

Modern Energy

Tuesday June 4 2013

www.ft.com/reports | twitter.com/ftreports

'Invisible fuel' promises more secure future

As oil and gas become more difficult to extract, energy efficiency represents one of the world's primary resources, says *Guy Chazan*

When energy economists gaze into their crystal balls to see what the world will look like in 20 years' time, some things are clearer than others.

Clearer of all is that the global population will grow and with it the world economy. As countries get richer, their demand for energy will rise, placing ever new strains on the planet's natural resources.

A closer look at forecasts for energy demand, however, reveals some surprising conclusions.

Consider ExxonMobil's annual energy outlook to 2040. The company says that total energy demand is growing: the world will need

35 per cent more energy in 2040 than it does now. That growth rate pales in comparison with that of the world economy as a whole: Exxon says global GDP will expand by 135 per cent over the same period. What is more, in the world's advanced economies – Europe, North America and Japan – energy demand will not grow at all.

The reason for this is energy efficiency. "The greatest source of energy in the future will be using it more efficiently," says Bill Colton, Exxon's vice-president for corporate strategy, and one of the authors of the outlook. "Huge amounts of energy will be saved in this way."

In the battle against climate change, renewables were long seen as the

silver bullet. The argument was that replacing fossil fuels with wind and solar power would reduce carbon emissions and thereby slow or even stop global warming, as well as curb consuming countries' huge dependence on expensive imported oil and gas. But in the debate about our energy future, the theme of energy efficiency – called the "invisible fuel" by some – is taking on a new prominence. Consumers are starting to understand that the energy they do not use can have almost as much impact as the energy they do.

The result is a shift in thinking about everything from building design to street lighting. That means the future of energy is no longer the

preserve of oil companies, wind farm developers and government officials, but of everyone from architects and appliance manufacturers to civil engineers and carmakers. Big energy savings have been achieved by seemingly minor technological changes such as moving from gas boilers for space heating to heat pumps.

The potential prize is enormous. A recent report by the Fraunhofer Institute for Systems and Innovation Research in Germany found that the EU's energy requirements could end up being 57 per cent lower in 2050 than they were in 1990, offering the tantalising prospect of €500bn a year in energy savings.

The institute says energy use in

buildings could be cut by 71 per cent, mainly through better insulation, modern construction technology and energy efficient heating and hot water systems. In transportation, improvements in traffic management and better logistics could result in energy savings of 53 per cent, while more efficient steam generation and electric motors could help reduce industrial energy demand by 52 per cent.

Cumulative spending on such measures is growing fast. The International Energy Agency (IEA) says that in 2011 \$180bn was invested globally in projects aimed at improving energy efficiency. Yet that is a paltry sum

Continued on Page 2



Sustainable living: Beddington Zero Energy Development is the UK's largest and first carbon-neutral eco-community

Inside »

Sun shines on photovoltaics

Subsidy and price cuts point to more competition

Page 2

Wood pellets muscle in on coal

Hungry boilers need fresh supply chain

Page 2

Offshore wind gains ground

New generation of farms gives cause for optimism

Page 3

Nuclear moves

Industry must compete on cost in future energy mix

Page 3

Passive power

Quality of life at home trumps burning desire for efficiency

Page 4

OIL COMPANIES SHOULD SUPPORT THE COMMUNITIES THEY'RE A PART OF.

WE AGREE.

Dr. Mark Dybul
Executive Director
The Global Fund to Fight AIDS, Tuberculosis and Malaria

Rhonda Zygocki
Executive Vice President,
Policy and Planning
Chevron

Healthy businesses need healthy communities. Jobs, education, and healthcare are essential. We've helped provide microloans to thousands of entrepreneurs in Angola. We've funded polytechnic universities in Indonesia. And we've played a part in saving 8.7 million lives through our support of the Global Fund to Fight AIDS, Tuberculosis and Malaria. We're making a difference where it matters. Because the truth is, our business depends on thriving communities. Learn more at chevron.com/weagree

CHEVRON, the CHEVRON logo and HUMAN ENERGY are registered trademarks of Chevron Intellectual Property LLC. © 2013 Chevron U.S.A. Inc. All rights reserved.

Modern Energy

Battle rages over fracking as reserves sought

Shale gas

Michael Kavanagh says a heated debate may be getting ahead of itself

The German brewing industry has become the latest lobby group to set its face against the expansion of hydraulic fracturing for gas and oil in Europe.

Last month the Deutscher Brauer-Bund, the brewers' association, issued an open letter to government ministers warning that fracking in Germany could threaten the purity of water as demanded by the "Reinheitsgebot", or German purity law.

The law, which dates from 1516, mandates that brewers produce beer using only malt, hops, yeast and water.

The association argues that more than half of Germany's brewers have wells

from which they draw their water in areas that would not be protected under planned fracking laws.

It has called on Berlin to back research to ensure that chemicals used in fracking are not capable of polluting groundwater before widescale fracking is allowed.

In European countries such as France and the Netherlands, fracking remains banned, while in Poland exploration drilling has proved disappointing.

Campaign groups in the UK are gathering strength following moves to reopen the door to fracking.

In May thousands of protesters in Romania took to the streets claiming prime minister Victor Ponta had reversed his anti-fracking stance by allowing a moratorium applying to Chevron and others to lapse.

But the debate is not going the same way everywhere. At last month's European Council – a gathering of EU member states'

heads of government – Poland's prime minister Donald Tusk and his British counterpart David Cameron pointed to the potential of shale, from which gas is extracted by the fracking process, to add to the indigenous mix of energy sources.

The summit agreed that expanding the EU's domestic sources of energy was key to cutting the union's "external energy dependency" and stimulating economic growth.

But, as governments and lobby groups across Europe continue to argue over the best path towards exploiting shale reserves while protecting the environment, many warn that the heated debate is getting ahead of itself. What if commercially viable shale reserves are just not available across much of Europe?

In the UK, many proponents of shale gas exploration await a British Geological Survey report they hope could suggest that the

extent of Britain's reserves had been vastly underestimated. Experts caution that any revised estimate will still not provide a useful guide on whether the UK can expect a shale gas bonanza.

A recent panel debate on energy policy held in parliament suggested that the

'The only way to find out what is there, is to do substantial drilling'

updated estimates provided by the survey would provide little guide to the commercial potential of the UK's shale reserves. The issue for the UK – and the rest of Europe – is whether the quality of shale lends itself to releasing hydrocarbons on the scale experienced in the US.

Professor Jim Skea,

member of the government-endorsed advisory body the Committee on Climate Change, told the panel in April that any revisions to the survey meant simply that "we will just get a more expert version of 'we don't really know yet'".

Peter Lilley, Conservative member of the parliamentary energy and climate change committee, concurred, saying the survey in itself would do little to prove the extent of the UK's commercially useful reserves. "The only way to find out what is there, is to do substantial drilling," Mr Lilley said.

Even companies at the centre of onshore exploration agree the debate over fracking could prove redundant unless it is demonstrated through drilling that commercial deposits exist.

"It's a fabulously English thing to try and divide up the riches before we've actually worked out whether or not we've got

them in the first place," says Andrew Austin, chief executive of IGas, which holds onshore UK licences. "We don't know whether the shale in this country will flow or not but the central argument is that the country deserves to find out. If it doesn't work, the rest of the conversation is entirely academic. The advantage we do have is that the one well that has been flow tested in the UK did flow at good rates, which is encouraging."

Faith, as much as science then, is shaping the debate over whether the UK and the rest of Europe can replicate the shale gas and oil boom of the US and elsewhere in the Americas.

As Mr Lilley, the UK parliamentarian, noted wryly: "Unless God is an American, and has only put shale gas in the United States, it is inconceivable, or extremely unlikely, that this technology won't have an impact on supply and demand elsewhere."

Sun shines on developing photovoltaic industry

Solar power Cuts to subsidies and tumbling prices for equipment have the potential to lead to more competition, says *Pilita Clark*

The first six months of 2013 have not been the most dazzling for the world's solar industry.

First came news that solar superpower Germany was looking at paring back the generous subsidy system that has helped it build more than 32 gigawatts of installed solar photovoltaic capacity – nearly a third of the global total and more than any other country.

Then came bankruptcy at the main operating subsidiary of Suntech, the Chinese company that was once the world's biggest solar panel producer.

Last month, it emerged that Brussels was looking at imposing duties averaging 47 per cent on Chinese solar equipment imports into the EU, in what is shaping up to be one of the bloc's biggest trade cases.

At the same time, the European solar industry reported that the amount of new solar power installed in Europe fell sharply for the first time in more than a decade in 2012, in what it called a "turning point in the global PV market that will have profound implications in coming years".

As growth shifts from Europe, long a champion of climate-driven energy policies, to countries with varying degrees of solar potential and the political will to exploit it, the global market's growth remains uncertain in 2013, argues the European Photovoltaic Industry Association.

"The factors lined up against the continued strong growth of PV in Europe and around the world are formidable," it said. They range from continuing economic and financial weakness to industry consolidation and regulatory instability, as governments reconsider their commitment to renewable energy sources and action on climate change.

Amid the gloom, however, 2013 may be a turning point of a far more

optimistic kind for the still youthful solar PV industry because it also features a growing number of cases of so-called grid parity – the point at which electricity from solar PV is as cheap as conventional electric power.

This is something of a holy grail for the PV market, which has shot up from just 1.4 gigawatts (GW) of global installed capacity in 2000 to a record 102GW in 2012. It raises the prospect of companies finally being able to operate without relying on subsidies that have become increasingly controversial in crisis-struck Europe and remain a sensitive issue elsewhere.

Tumbling prices of solar equipment is one reason for the shift because they have made solar power more affordable than ever before.

Average PV module prices have fallen more than 80 per cent since 2008, amid a glut in supply that has caught out manufacturers such as Suntech, but opened new doors for companies supplying solar systems.

"The falling cost of solar is creating a lot of opportunities for unsubsidised solar," says analyst Jenny Chase of research group Bloomberg New Energy Finance. "A lot of countries are going through a transition from high to very low or nominal subsidies. Spain is one of the first countries we are seeing build without subsidies but it's certainly not the only place. It is also happening in Chile and the Netherlands."

Spain is an obvious place for such construction, given the extent to which it has cut back on the solar subsidies that helped give it 5 per cent of global installed PV capacity.

The German solar system supplier, Conergy, says it has worked on 15 unsubsidised solar projects around the country since late last year. This started with an 8 kilowatt system on the roof of an organic beachside restaurant, La Sal del Varador, a few



Power play: using sunlight to generate electricity in Sanlúcar La Mayor, Spain

miles north of Barcelona. It has been carefully designed to match the amount of electricity the restaurant uses, meaning the owners intend to use about 95 per cent of what they generate. Conergy says that means the restaurant will hardly need any electricity from the national power grid during the day, which would otherwise cost about 15-17 euro cents per kW per hour.

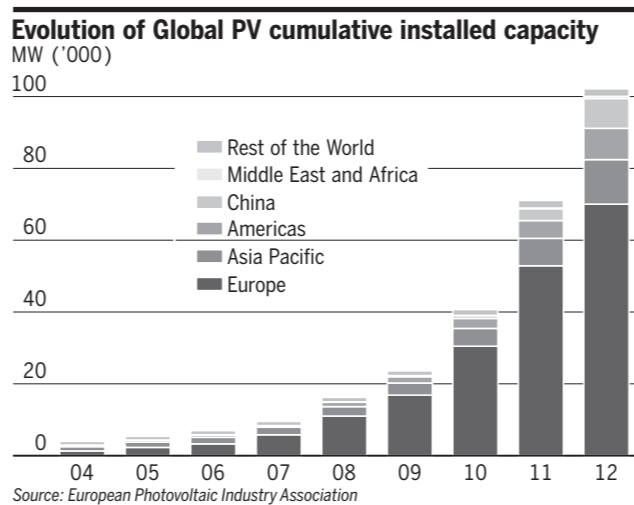
Instead, the restaurant will be

generating its own electricity at a cost of about 10 euro cents, assuming it has a lifetime of 25 years.

"This is the first project of its kind in Spain," says Luis Jiménez Gutiérrez, managing director of Conergy in Spain, explaining that solar is moving away from an investment-driven market towards a more traditional energy market, where the most important factors are price and availability.

"With this project, we can show very clearly that solar power is already competitive today, especially for businesses and companies that can consume the solar energy they generate themselves during daytime. The objective is no longer for the plant to be as large as possible but for it to be matched precisely to the customer, in order to optimise electricity generation and consumption behaviour."

Mr Jiménez says it may be some time before large, utility-scale unsubsidised projects emerge. One big problem is that the most obvious customers would be utilities themselves, which already have a number of under-used plants so are unlikely to be keen to add more, he says. Still, for individual businesses and households, unsubsidised solar power that some might have thought years away is already here.



'Invisible fuel' promises more secure future

Continued from Page 1

compared to the money flowing into traditional energy production. The IEA says more than three times that amount – nearly \$600bn – was invested the same year in expanding or maintaining the world's supply of fossil fuels.

The problem is that there are still significant barriers. With assets such as buildings, the payback time for investing in an improvement in energy efficiency can be several years – often longer than the buyer plans to own the asset.

Also, it can be hard to measure success. The EU recently said it would not meet its target of saving 20 per cent of its primary

energy consumption by 2020, partly because of the "lack of appropriate tools for monitoring progress and measuring impacts on the member state level".

There is another potential danger – the so-called "rebound effect". If you save money on electricity by installing a heat pump, for example, but spend what you save on air travel, the improvement in energy efficiency is meaningless. The EU has identified rebound losses of 10-30 per cent.

Still, despite the potential dangers, companies involved in energy efficiency are becoming a new and attractive asset class for investors. Alastair Bishop, portfolio manager of BlackRock's natural resources

team, singles out companies such as Schneider Electric and Johnson Controls, specialists in building automation systems that monitor and control the heating, ventilation, air conditioning and lighting in an office block. Such companies install sensors that turn off lights in a room when it is empty or shut down heating overnight, steps that can

'The most secure energy is the barrel or megawatt we never have to use'

contribute to big savings. "If you look at the larger energy story, before the financial crisis it was all about producing more energy," Mr Bishop says. "But since the crisis, there's been more awareness of the sustainability and affordability of power."

Nevertheless, he stresses that investments need government support to work. This is happening – on a large scale. In recent years, all the major energy-consuming countries have passed laws to encourage energy efficiency. The US has introduced new fuel-economy standards for vehicles; the EU has its target of reducing energy demand by 20 per cent by 2020; Japan wants to cut electricity

demand by 10 per cent in 2030 compared to 2010; and China has a goal of cutting energy intensity by 16 per cent between 2011 and 2015.

"There's a theme here," says Exxon's Mr Colton. "The improvement in efficiency that we've been seeing is mostly being driven by government policy. Consumers would not get there on their own."

Some policies are highly specific. In 2010, the EU adopted a directive on the energy performance of buildings. It requires all new buildings to be "nearly zero-energy" by 2021. On a national scale, too, governments are coming up with ever-more innovative ways of encouraging energy savings. Under the UK's Green

Deal scheme, for example, consumers can take out a loan for home improvement measures such as getting rid of an old boiler and pay it back through a surcharge on their electricity bills.

Although energy conservation is a big concern in the west, some parts of the world have made little or no progress. The abundance of fossil fuels in the Middle East and the low cost of energy – with heavily subsidised prices for petrol and gas – gives the region little incentive to husband resources. The IEA says the average efficiency of fossil fuel power generation in the Middle East is just 33 per cent – 9 per cent lower than in the west. That is why some are sceptical that

Wood pellets muscle in on old role of coal

Biomass

Hungry boilers need new supply chain, writes *Guy Chazan*

Drax, the UK power supplier, is pushing ahead with what is shaping up to be a huge bet on biomass.

The company, which has a big coal-fired power plant in Yorkshire, has launched a £750m investment programme to convert three of its six units to wood pellets, a renewable source of energy. It started commissioning the first converted unit in April.

For Dorothy Thompson, chief executive, the attraction of biomass is obvious. "It's a lot cheaper than offshore wind, there is security of supply and it's more flexible," she says. The pellets burned in biomass boilers are made from the "cheapest part of the forestry industry product – harvested residues and thinnings" – and a "supply chain is developing".

Drax's interest in biomass is part of a wider industry trend. New EU emissions regulations have put pressure on many of the continent's old coal-fired power stations but some operators have realised they can keep the plants alive by converting their boilers from coal to wood pellets. The discovery of biomass has given a new lease of life to ageing coal assets that would otherwise have been shuttered.

Bloomberg New Energy Finance (BNEF) says between 3.6 and 6.8 gigawatts of biomass generating capacity could be commissioned between 2012 and 2016, though it warned that slow governmental decisions on future subsidies "risks unnerving manufacturers and investors".

Interest has been driven by EU laws that stipulate member states must source 20 per cent of their energy from renewables by 2020. That will not present much of a problem for Germany, with its massive investments in wind and solar power. But the UK and others may struggle, hence the embracing of coal-to-biomass conversion.

"It's an easy, quick and capital-lite way to meet the renewables targets," says Harry Boyle, an analyst at BNEF. "Coal plants are already connected to the grid and what's required are relatively minor modifications to an existing asset."

Biomass is also a consistent source of supply, in contrast to the intermittency of wind and solar.

Such considerations have pushed the UK to create a generous subsidy regime for the fuel. Previously, developers were awarded half a renewables obligation certificate (ROC) for co-firing coal with biomass. Now, the government is offering operators a whole ROC if they fully convert their boilers to biomass from coal. It was this decision that underpinned Drax's big investment programme.

As a result of this and

other subsidies, generating capacity is expected to grow quickly across Europe. BNEF says European pellet demand will rise to 25m-30m tonnes by 2020, up from about 12m tonnes now. Most of that will be imported from outside the EU.

Yet biomass remains much more controversial than wind and solar. This is partly because when wood is burned, it releases carbon dioxide into the atmosphere – just like fossil fuels such as oil, gas and coal.

Advocates like Ms Thompson stress that these emissions are neutralised by regrowth in the forest from which the wood was harvested. "You're not using trapped carbon." Partly because of that, she says, the carbon footprint of biomass is "70-80 per cent smaller than that of coal".

Environmentalists are unconvinced. A recent study put out by the Royal Society for the Protection of Birds together with Greenpeace and Friends of the Earth says it may take "many years for the end-of-pipe emissions to be neutralised" by regrowth of forests. It disputes the industry's assertion that pellets used in power generation are made of residues from timber production, saying there is evidence that whole trees are often used. The study claims that the UK government's proposed sustainability standards for

'It's a lot cheaper than offshore wind, there is security of supply and it's more flexible'

biomass will not prevent wood being used that comes from forests "where management regimes cause problems for biodiversity".

The report's authors say there is a risk the UK will be "locked into financially supporting an industry that results in increasing greenhouse gas emissions and other serious sustainability issues".

Biomass developers face other difficulties, aside from the objections of green groups. A big challenge is finding enough pellets to supply their hungry biomass boilers.

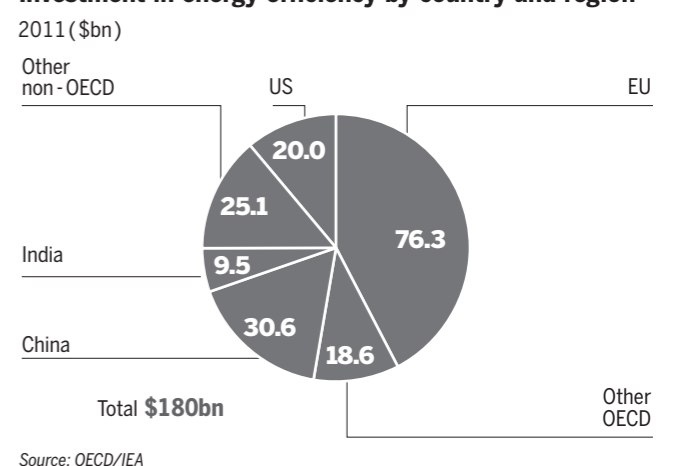
"It takes time to build up the supply chain," says Ms Thompson. "Each [converted] unit requires 2.3m tonnes of biomass a year – and the total global cross-sea trade is only about 7m tonnes."

So a chunk of Drax's £750m investment will go on building a wood pellet factory in the southeast of the US to fill Drax boilers.

Some people worry about the carbon emissions involved in transporting pellets from the US to Europe.

BNEF's Harry Boyle says the problem is not necessarily the emissions released by tankers bringing huge cargoes of pellets across the Atlantic, but those of trucks transporting the wood from pellet factories hundreds of miles to ports in the US.

Investment in energy efficiency by country and region



global energy intensity – the amount of energy consumed per unit of GDP – will come down drastically soon. Futurologist Jorgen Randers, in a report offering a global forecast for the next 40 years, expects energy intensity to fall by

only a third compared to 2010 – not enough to stop catastrophic climate change. Still, Maria van der Hoeven, the IEA's executive director, believes: "The most secure energy is the barrel or megawatt we never have to use".

Modern Energy

Latest generation of farms raises optimism

Offshore wind Some observers are sensing a turning point after early setbacks on natural, political and technological fronts, says *Rose Jacobs*

At the official opening of the Robin Rigg wind farm, off the south-west coast of Scotland, an engineer happened to mention that the operation was managing 99 per cent capture of the available energy.

That was in September 2010, but for Gordon Edge, head of policy at the trade group RenewableUK, it was one of the most pronounced signs recently that the technical prospects for offshore wind have fundamentally changed.

It was a vastly higher figure than achieved by the first generation of offshore wind farms. Moreover, says Mr Edge, "the load factors from the offshore fleet are finally starting to pull away from the onshore fleet" – moving from about 30 per cent to closer to 40 per cent. "They were always supposed to be higher offshore but an early disappointment was that they weren't."

There have been many early offshore wind disappointments, from natural to technological to political.

But this year has felt like something of a turning point, particularly in the UK, according to some observers. Here, the political nadir for the industry came towards the end of 2012, before the coalition government had published its energy bill and as some ministers were lobbying against onshore wind. Now, with the government aiming to get 30 per cent of UK electricity from renewable sources by 2020, some certainty has been added. "The UK is perceived as one of the safest countries right now," says Thérèse Brouwer, head of structured finance for utilities, power and renewables at the Dutch bank ING.

Elsewhere in Europe, German elections in the autumn mean debates over energy pricing will increase, while the continued sovereign debt crises in the south have sapped funding for projects in Italy and Spain. Still, says Ms Brouwer, there are new opportunities and she believes France will be the next offshore wind market to come to life.

London has played host to one of

the most interesting developments in recent years in wind-farm financing. The flotation in March of Greencoat UK Wind, a vehicle for investing in onshore and offshore wind farms that promised a 6 per cent dividend, wound up oversubscribed.

"We were trying to pair the needs of investors with a matching capital requirement in the sector," says Stephen Lilley at Greencoat Capital. He said investors who were new to wind were comforted by the familiar structure of the fund, which looks much like more traditional infrastructure funds.

The three key differences – a lack of debt built into the capital structure, the decision to take on power price risk and the variability of the wind itself – might have scared off investors. But Mr Lilley argues they were in fact key to the success of the idea. By taking on the power price risk, for example, the fund would become a better partner to the owners and managers of wind farms – utilities, which are keen to remove that risk from



Farming power: some of the 30 turbines in Caister on Sea, England

their leveraged capital structures. Hans Bunting, head of RWE Innogy, which owns two of the wind farms in which Greencoat is investing – including one offshore farm – was pleased to partner with Greencoat, not least because of RWE Innogy's need to recycle capital into new projects.

But he also argues that his company has something to offer: an offshore farm – Rhyl Flats, off the North Wales coast – with a solid, five-year track record. That helped bring the government on board, in the form of a 25 per cent stake in the project, purchased by the UK's Green Investment Bank – its first ever investment in offshore wind. "They needed a reference project," Mr Bunting said. "It was a trial case."

That, in turn, has increased investor confidence, says Mr Edge at RenewableUK: "The government isn't going to mess people around with this when its own money is at stake."

Yet, for all that the deal felt like a win-win, Mr Bunting is doubtful that this model might spread elsewhere quickly: "I think the UK population is more open to market-traded instruments," he says.

Others are more optimistic. Ms Brouwer argues that it is "too early to call it a one-off" and Mr Edge agrees: "I don't think the UK is alone in having historically low interest rates. Where else are investors going to get this sort of return?"

Mr Lilley at Greencoat is thinking even more broadly. Why not create a way for retail investors to tap into solar power generation in southern Europe, for example? The reason he might veer away from continental Europe, in fact, has more to do with currency risk than the natural elements: "Actually, over a five-year period, the amount of wind that blows is very predictable and consistent."

Nuclear industry must compete on cost in future energy mix

Nuclear

Safety and delays in construction remain at issue but degree of confidence returns, says *Sylvia Pfeifer*



Allaying fears: Taiwan's fourth nuclear power plant in the northern Gongliao district

This spring, just two years after the devastating accident at the Fukushima nuclear power plant, Japan landed its first overseas contract to build a reactor. Mitsubishi Heavy Industries, as part of a consortium, secured negotiating rights to build a facility in Turkey. For Japan, the agreement was economically and symbolically significant given the blow to its safety reputation in 2011.

It is just as significant for the industry as a whole. Despite seeing a slowdown in orders since Fukushima and the withdrawal from atomic power by some countries, notably Germany, nuclear power is not in universal retreat.

China, India and Russia are all moving ahead with construction programmes, as are countries in the Middle East, including Abu Dhabi. In Europe, Turkey, the UK, Finland and the Czech Republic are committed to building new plants. In the US, where abundant low-cost shale gas has priced out a lot of other forms of energy, there are still plans for some, although fewer, reactors. This year federal regulators have approved plans by Scana Corporation, the utility, for two reactors.

"Nuclear projects take time to develop but activity is building," says Fiona Reilly, partner and head of nuclear services, at Norton Rose. "Fukushima has not had the effect people had initially expected."

Nevertheless, for an industry with a reputation for cost overruns and delays, the real challenge will be how to secure a long-term role in the world's future energy mix – one that provides affordable and low-carbon power. The world's demand for electricity will grow almost twice as fast as its total energy consumption by 2035, according to the International Energy Agency (IEA).

Nuclear offers a low-carbon source of power but concerns about its safety persist. The IEA has scaled

back its forecast for the anticipated use of atomic power as countries have reviewed their plans after Fukushima. The agency last year projected that nuclear power would supply 12 per cent of the world's electricity in 2035, fairly close to today's level.

With government and power companies' budgets under pressure, how to finance and reduce cost is critical. Nowhere is this more in the spotlight than in the UK where the government has said it needs new reactors to help keep the lights on.

The focus is on negotiations between ministers and EDF, the French utility proposing to build the UK's first new reactor for more than two decades, over the proposed "contract for difference". This guarantees a long-term fixed price for low-carbon generators and both sides are locked in talks over the level of the "strike price".

"Nuclear has a future in Europe if the costs come down," says Roland Vetter, head of research at CF Partners, the advisory and investment firm. "If the construction costs come down and delays can be kept under control then the return on capital that the operator expects should also come down as the risks are lower."

Industry supporters argue that "repeat projects" are needed. Professor Paul Howarth, managing director at the National Nuclear Laboratory in the UK, believes it is critical that the industry goes ahead as planned with building a third generation reactor system like the Areva EPR earmarked for the UK.

"It is a case of keeping the faith with standard

reactor designs so that we can get from first-of-a-kind costs – which can be high – to the nth-of-a-kind costs," he says. "Then there would be much greater certainty about what the cost of nuclear is and we could then see fleets being built."

The industry has funding options even if they are problematic. According to Ms Reilly, the sector has moved away from what was historically government funding to looking at other routes, in particular the use of export credit agencies. "Some projects are also seeing equity financing – in addition to equity from the

'Activity is building. Fukushima has not had the effect people had initially expected'

developers some of the supply chain may offer some equity. We are also seeing an increase in third-party investors looking to invest in nuclear projects," she adds.

The focus on cost is helping to drive innovation, with investment being ploughed into small modular reactors (SMRs). These typically generate up to 300 megawatts of electricity per reactor – about a fifth of the output of a normal full-size plant – and are about a third of the physical size of traditional ones.

Their size means that their capital cost should be much lower, making them attractive to lenders who would also see a quicker return on their investment, especially if built in modu-

lar form in a factory.

They offer flexibility and the ability to power remote or standalone industrial sites. Developing nations that do not have established distribution networks could benefit.

Meanwhile, the US, South Korea and China are among those nations leading the charge but the UK is also looking into the potential benefits and applications. Amec, which provides project management and engineering services to the industry, is among several players talking to companies that are looking to deploy SMRs.

In the US, Chris Gadowski, nuclear analyst at Bloomberg New Energy Finance, forecasts "a spurt start in nuclear power but one that will then be held back principally by shale gas and then SMRs".

China remains the leading growth market for new construction and, potentially, exports. Twenty-eight reactors are under construction and 49 are planned.

China's ambition does not stop at home. Chinese operators want to develop, alone or in co-operation with foreign suppliers, generation-three reactors. Already having 17 reactors in operation, they are "acquiring the operation and maintenance knowledge that are indispensable to improve the reactors' design and safety," says Colette Lewiner, energy and utilities adviser at consultants CapGemini.

She believes that China could become a dominant low-cost supplier. "As they have cheap manufacturing costs, they will become a very competitive and safe nuclear vendor as they are today in photovoltaic solar energy."

New gas deposits change trade flows

Innovation

Demand is rising but very unevenly, *Sylvia Pfeifer* discovers

Halliburton, the US services group, has taken to YouTube to promote its recent innovation: the deployment of nearly 100 new light duty trucks across several of its field locations. What makes the trucks worthy of a video is the way they are powered: not by gasoline, but by compressed natural gas (CNG).

The trucks come with bi-fuel tanks that are fully automated and run on CNG first and switch to gasoline when the gas tank is empty. They emit about 90 per cent less emissions and are expected to save Halliburton about \$5,100 per truck in fuel costs every year. It is a pilot programme and the latest sign of how North America's shale revolution is spreading.

"Clean is good, domestic is good but the savings on a fuel is what make it happen," intones T Boone Pickens, the Texan oil billionaire, in the video, headlined "The Right Fuel for Today".

Halliburton and T Boone Pickens are not alone in espousing the benefits of natural gas. Thanks to improvements in the techniques of horizontal drilling and hydraulic fracturing, or fracking, North America's energy landscape has changed as new supplies – of shale oil and gas – have been unlocked. The glut of gas has seen prices tumble, prompting utilities to

switch from burning more expensive coal to gas to generate electricity.

US industry is benefiting, with the petrochemicals sector, a big user of gas as feedstock, enjoying a revival. Gas is making inroads into other sectors such as transport, where companies from Warren Buffett's railway, BNSF, to UPS and Royal Dutch Shell are substituting liquefied natural gas (LNG) or CNG for diesel. Others, such as Apache Corporation are using gas to power fracking equipment, one of the most energy-intensive processes employed by the industry.

The US's shale bonanza is transforming the global energy landscape. Last month, the Obama administration approved wider exports of LNG, raising the prospect that the US could become an energy supplier to the rest of the world. For its supporters, natural gas – cleaner burning than oil – looks set for a "golden age".

Yet the outlook for gas is not uniform. In Europe, where demand has slumped as a result of the recession, much investment into new infrastructure is on hold. In east Africa the discovery of conventional sources of gas off the coasts of Mozambique and Tanzania has sparked a scramble by the world's largest energy groups and raised the prospect of significant exports of LNG to nations in Asia.

Wood Mackenzie, the consultancy, estimates that commercially recoverable gas reserves increased from 4,700tr cubic feet to 7,900tr between 2007 and 2012. While the low prices in the US have prompted companies to slow drilling activities and focus on more oily

resources, experts believe gas supplies will keep on rising.

Gas resources continue "to be added", says Noel Tomnay, head of global gas research, at Wood Mackenzie. "With the exploration budgets of companies growing, while they are not necessarily looking for gas, they will find it and the likelihood is therefore that the resource base for gas will keep expanding over the next few years."

Mike Bahorich, chief technology officer at Apache says: "The rate of return will drive activity. As gas prices go up a bit we will see a strong return to drilling." He believes that the

managing director at First Reserve, the private equity and infrastructure investment firm.

If North America's shale revolution is firmly entrenched, the development of unconventional gas elsewhere is less clear and is expected to take time. Companies are exploring in Europe, China and South America. The industry struggles to replicate the unique set of circumstances that enabled the North American revolution, such as a benign regulatory environment, an existing oil and gas infrastructure and greater incentives as landowners own the mineral rights themselves.

An added problem for gas outside North America is coal, which is still much cheaper.

In Europe, utilities have been burning coal instead of gas to generate electricity. Gas in Europe is generally sold on contracts linked to the oil price, which has remained relatively strong. Europe could see a big boost to gas supplies through potential shale gas developments at home and LNG exports from the US and Canada.

"Demand for gas is rising but very unevenly," says Eric Oudenot, principal in the energy practice at Boston Consulting Group.

"In Europe, thanks to the recession and efforts to improve energy efficiency, demand has dropped for the second consecutive year," he adds. "China and India are leading the way in terms of future demand for gas. There will be an increase in global gas production but a significant change in the trade flows and gas prices."

'There will be an increase in global gas production but a significant change in the trade flows'

difference in price between gas and oil in the US "will last for a long time to come".

Apache has teamed up with Schlumberger and Halliburton to develop the increased use of gas in powering fracking equipment, which uses a lot of diesel. Potential cost savings go "straight to the bottom line", says Mr Bahorich.

The US shale revolution has driven investment in infrastructure such as pipelines. "There are a lot of opportunities [for investment] on the infrastructure side, and on the mid-stream side in companies that consume the gas to make other products," says Tim Day,

Contributors

Guy Chazan
Energy editor

Pilita Clark
Environment writer

Michael Kavanagh
Energy sector correspondent

Sylvia Pfeifer
Special correspondent

Rose Jacobs
Freelance journalist

Aban Contractor
Commissioning editor

Steven Bird
Designer

Andy Mears
Picture editor

For advertising contact:
Liam Sweeney on
+44 (0)20 7873 4148;

email liam.sweeney@ft.com
or your usual FT representative.

All FT Reports are available on FT.com at ft.com/reports

Follow us on Twitter at twitter.com/ftreports

It's a jungle out there

Warwick Business School: a top institution for ambitious people.

At WBS we believe that sustainable and affordable energy lies at the heart of growth and prosperity across the world. Join us to learn how successful business leadership is transforming the energy industry and can transform your future as well.

∴ **The Warwick Global Energy MBA**

Be part of an international cohort of industry professionals exploring the management challenges of how we will provide and use energy in the future.

Warwick Business School: A leap ahead

Don't forget to follow us on Twitter @warwickbschool



+44 (0)24 7652 4100

warwickmba@wbs.ac.uk

wbs.ac.uk/go/ftmodern

THE UNIVERSITY OF
WARWICK

Modern Energy

Rising costs help drive a shift to lower carbon living

Passive power Improving quality of life at home, rather than a burning desire to be efficient, holds the key, says *Michael Kavanagh*

In times gone by, homes both grand and modest were of necessity built on the assumption of limited heating or power supplies. Until relatively recently, most households were distinctively "off grid".

For architects today, and particularly in urban settings, power supplies are one of the factors that signify modern living.

But are we moving back to an era where household heating or cooling uses little or no energy, yet offers the best in modern standards of comfort?

Gavin Killip, senior researcher at Oxford University's Environmental Change Institute (ECI), argues that there are few technological barriers to achieving sharp reductions in the energy consumption of households and non-residential buildings in the coming decades. "A lot of technologies are available out there. It's not a technological problem but a societal one."

He estimates that energy used and lost through buildings accounts for about half of the UK's overall carbon dioxide emissions. More than half is accounted for by domestic use, suggesting that household consumption accounts for 25-30 per cent of the UK's carbon dioxide emissions.

Within a typical home, 60 per cent

of energy is used for heating, 20 per cent for hot water, and the remaining 20 per cent for lights and appliances.

While much in the short term can be done to encourage improved energy efficiency in the home and public buildings – through replacing old boilers, for example – Dr Killip argues that policy should encourage improved designs of new houses and refitting of old houses to drive down energy demand to a fraction of what is consumed at present.

"The Victorians and Edwardians were fresh air fanatics," he says. Much of the UK's and northern Europe's housing was designed with the need for plentiful circulation of air demanded by the burning of fossil fuels.

Beyond improved insulation, the main imperative for achieving substantial reductions in energy demand for heating now is "make it tight, ventilate right", says Dr Killip.

At its most basic – but perhaps also most elegant – the notion of using design to control temperatures was exemplified by the Italian classical architect Palladio, whose villas were designed to moderate interior temperatures across the extremes of winter and summer.

The Passivhaus – or Passive House

– movement that began in the 1980s, has led to a wave of new houses designed to achieve a 90 per cent drop or more in usual energy use compared with the typical central European home.

High specification insulation, heat exchange systems controlling air flow and even recouping energy from warm water, along with other efficiency measures, are combining to drive down energy consumption in workplaces and homes.

In a Passivhaus, human bodies and the odd electrical appliance provide enough heat for comfort. Though more common in Germany and Scandinavia, the Passivhaus template has been used in a growing number of construction projects in North America and the UK.

But what of the remaining housing stock? Dr Killip argues that the biggest contribution to energy demand management in the home can be made through refitting of old housing stock.

Not all housing is suitable for the highest specification of energy-saving measures, such as the ducting of air to prevent the unnecessary loss of ambient heat.

Even so, he argues that a suite of refitting measures for most buildings,

even if not capable of meeting the Passivhaus targets, could still achieve 60-65 per cent falls in typical energy use.

Even if the house of the future may include such items as solar panels, air ducting, biomass burners or CHP (combined heat and power) units instead of boilers, "it doesn't have to look that different", he argues.

However, research conducted by the ECI examining the potential and constraints of refitting in France and the UK suggests low uptake of the most modern energy-saving measures available.

"In both countries, the current market for low carbon refurbishment is extremely small, and it needs to grow significantly and at a considerable rate if the housing sector is to make its contribution to national and international carbon reduction targets", the research concluded.

The Institute's Katy Janda, who is also involved in the project says: "I see deep renovation as very much of a 'chicken and egg' question."

"It is about both supply of expertise as well as the demand for it. This is certainly true with new housing... The skill involved in building a passive house is not the same thing as building a 'normal' house."

House proud: built by the Prince's Foundation for Building Community, the Natural House at BRE Innovation Park in Watford, England

Peter White



Another factor that prevents refitting along Passivhaus lines is the passivity of consumers themselves.

A study recently conducted by academics at the University of East Anglia (UEA), funded by the British Energy Research Council, suggested that energy efficiency was rarely the main motivating factor for people's decisions to renovate their homes.

Instead, the biggest motive was to improve the comforts of domestic life by extending or adapting space. Other triggers might include specific events such as the need to replace a boiler or window.

According to George Chrysoschochidis, leader of the university team: "The fundamental insight from this research is that home renovations have to be understood through the lens of normal, routine domestic life."

"Decisions to renovate are rooted in a need to improve the quality of life at home, rather than any burning desire to be energy efficient," Mr Chrysoschochidis adds.

Rising energy costs though, argues Dr Killip, alongside enlightened public subsidies for refitting, could accelerate the emergence of the low-carbon house – and the human body as a key supplier of ambient warmth.

'The skill involved in building a passive house is not the same thing as building a "normal" house'

US steers bumpy course to green fuel

Biofuels

Oil and ecology make troubled mix, writes *Rose Jacobs*

In February this year, a US appeals court handed down its verdict in a case brought by the American Petroleum Institute against the Environmental Protection Agency. The API had argued that the government agency overestimated the volume of cellulosic ethanol – a second-generation bio-fuel made from feedstocks that are not part of the human food chain – available on the market in 2012.

That, the plaintiffs said, put refining and blending companies in a bind. The targets US refiners are expected to meet for renewable transport fuel levels are tied to EPA estimates. But, while the EPA set the goal at 8.65m gallons of cellulosic ethanol last year, only 20,000 gallons were in fact produced. Surely, said the API, that shortfall should not fall on its members' shoulders?

The judges' decision was mixed. On one hand, they found the EPA had indeed let the wish for higher output of the fuel be "the father to thought" – something the law had not intended. On the other, the judges agreed with the EPA that the target need not be lowered, since other second-generation biofuels could be used instead, if necessary.

The decision underscores two strains running through the biofuel industry. First, say critics, regulation appears to be out of step with science. Deriving energy from switchgrass and orange peel is hard to

do and producers will almost certainly fall short of 2022 targets set out by the US's Renewable Fuel Standard (RFS).

Yet regulators and politicians do not appear to be backing away from their ambitions. In fact, days after the appeals court decision in the API versus EPA case, the EPA increased its production estimates – and therefore volume mandates – for cellulosic ethanol to 14m gallons in 2013.

The situation has investors and companies making bets on whether political will, and government funding, can force the hand of science – and often hedging those bets soon after.

BP appeared to get a step or two ahead of itself in Florida, pushing forward on a plant that would produce cellulosic ethanol on a commercial scale, only to cancel the plans last autumn in favour of investment in cell-

New standards 'virtually eliminate' incentives for making flexible-fuel vehicles available

lulosic biofuel research and development.

"Given the large and growing portfolio of investment opportunities available to BP globally, we believe it is in the best interest of our shareholders to redeploy the considerable capital required to build this facility into other more attractive projects," said BP at the time.

Detlef Schoen, a managing partner at Aquila Capital, a company focused on



Biodiesel is used by some taxi drivers in San Francisco Getty

alternative investments, argues that investment by traditional oil and gas companies in biofuels has, in many cases, more to do with managing reputational risk than real hopes for commercial scale production.

He says a cold hard look at biofuels, and one unaffected by politics, would acknowledge that some "green" fuels do not offer a considerable environmental advantage over traditional fuels: "The output of energy is not higher than the input when you look at the whole life cycle of biofuels," says Mr Schoen.

Add in the problems associated with first-generation biofuels, such as ethanol made from corn – which thereby diverts human food stocks away from human mouths – and many question the wisdom of the RFS.

But Ernie Shea, who heads the group 25x25, which aims to push the bio-fuel portion of transport fuel to 25 per cent by 2025, believes that much of this scepticism is simply the result of entrenched interests. "It was a political decision to go to 36," he says of the 36bn gallons that will need to be blended into

transport fuel by 2022 under the RFS – up from 9bn in 2008. "But it was designed to be aggressive and it unleashed significant human capital and financial capital."

He is concerned, therefore, that new fuel economy standards, unveiled last August, "virtually eliminated" the incentives for carmakers to offer flexible-fuel vehicles. Nor does he think there are enough incentives in place to encourage the creation of the infrastructure – gas stations and pumps – that would support flexible fuels. Moreover, the appeal of biofuels as a solution to energy security in the US has been undermined by the shale gas revolution.

Still, in his view, the opportunities outweigh the challenges.

The next front, he says, is educating the public and politicians about the human health benefits of lower-carbon fuels, since they produce significantly lower levels of particulate matter.

"At some point, we're going to look at the 36bn number and ask, why stop there?" he says. "We're on the glide path the RFS was designed to bring about."

Boilers on the backburner as consumers rein in waste

United Kingdom

Enlisting public support remains difficult, writes *Michael Kavanagh*

For many households across Britain, the gas boiler is the prime source of domestic heating and hot water.

Yet, according to the UK Energy Research Centre, consumers could enjoy a future without boilers for generating heating for homes within 30 years. "By 2050, individual gas boilers will be largely a thing of the past," it says.

"Instead, electricity, either directly or through heat pumps, will make a major contribution to heating, supplemented by biomass and solar thermal."

In the meantime, however, many inhabitants of the UK and other advanced economies will continue to rely on domestic combustion of gas for their creature comforts.

But today, most of the UK's domestic boilers are still the older, non-condensing models whose efficiency ratings have fallen off considerably with age.

Replacing an old boiler with a modern condensing model, capable of achieving a 90 per cent efficiency rating in energy transfer, is the biggest single way in which households can reduce their energy use and carbon footprints, says the Department of Energy and Climate Change.

The new boilers, capable of recapturing heat lost in venting by older units, can achieve an annual saving of 2,500 kilowatt hours. This is five times the reduction in energy use achieved by loft insulation and about 50 per cent more than that

achieved by cavity wall insulation (see chart).

The cash savings can also be considerable.

The Energy Savings Trust calculates that modern condensing boilers, when replacing old units with efficiency ratings of less than 70 per cent, can achieve an annual saving of more than £300 a year for a gas-heated, semi-detached home with three bedrooms.

It is therefore unsurprising that the unglamorous replacement of boilers was singled out by energy minister Ed Davey last year as a central pillar of the UK's plan to reduce demand for fossil fuels while alternative power sources are developed.

Stuart Rolland, managing director of smart metering at British Gas, the country's biggest energy retailer, says switching to a new boiler can reap dividends.

"One pound in every four [worth] of energy is wasted in households," he says.

The company, which is mandated by the government to encourage energy saving among its customers, says a quarter of the 4m boilers it maintains for insured customers "are 15 years old or more".

A combination of regulation and incentives – along with the natural breakdown of boilers which then require compulsory replacement – are slowly nudging consumers towards making the savings on offer on bills and carbon emissions.

Mr Rolland argues that the adoption of smart meters in the home, offering clear, visible means of monitoring energy use, can lead to an immediate reduction in consumption of at least 5 per cent.

'Households waste one pound [worth of energy] in four'

Stuart Rolland
British Gas

It can also instil broad interest in consumption patterns among customers, leading to further changes. "People with smart meters go on to put other [energy saving] features in their home," he says.

Since 2005, government rules have largely banned the installation of non-condensing gas boilers – with a similar ban placed on oil-fired boiler units since 2007.

The Department of Energy and Climate Change expects that, by 2020, condensing boilers will be installed in 75 per cent of homes across Britain, more than doubling an annual saving of £1bn already achieved by 2012.

That assumes the scrapping of more than half the UK's remaining fleet of non-condensing units – estimated at 13m last year – whether through deliberate planning or wear and tear.

Beyond boiler replacement, a key objective set for government is to encourage the uptake of other measures to drive down consumption and avoid wasting heat, however it is generated.

Yet raising public awareness of funding schemes on offer continues to be a problem.

Last week it emerged that the number of Britons insulating their homes had collapsed since two schemes setting mandatory targets for home insulation were replaced in December with a more voluntary approach.

The fall is likely to disappoint a government that has emphasised the role of high-grade insulation, more efficient condensing boilers and other energy-saving measures, which have the added benefit of containing fast rising gas and electricity bills.

If the UK still has a considerable way to go in reducing unnecessary waste of energy used to heat its buildings, at least it is moving in the right direction.

The Department of Energy and Climate Change estimates that over the past four decades, technologies such as condensing boilers and loft insulation have radically improved the thermal efficiency of buildings and cut demand for heating fuels by nearly half.

