phones) in a typical dwelling.

Adding a PV array to the scenario – the battery allows the variable output of the PV to balance with the various DC loads within the apartment, with direct DC/DC conversion from a typical 50 V PV array output to 12 V for the LED lighting and 5 V for the USB circuit

The battery allows the variable output of the PV to balance with the various DC loads within the apartment, with direct DC/DC conversion from a typical 50 V PV array output to 12 V for the LED lighting and 5 V for the USB circuit



The Hoare Lea/Moxia Energy demonstration project – battery and DC voltage converter enclosures

circuit. With the whole house ventilation also connected to the system, the whole house is illuminated and ventilated, with some of modern life essentials such as mobile phones and tablets also benefiting. Many homes now have PV systems on their roofs so this is a real option available commercially now.

Moving forward

Moving forward, there are two significant changes on the horizon:

electric car charging and fuel cells. Currently, a typical electric car (based on a Renault Zoe, 4-door family car) requires 22 kWh of charge for a 100-mile journey (full charge); this requires either a rapid 1-hour charge (61 A at 360 V DC) or more of a typical charge over 7 hours (8.7 A at 360 V DC). Even the 43 kW rated rapid charge point found in locations such as motorway service stations takes just under half an hour for a full recharge (approximately 120 A at 360 V).

On an individual dwelling basis, you would need 92 m² of PV (8 m² per 1 kW peak with a capacity factor of 8%) to charge a car each day (for a full 100-mile recharge over seven hours), with battery storage to align the PV output to when the car charging is required (most likely overnight). The fuel cell voltage is more likely to be matched to the electric car and would be more viable in terms of space take.

Conclusions

Large scale thermal power stations (coal, gas, nuclear and oil-fired), together with the transmission and distribution network, are AC-focused, with the exception HVDC interconnections linking large networks (such as the links from

the UK to France and Scandinavia) to avoid the need to operate in synchronism. This is not about to change.

DC will develop on a large scale with the need for rapid car charging (or battery changeover) stations replacing petrol stations. It is foreseeable that such facilities could have local power generation from PV and/or fuel cells with a significant reduction in losses by removing the need for AC to DC voltage conversion.

PV costs have dropped significantly in a very short time, with the US Department of Energy reporting a reduction from 21 c/kWh to 11 c/kWh between 2010 and 2013, with less than 4 c/kWh being for the PV module. Local connection of DC generation to DC loads with internal DC distribution will become more commonplace.

The added advantages of DC storage options could lead to the operating range of national distribution networks broadening to effectively expand capacity of the existing network assets. ●

Ian Billington, is a partner with Hoare Lea, www.hoarelea.com

1. *Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings*, The Institution of Engineering and Technology, April 2015.



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Model community breaks ground in energy network sophistication

Panasonic, along with a group of other players, is building an intelligent, energy efficient town south of Tokyo. Julian Ryall took the tour.

Towns of the future – efficient, energy neutral, safe and truly communal – may look a lot like the Fujisawa Sustainable Smart Town (SST), in Japan.

Energy World had the opportunity to tour this pioneering project, located 50 km south of central Tokyo. It is the brainchild of the Panasonic Corporation and 17 other companies, including Tokyo Gas Co, Nippon Telegraph and Telephone East Corp, Sohgo Security Services Co and Sumitomo Mitsui Trust Bank. All are keen to put their cutting-edge technologies in the areas of energy, construction, security and the utilities to the test at the project.

The first families have moved into the initial phase of the community (pictured), which is built on a 19 ha plot that was formerly the site of three production plants for home appliances manufacturer Panasonic, and the ground has been broken on phase two.

When it is completed, the Japanese Yen JPY60bn (US\$502mn) development will be home to around 3,000 people in 600 detached homes and 400 apartments. It will include transport and shopping facilities, restaurants, communal centres, parks and a 'Wellness Square' that will provide special nursing facilities for the elderly alongside a clinic, childcare centre and sheltered accommodation.

The concept, Panasonic noted, is on a grand scale. 'We have a 100-year vision for the entire project and we believe that the most important thing is how we make this community evolve sustainably and constantly over that timeframe,' said Hiroyuki Morita, Chief of Panasonic's Business Solutions Division.

This idea has also been applauded by energy sector analysts. 'It is a very important project and I believe that it has



Each home in Panasonic's Fujisawa Sustainable Smart Town is fitted with solar panels and storage batteries

Photo: Panasonic

great potential to showcase many energy-related devices and systems that were just ideas only a few years ago,' said Dr Kaoru Yamaguchi, a Senior Economist with the Tokyo-based Institute of Energy Economics, Japan.

'The Fujisawa project demonstrates just how energy can be used efficiently, and that is on both the supply side and the demand side,' he said. 'We are able to better see how demand can be controlled and energy can be most efficiently used. This is going to permit us to improve energy consumption in Japan and promote new Japanese technologies,' he added.

But while the Fujisawa SST blueprint could be transplanted in Japan, Mr Yamaguchi believes, it may be more difficult to export the concept.

'Japan is very sensitive to the two issues of energy pricing and security,' he said, pointing out that

this nation is largely reliant on imported energy to meet its needs. That reliance on imports – primarily coal, gas and petroleum products – has been even more acute since the March 2011 accident at the Fukushima Daiichi nuclear plant. Even today, more than four years after the disaster, every one of Japan's nuclear power plants remains mothballed.

'While this sort of community is working here, it may not be suitable for places like the US, where energy is more plentiful and affordable,' Mr Yamaguchi said.

Big ambitions

The proposal for a community that incorporates the best practices gleaned from all of the companies involved was first broached in 2008. The first residents were able to move in last year and the plan is for the town to be physically completed in 2018, said Morita.



When it is completed, the smart town will be home to around 3,000 people in 600 detached homes and 400 apartments

Photo: Panasonic

The following 30 years have been designated as the growth period, which will be followed by a three-decade maturation phase and, to round out the century, the evolution period.

Working with the local city authorities, Panasonic and the other companies want the community to become the template for future cities, utilising technology for generating energy from renewable sources – primarily solar – and then storing that energy for later use or selling it back to the grid. In total, the new town will have 3 MW of solar modules.

Using renewables and other innovations in high-tech smart grids, and advanced and sustainable architecture, designers have set themselves ambitious performance targets: the community's carbon dioxide emissions will be 70% lower than a comparable town in 1990; water consumption will be 30% less than 2006 levels; and more than 30% of energy used will be from renewable sources.

An added element – and an important consideration after Japan recently marked the fourth anniversary of the 'Great East Japan Earthquake' which swamped Fukushima – is the incorporation of a 'Community Continuity Plan'. This means energy stored in batteries – along with emergency food supplies, temporary shelter and first aid equipment – is stored at the centrally located Committee Centre. Sufficient energy is stored to provide heat and lighting to the

building for three days, along with provisions.

Smart homes

Central to the community, however, are the homes. The detached houses of 120 m² are selling at around JPY50mn (\$419,000), being fitted with all the latest enhancements, including the most cutting-edge energy-saving kitchen appliances, lighting that is activated when a person approaches and solar modules covering the roofs. The apartments have yet to be built and Panasonic has yet to decide on costs or available enhancements for these properties.

Residents are able to choose between an all-electric energy system or a fuel cell-equipped home, with a cupboard in the entrance hall housing a lithium-ion battery for storing energy. A portable tablet device enables the residents to access the home energy management system and monitor the power being generated and where it is being consumed. The handheld system, which is also accessible via the television, connects the other homes in the community and enables people to find out about and sign up for social events.

Devices managing the power consumed by each of the home appliances are integrated into the Panasonic 'Smart Home Energy Management System', which tells the homeowner how much energy is being used. Residents claim on Panasonic-supplied videos that this

encourages them to cut back on consumption where it is not needed.

'Residents can check the amount of electricity their homes are generating and the energy they are consuming, as well as the amount that the entire town is using, through their television, smartphone or tablet at their home,' said Masako Wada, a senior member of Panasonic's Fujisawa SST team.

'This ability to visualise the progress they are making towards the town's environmental targets has made them more conscious of the environment,' she added. There is also a growing understanding of the importance of insulating homes, something that is lacking in most properties here, with the houses even incorporating insulating glass in windows and doors.

Detached homes are fitted with Panasonic's latest 'Energy Creation-storage Linked System for Home', which connects a solar power generation system or storage battery to the Panasonic ENE-FARM household fuel cell cogeneration system. Electric power generated by different systems can be used to meet the requirements of the household, and the excess power can be sold.

In the future, Panasonic intends to link individual houses to a broader building energy management system of facilities within the town to create a group that can share energy. Linked further beyond that will be the 'community energy management system' for the entire town.

Getting around

The town's streets are the first in Japan to be illuminated by newly designed LED security lamps, powered by solar panels and utilising sensors to detect pedestrians, turning on when they are present, while a network of 47 surveillance cameras provide 'security without gates', Panasonic said.

And while much of the development has been focused on installing energy systems utilising renewable sources to power homes, shops and communal facilities, a major part of the project is focused on creating a town that is active, yet does not require each and every one of the residents to have their own car. That, inevitably, helps to reduce emissions from vehicles. There are also no petrol stations marked in the schematic of the town.

The concept is for 'entirely new, total mobility services for all

Residents are able to choose between an all-electric energy system or a fuel cell-equipped home, with a cupboard in the entrance hall housing a lithium-ion battery for storing energy

residents,' said Wada. Shared electric vehicles can be reserved online or through the interactive televisions in each of the community's homes. The vehicles are simply picked up from one of the designated electric vehicle refuelling spots that are dotted throughout the site and where the previous user parked them.

Similarly, electric scooters and bicycles that have been enhanced through the addition of lithium-ion batteries are available for all residents to use.

'These days, traffic jams can be seen regularly around Fujisawa, with long lines of vehicles heading for tourist spots – especially on holidays,' said Wada. 'Our mobility sharing services will contribute to the solution to the social problem of traffic gridlock.'

'Mobility innovations in the Fujisawa SST will benefit residents, the environment and the regional community,' she added. 'Fujisawa mobility will help create a flexible and comfortable relationship between residents and their cars.'

Through the community's online Total Mobility Service Centre, residents are able to inquire about the availability of vehicles and make a reservation for a time and specific pick-up spot. An online

concierge service even offers advice on local places to go and activities to do – as well as providing warnings on road conditions, roadwork and other potential hold-ups. Available through a user's smartphone or the interactive television at home, it also permits the driver to monitor the distance travelled and how much carbon dioxide emissions they have prevented by using communal equipment.

'We are also planning a battery sharing service, which will enable residents to replace and use batteries for electric scooters and electric-assisted bicycles,' Ms Wada said. The system will ensure that replacement batteries are provided at different locations around the community – all within easy walking distance – so that users do not have to recharge their own batteries or worry about the amount of power left.

The battery exchange sites will be linked to parking spaces that have solar panels on their roofs and will automatically recharge the batteries.

Panasonic is even factoring in the environmental requirements that have been added to the mandatory automobile inspections for all vehicles. Vehicles are monitored to determine their

emissions and cars that meet the standards will have 'eco clean' stickers attached – a strategy designed to minimise the release of carbon monoxide, carbon hydride, nitrogen oxide and 'dark smoke', as well as carbon dioxide. While preserving human health and the environment, Panasonic hopes the system will also raise awareness of available solutions.

Town participation

Morita is also keen to emphasise the difference between the Fujisawa project and other smart towns elsewhere, pointing out that this community is service-oriented rather than focused solely on the products and technology that can be applied. Residents here commit to playing a central role in the management of their town rather than having decisions made by local governments.

Panasonic is also not looking to make a profit from Fujisawa: 'The town is on target to break even this year, but any profit that we do make in the future we intend to invest back into the community,' Morita said. ●

'Residents can check the amount of electricity their homes are generating and the energy they are consuming, as well as the amount that the entire town is using, through their television, smartphone or tablet at their home'

**Masako Wada,
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