

Carbon, cost and consequences

How we manage the transition to a lower-carbon economy is one of the most important challenges facing the UK.

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Paul Golby's message

Affordable energy at the flick of a switch is something that most of the world has come to take for granted, or is determined to have. Rising energy consumption that increases global warming is something the world has to avoid.

For the UK, these global issues are coinciding with changes to national generation capability - the closing of old coal and nuclear plants and the implementation of EU renewable targets.

The energy model of the future needs to be viewed in terms of carbon, costs and security. The goal of policy must be to combine low carbon with realistic affordability and secure availability. To achieve this goal, the UK and its energy industry have some tough actions to take. To provide assets and an infrastructure that meets the country's needs in time, these decisions have to be taken now.

There is no silver bullet; but there is often polarised debate about the different technology options available. Each form of energy, be it coal, gas, nuclear, renewable or decentralised generation, has well-documented attractions - but also drawbacks. Coal is cheaper than some other sources of energy but currently produces twice as much carbon as gas; gas power stations are relatively quick to build but increasingly reliant on a costly and price-volatile imported fuel; nuclear is undoubtedly low-carbon but has high investment costs and takes a long time to build; wind, the most developed form

of renewable energy, is effectively carbon free but intermittent and inflexible, requiring extensive back-up capacity; decentralised generation is highly-efficient but it will be a long and costly haul before it can play a major role.

Looking at the other side of the equation, at demand, energy efficiency is both cost and carbon effective but its uptake is slow and customer interest is low. Energy efficiency is still in its infancy. We are only now beginning to explore with our customers the technologies and, even more importantly, the business models required to move energy efficiency into the mainstream. The introduction of Smart Meters will be an essential first step which we are already taking with our customers. However, we cannot safely predict when energy efficiency measures will impact overall demand enough to let us reduce energy generation requirements.

The reality of the problems facing us is undeniable - an unparalleled transformation of our energy generation infrastructure at a time when prices are high and rising. Of course, this transformation provides unparalleled opportunities, not least for new renewable energy technologies. My concern though is that the tone of the present debate over energy policy is, in some quarters, still unrealistic. As a result, it appears to have seduced at least some parts of our country into believing that we can somehow build a bridge to a low-carbon world without pain. That we can obtain 15 per cent of our energy needs

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from renewable sources without it having a significant impact on electricity prices. That we can somehow live without coal and nuclear and yet still enjoy uninterrupted and secure energy supply. The Foreign Secretary, David Miliband, recently said: 'The shift to low carbon represents a wrenching transition in political economy'. He is right, and the implications will be felt by households and businesses across the country. Low carbon has consequences, and these consequences have costs.

My belief is that the UK needs a consensus around the strategy of supporting energy diversity - embracing renewables and decentralised generation, nuclear, gas and coal - as the only way to achieve a future in which energy remains affordable, secure and acceptable in terms of carbon emissions. We need to be transparent about the challenge because energy and the environment are everyone's issues. And we need to accept the consequences of this strategy before the transformation of UK energy supply faces death by a thousand planning inquiries, or before those who most advocate carbon reduction end up blocking a technology vital to its implementation - carbon capture and storage (CCS).

E.ON is fully committed to clean, low-carbon energy generation. Some attack us for supporting new nuclear build, some for promoting cleaner coal and some for building wind power, both on and off-shore. But such criticism avoids confronting the real issues - that the threat of climate change is real; that there is increasing global demand for energy; that the UK no longer has sufficient energy reserves of its own to exploit, and that the UK needs to replace a major part of its energy generation assets - now.

This document is our contribution to the national debate about these issues. It is a debate that we need to conclude quickly.

We have specific recommendations to the Government, but more importantly we are urging that the energy debate become more real, more honest, and more urgent.

Paul Golby - E.ON UK Chief Executive

Introduction

The UK is committed to becoming a low carbon economy. We have a short-term goal of cutting our CO₂ emissions by 26 per cent and delivering 15 per cent of our total energy from renewable sources by 2020, and a longer-term one of reducing CO₂ emissions by between 60 and 80 per cent by 2050.

These UK targets will be overlaid by legally binding targets at EU level, to be achieved by 2020.

Much of the responsibility for achieving these ambitious targets will fall on the energy supply industry at a time when it is replacing around a third of its current capacity (or 23.5GW) as coal and nuclear plants reach end of life. In addition, the need to provide back up capacity for wind generation could require further substantial investment.

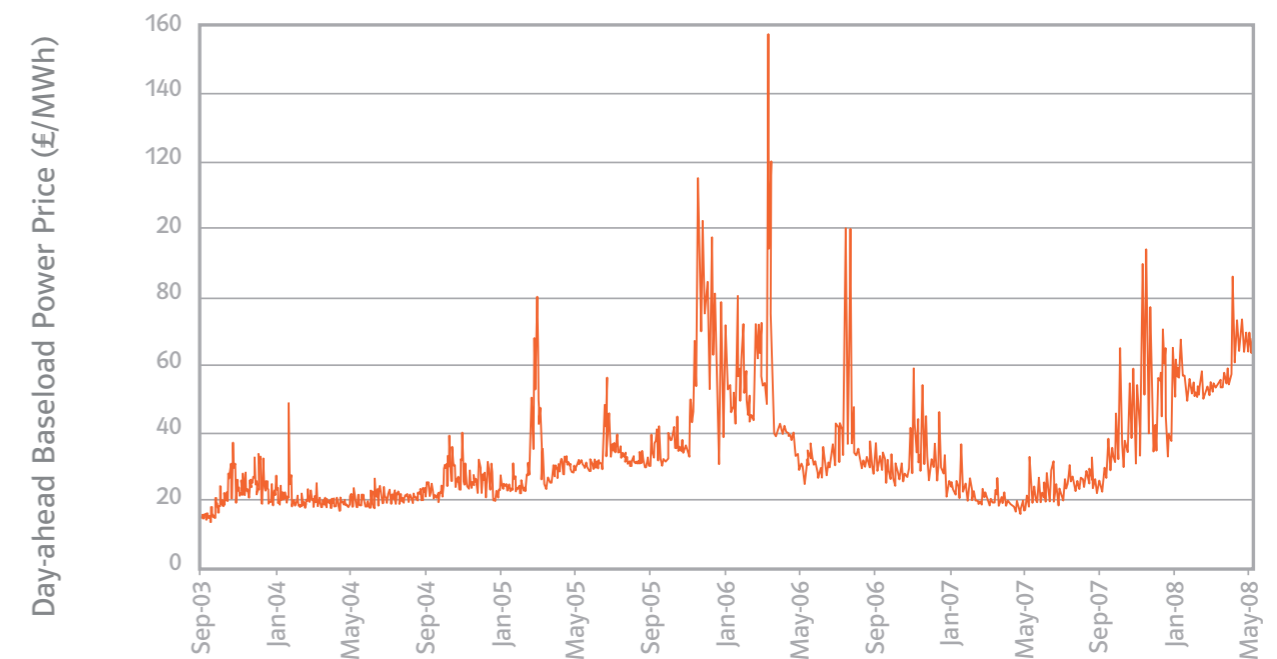
Changing to a low carbon economy, a task which will also be faced by the transport sector, comes with costs and consequences. Most important of these is an obligation to ensure targets are met in a way that keeps our heating and light affordable and protects security of supply. That is vital, for the competitiveness of the UK economy as a whole and for the well-being of those least able to absorb rising energy prices in particular. The number of people who spend more than 10 per cent of their income on energy,

the Government's definition of fuel poverty, has risen from 1.6 million in 2004 to 4.5 million (source: energywatch) today with nearly a third of those now having to use 20 per cent of their income on household fuel bills. All of us involved in the energy debate have a responsibility to bear these figures in mind in all we do.

The UK's past has perhaps handicapped its transition to a low carbon economy. For years we were been reliant on indigenous coal and then gas, neither of which are now available as the staple for power generation - coal because (without CCS) of its carbon content; gas because the North Sea bonanza - cheap and plentiful gas - is running out. To this we have added a legacy planning system that makes delivering large scale infrastructure projects more complicated and time-consuming than they need to be. For example, it appears that everyone wants renewable energy but not in their back yard.

Despite the 50% cent increase in average energy bills over the past three years, UK electricity prices are still on a par with the European average, and cheaper than those in Austria, Belgium, Italy and Denmark.

Wholesale Day-ahead Baseload Power



(Source: E.ON UK)

The debate about the future of energy cannot take place through a low-carbon lens alone, vital though this lens is. Energy industry customers - whether they are households or businesses - increasingly understand the need to move towards a low carbon future. But they also need to understand that this is not an objective that can be pursued for free. Nor can it be done overnight. The environmental impact of how our energy is generated is important for energy customers. But, for most of them, the two most pressing issues are how much they pay for their energy and whether it is available when they need it.

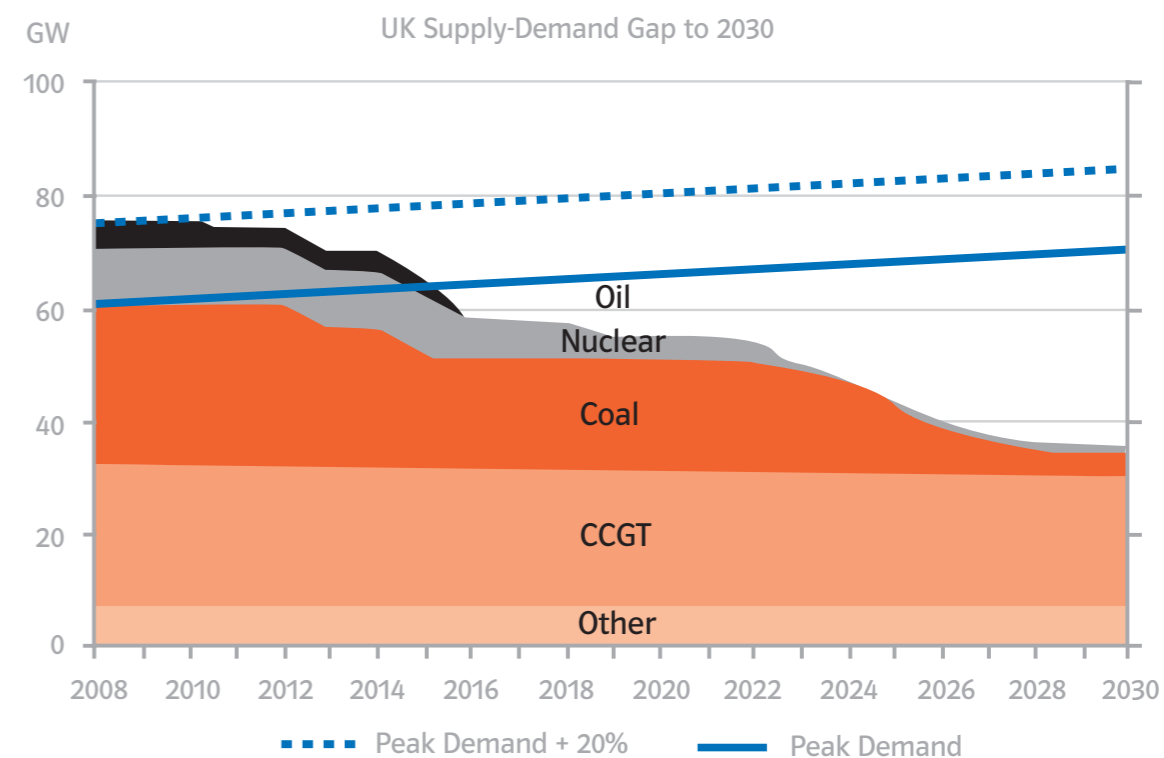
Despite the 50 per cent increase in average energy bills over the past three years, UK electricity prices are still on a par with the European average, and cheaper than those in Austria, Belgium, Italy and Denmark, while our gas prices remain amongst the lowest in the European Union and are considerably cheaper than those in competitor economies such as France and Germany (source Ofgem).

More importantly, we need to recognise that most of the factors driving energy prices higher are beyond Europe's control. Increasing global demand is putting pressure on supply, both of fuels and of the materials to build new capacity.

It seems that the upward price trend of recent years is set to continue, and that the main question is how to contain it at acceptable levels. On energy efficiency there is still a long way to go. As a nation, we are continuing to use more energy, with consumption increasing by 13 per cent between 1970 and 2001 and by 11 per cent since 1990 (source: BERR).

As for energy saving, we have a great deal more to do before energy efficiency becomes more than a means of partially offsetting the annual increase in consumption and succeeds in reducing net energy usage. This will be a lengthy process, akin to the encouragement of waste recycling, but even more significant. The technologies to facilitate energy efficiency are becoming available, notably Smart Metering. The business models also need to be put in place so that energy companies can make a profit from selling energy services as well as selling energy.

The debate about the future of energy cannot take place through a low-carbon lens alone, vital though this lens is.



(Source: E.ON UK)

So how should the UK meet its future energy needs?

UK power generation is undergoing two fundamental changes. The first is the phasing out of much carbon intensive but reliable and flexible power generation from coal, and the closure of older baseload nuclear plant.

The second is the expansion of low-carbon renewable sources such as wind, biomass and marine. E.ON alone is closing 4.2GW of fossil fuel power – coal and oil – and is developing a pipeline of 2.3GW of renewable projects in the UK. In other words, E.ON is closing some 40 per cent of its generating capacity, which is why we are determined to take the lead in this debate. The combined effect of these two factors and the run down of North Sea gas production, presents us with a huge challenge.

Currently, the UK's energy generating mix is split 35 per cent coal, 35 per cent gas, 20 per cent nuclear, six per cent imports and four per cent both oil and renewables. But, over the next decade or so, around a third of our generating capacity is due to close as older coal and nuclear plants are retired. At the same time, we will become more reliant upon imported gas – subject to increasing price volatility and potential political instability – as indigenous North Sea supplies run down.

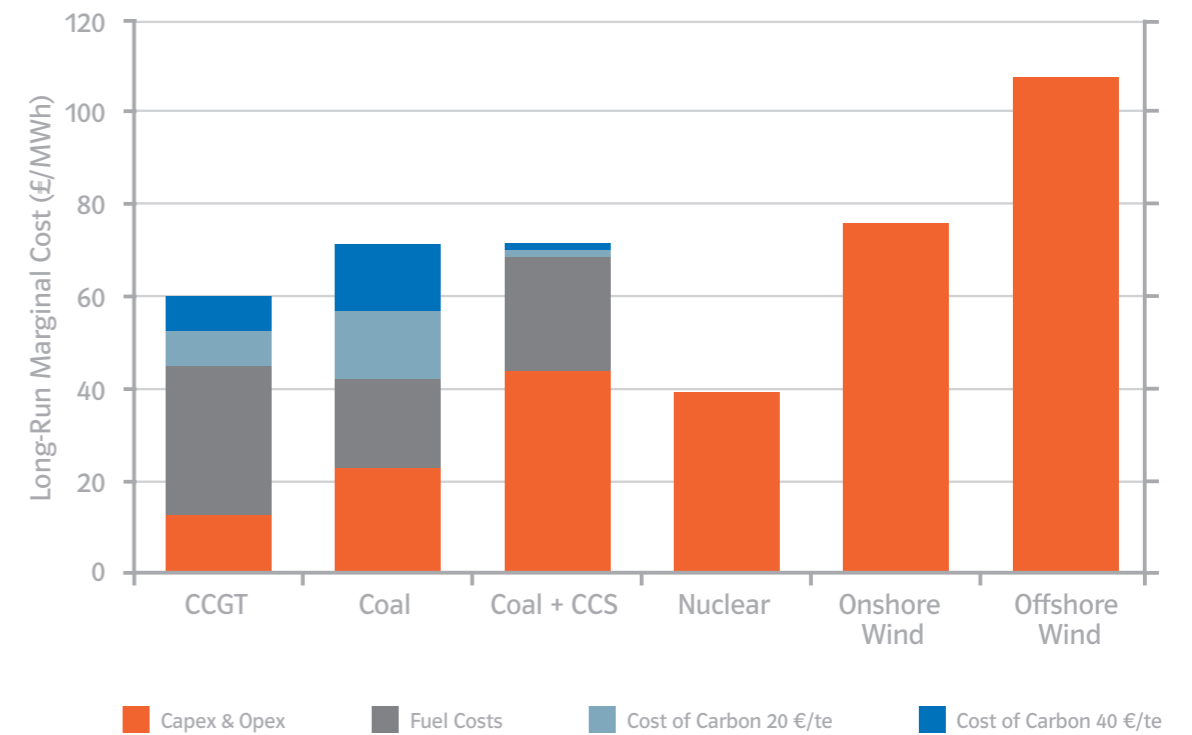
Finally, we are committed as part of our EU membership to meet 15 per cent of our total energy needs (heat, transport and power) from renewable sources by 2020. Given the limited scope for this in transport and heat, a realistic estimate says that at least 35 per cent of our electricity will need to be renewable.

And, of course, that is not all. Given the nature of wind power, the more of our energy that comes from wind, the greater the amount of back-up capability that needs to be ready to step in on days when wind is insufficient. Indeed, some have suggested that the net effect of the changes outlined above is that the UK's total generating capacity will need to be increased from 76GW today to over 120GW by 2020 (source: UKBCSE).

In order for UK energy policy to operate holistically, it is essential that these initial estimates be checked. If confirmed, then policy needs to be put in place to make sure that such a scale can be delivered on time. In the very long term (more than 50 years) it is quite possible that advances in renewable technologies, and, even more, in electricity storage and in energy efficiency, will mean that there is no need to back up renewable generation with spare capacity. This future is not with us now, and therefore we have to plan on the basis of what we know.

Energy diversity is key to maintaining security of supply and managing costs for our customers.

Cost Comparison of Various Technologies



(Source: E.ON UK)

Overall then, it is not difficult to see how we could become over-dependent for our future energy needs on a combination of price volatile gas and intermittent wind power. Instead of affordable, secure and low carbon energy, we could be faced with higher bills, increased dependency on foreign fuel reserves and a smaller reduction in CO₂ than we had anticipated. This is not the outcome anyone wants, but it could be the consequence if we do not allow for future diversity in our energy mix.

How we manage the transition to a lower-carbon economy is one of the most important challenges facing the UK. It is not an academic exercise or a mere policy debate. It is urgent and will require potentially unpopular decisions now – and actions to back them up.

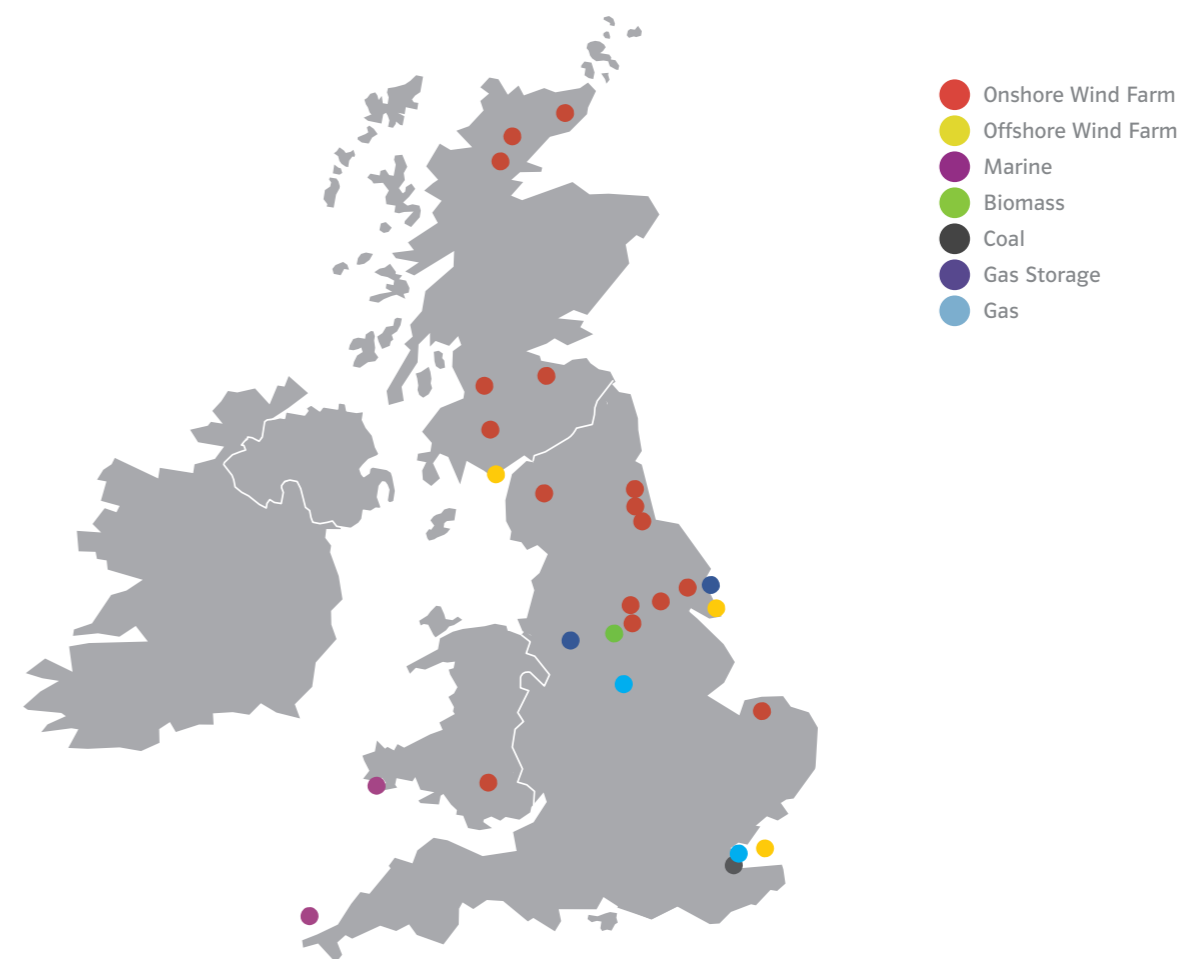
There are three imperatives for energy policy – carbon, cost and security. We need to meet all three in a way which gets emissions down, maintains affordability and keeps the lights on. The answer is to implement a balanced energy policy, which involves using all the generating technologies available to us – renewables, gas, nuclear and cleaner coal – making sure that each source is used in a way that maximises its strengths and compensates for its weaknesses.

It sounds simple, and it is often discussed simplistically. But it is a much more complex solution than adopting one form of energy at the expense of another. It means increasing our investment – in new generating capacity and also in new pipelines and storage facilities and local distribution networks. As a group, E.ON intends to invest around €50bn between now and 2010 and increase its renewable generation capacity from 1.3GW to 10GW worldwide by 2015.

The most important need is for the UK to put policy into practice. The Planning Reform Bill will help, but there needs to be a revolution in public attitudes as well to enable big energy infrastructure projects to be delivered on time. Much more needs to be done on the grid infrastructure side. Given the amount of investment required to deliver the 2020 targets, we need to ensure that the necessary reinforcement in the grid is carried out in a cost effective and timely way.

It is clear that there are advantages – and drawbacks – of each form of energy and we discuss some of them in the pages that follow. We also make an assessment of where we are now and what we must do to meet the UK's future needs; and finally, the action that E.ON is taking to lead the way.

We need to use all available technologies – making sure that each source is used in a way that maximises its strengths and compensates for its weaknesses.



Our development portfolio

Alternatives to centralised generation

E.ON is committed to the reduction of energy use in home and business.

Historically this has been low on the agenda of energy users and engagement by suppliers has been governed by regulatory obligations. This is now changing.

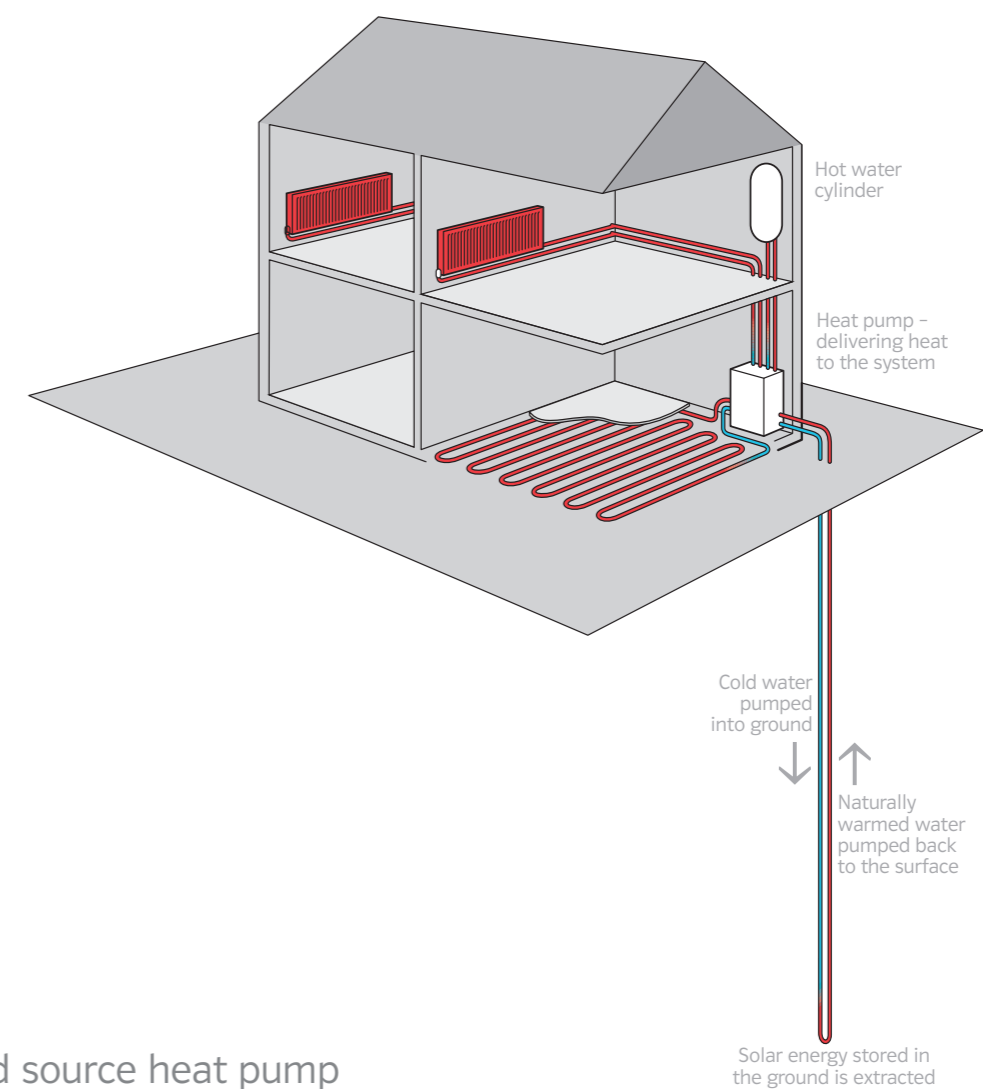
This change has been driven by three key areas - the impact of higher prices, carbon concerns and developing technology which allows consumers to see how much they are using in order to manage their consumption better. The latter has led E.ON to become increasingly committed to the role of smart metering in homes and businesses, not just to deliver improved business practice and better economics but to deliver significant carbon savings. Despite a wide variety of energy saving initiatives, many of which are supported, promoted and funded by E.ON, energy usage continues to rise. Energy efficiency is an important component in the equation but our planning has to be realistic about both consumer behaviour and about demand growth.

Other low carbon technologies will also change the face of energy in UK homes.

Microgeneration is the use of small scale heat and power technologies, such as micro wind turbines, biomass boilers, micro combined heat and power units (CHP), ground source heat pumps, air source heat pumps, solar thermal heating and solar photovoltaic energy. Microgeneration is a major growth sector for the energy industry and E.ON has formed partnerships with leading manufacturers to develop these.

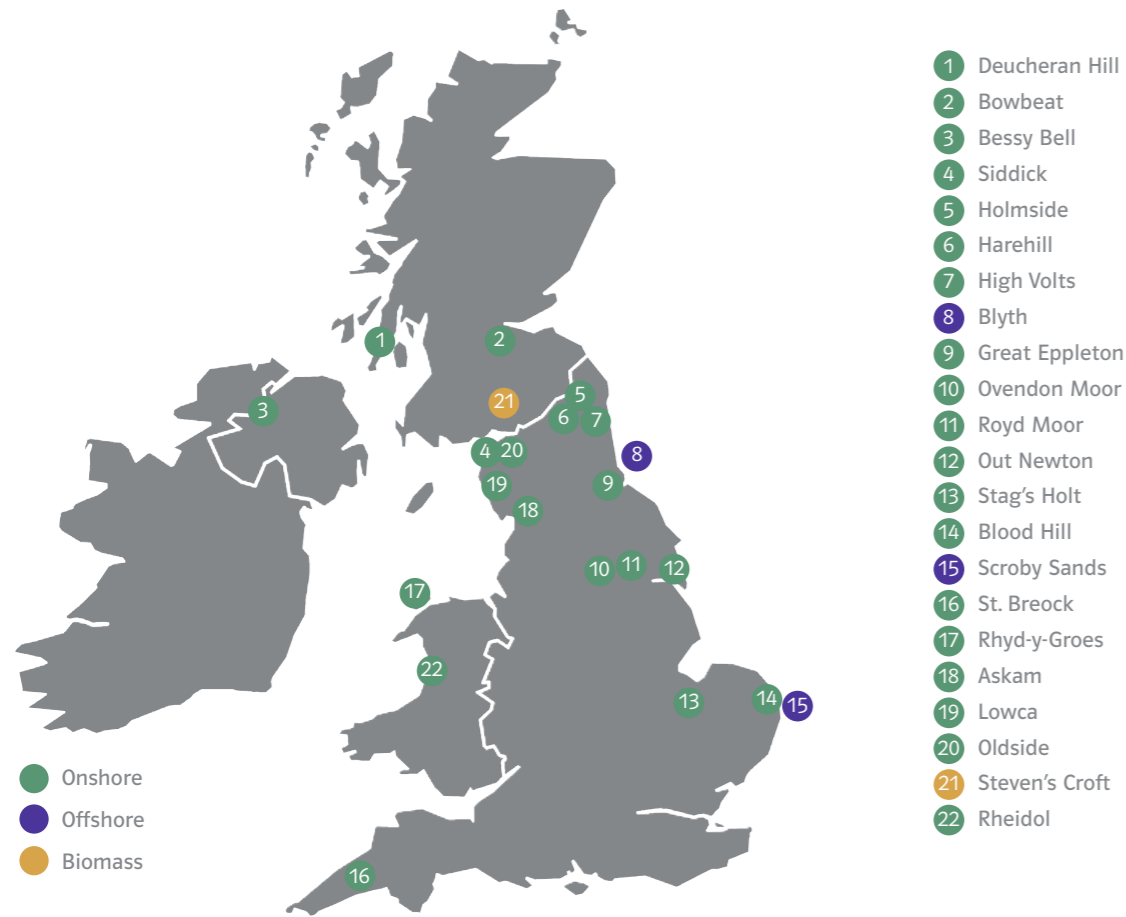
On a larger scale, distributed energy could provide a significant proportion of the UK's electricity needs through community energy centres. Decentralised generation is often cited as a key means of bridging the energy gap, especially as it is usually better at capturing and using waste heat. We believe decentralised generation has substantial possibilities and we have a number of programmes in place to provide local generation schemes. But, like all energy sources, decentralised generation also has limitations. It is energy efficient but, despite successes like E.ON's scheme in Malmo, Sweden, can be impractical, costly and complex to introduce on a commercial scale.

We believe decentralised generation has substantial possibilities.



Ground source heat pump

We believe renewable energy is key to addressing the fundamental energy challenges facing the UK.



Our operational renewable portfolio

Renewables

E.ON is passionate about renewable energy. Indeed, few companies are doing more. The development of renewables is essential for climate protection and an important part of our growth strategy. At the same time, our expertise gives us insight into the challenges and obstacles facing renewables.

Renewables are key to addressing the fundamental energy challenges facing the UK and, as such, receive substantial government support. Developments of this kind do, however, also provoke their own kind of environmental opposition.

Renewables will be a major driver for reducing CO₂ emissions; can reduce dependence from fossil fuel resources and contribute to meeting increased energy demand, and will increase price stability and thus the affordability of energy by tapping into new potential. Wind is a key resource in the UK for delivering substantial growth in renewables, but we also believe that a balanced portfolio approach is essential even within renewables. This is why we are investing in biomass and marine developments.

As well as benefits, there are two issues with renewable energy that need to be addressed directly. One is the cost implications of delivering the EU 2020 targets – this needs to be explicitly acknowledged and accepted now. The other is the recognition that wind power is intermittent and will require back-up from other, more flexible forms generation in order to pick up the slack during peak times and to provide

necessary flexibility to the overall power supply system. This will have consequence over the degree of network reinforcement required and the way in which other plant is operated and remunerated. Both of these costs will impact domestic fuel bills.

E.ON is one of the UK's leading renewable players, with a generation capacity of 252MW produced from a combination of wind and biomass. We own and operate 19 onshore windfarms and are currently building Robin Rigg, a 180MW offshore wind farm in the Solway Firth; and have submitted a planning application for the 300MW Humber Gateway offshore wind farm. We have also spent £90m on the Steven's Croft biomass station in Scotland and have plans for a second such facility in Sheffield. E.ON is a leading developer of marine energy schemes, both wave and tidal.

Our target as a group is to have 24 per cent of our energy generating capacity from renewable sources by 2030. But the costs associated with this are large and the cost-benefit can be uncertain.

Coal

Coal is relatively cheap, plentiful and easily stored on site. But until carbon capture and storage (CCS) technology is proven on a commercial scale, it remains twice as carbon intensive as gas.

Therefore we need to think very carefully about coal's role in the energy mix, which is partly in order to restrain price increases, and, in the future, partly as an alternative provider of flexible capacity in order to back up wind power. Our conclusion is that this role, though diminishing over time, is still important. In the long run, however, the continued role for coal will depend on successful full scale CCS.

Without coal, however, bridging the energy gap will mean allowing gas to dominate our energy mix and a second 'dash for gas' is something we need to avoid. Many countries are coming to this conclusion, including India and China, with the latter building two coal power stations each week.

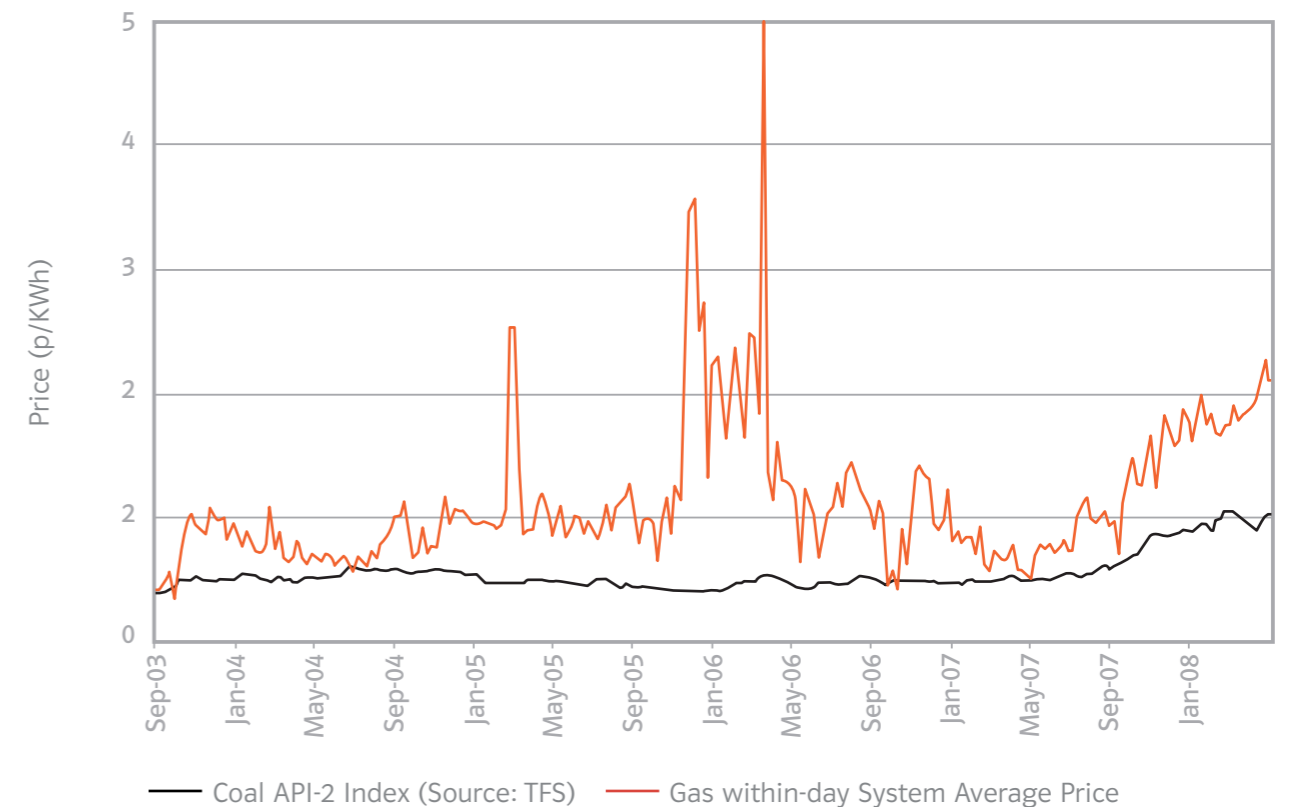
To make clean coal a reality we need to press ahead with the Government's CCS competition and build the new coal stations required to demonstrate that the technology works on a large scale. One of the biggest ironies of the current energy debate is that many of those who call for the largest cuts in CO₂ emissions are, at the same time, campaigning against the

first planned implementation of CCS in the UK. Provided CCS is proved to be effective, the UK should impose a cut-off date beyond which new coal capacity will not be built unless it is fitted with CCS. We also need to press for a global carbon trading system so that CCS technology developed here can be exported internationally.

E.ON will be reducing the running time of 3GW of coal plant before closing them in the next seven years, and also plans to build a 1.6GW supercritical cleaner coal station at Kingsnorth. The proposed new Kingsnorth power station will be built carbon capture ready and, once the technology has been demonstrated at a commercial scale, we will retrofit CCS to the new units as soon as regulatory and market conditions reward the investment. If CCS technology is proven commercially, then the UK industry overall could support six or seven such stations. Provided CCS is successfully developed, E.ON as a group will not build any coal stations beyond 2020 without the technology fitted.

To make clean coal a reality we need to press ahead with the Government's CCS competition and build the new coal stations required to demonstrate that the technology works on a large scale.

Coal vs Gas prices change over past 5 years



Nuclear

Nuclear power has the advantage of being low-carbon, comparable overall with wind generation.

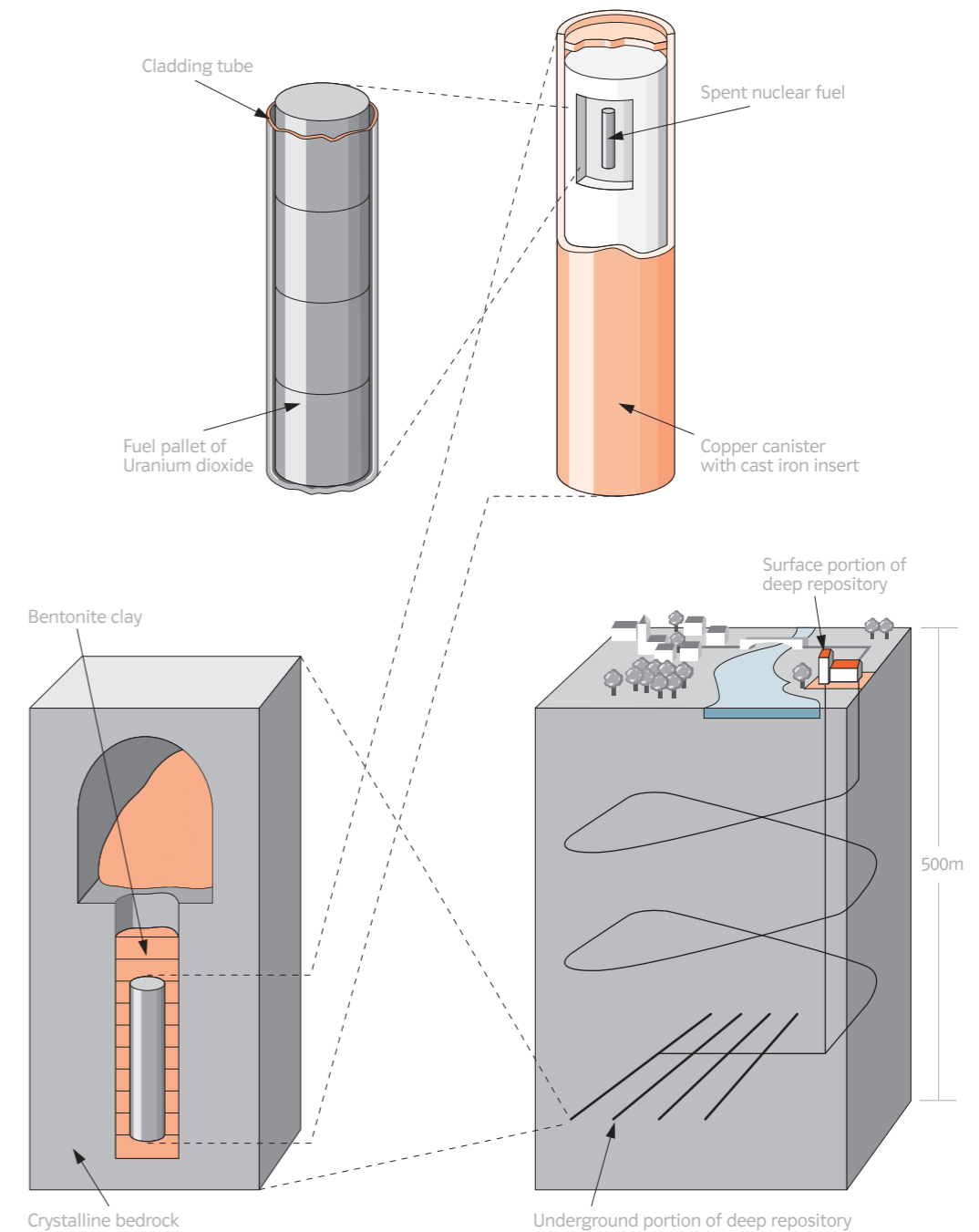
Supplies of uranium fuel are relatively cheap, plentiful and available from mature, reliable overseas markets. Though nuclear plants are economical to operate, the reactors themselves are expensive and time-consuming to plan, get approved and to build.

A further problem is the long-term disposal of nuclear waste. Although deep underground storage facilities are agreed to be the best solution for the UK's legacy nuclear waste, which is equally applicable for new waste, no specific location has yet been agreed for them. This is essentially a political, not a technical, issue. Other countries, such as Sweden, have made better progress towards implementing a safe and practical solution.

If we are to achieve a low carbon economy and maintain security of supply, then existing nuclear capacity needs to be replaced on at least a like-for-like basis, so maintaining its contribution to the UK's energy needs at between 20 and 30 per cent nuclear capacity. Indeed, not replacing our nuclear capability would almost certainly increase our carbon emissions.

E.ON is Europe's second largest nuclear power generator and is interested in developing at least two new nuclear sites in the UK, subject to the acquisition of suitable sites. New nuclear capacity can be built free of taxpayer subsidies but we need to streamline the planning system (without diminishing the effectiveness of oversight by safety and environmental regulators) and ensure clarity on waste disposal.

Deep underground storage facilities are agreed to be the best solution for the UK's nuclear waste.



Beyond 2020, the UK will depend on imports for more than 80% of its gas needs.

Gas

Gas-fired power stations are easy and relatively quick to build and gas remains comparatively cheap. In the future, it will be an important fuel for decentralised energy.

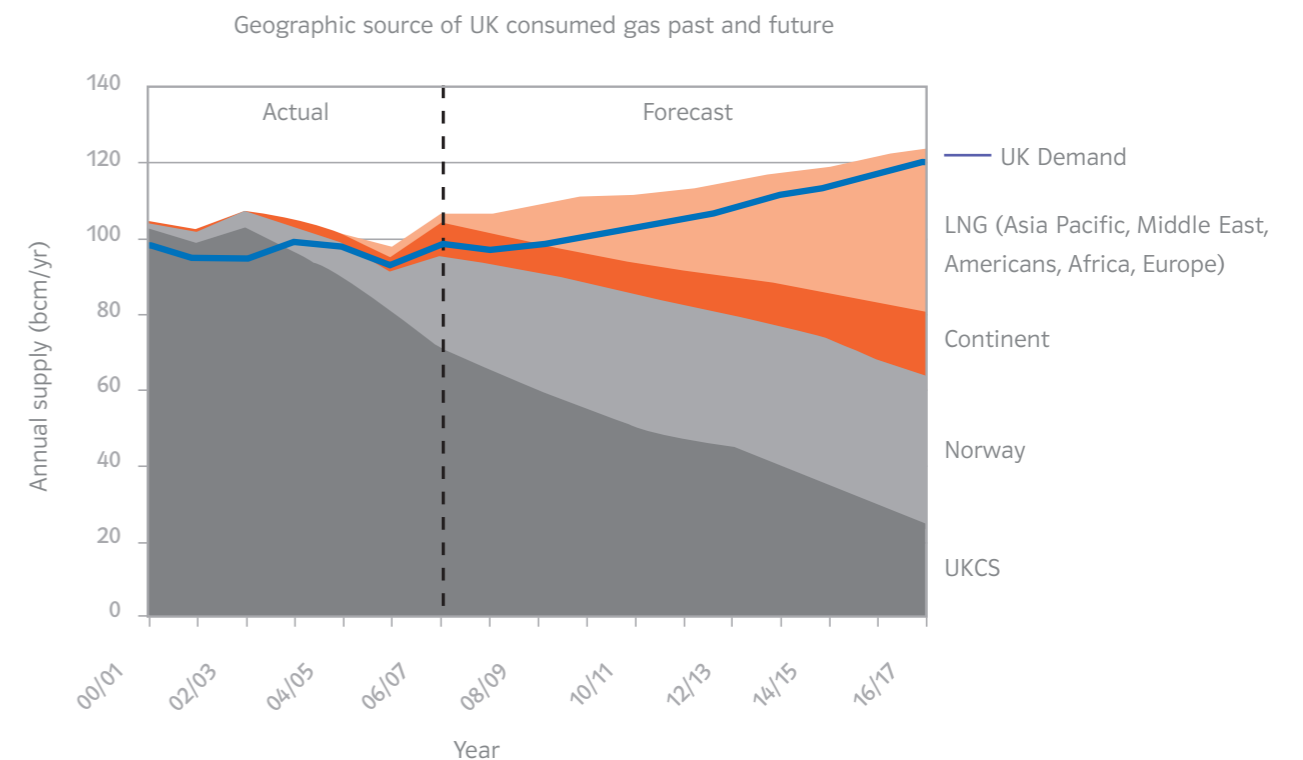
But, as North Sea supplies run out, we will be forced to rely upon gas supplies that are out of our control, which may be sourced largely from distant or unpredictable regions of the world and the subject to intense price volatility.

Beyond 2020, the UK will depend on imports for more than 80 per cent of its gas needs. We must avoid at all costs the over dependence that would result from a renewed 'dash for gas', but this time one based on a price-volatile, geographically remote resource.

At the same time, we must recognise that gas will remain an important part of the energy mix and build more gas storage capacity. Because the UK effectively used the North Sea gas capacity as storage, we have dedicated facilities to store just four per cent of our daily gas demand. In France and Germany the figure is 20 per cent. It would be unwise to allow our use of gas and our ability to store it to remain out of step.

E.ON is addressing this by investing more than £500m in new gas storage projects. The Holford scheme in Cheshire, once complete, will be capable of storing enough gas to supply around 3.5 million homes. We have also applied to build a facility in Yorkshire which is three times bigger.

We are also developing two new gas-fuelled power plants - at Grain in Kent and Drakelow in Derbyshire. The new power station at Grain is already under construction and, once built, will be one of the world's largest combined heat and power (CHP) plants, displacing the emissions of up to 350,000 tonnes of CO₂ every year through the provision of excess heat to the nearby LNG facility.



(Source: NG ten year statement 2007)

Our recommendations

In this document we have sought to highlight our view of the energy options facing the UK, and the actions the country needs to take.

We believe that the Government's policy framework is broadly correct – reforming the planning system, supporting a new nuclear programme, promoting renewables, taking forward clean coal and examining the barriers to uptake of decentralised energy. But we also believe there are two energy gaps confronting us: one in future generating capacity, the other in the current public energy debate.

On the first of these gaps – in generating capacity – the next critical step is the Government's consultation on the UK's renewable targets. These targets are a key part of the transition to lower carbon energy supply, but they are only part of that transition and should be viewed in the context of the overall scale of what is being undertaken. This opportunity should therefore be used to address a number of the key outstanding issues in energy policy. We believe the Government should:

- Clearly communicate the scale and nature of the challenge in delivering the UK's energy needs and renewable energy targets. This includes the need to invest in up to 25GW of new capacity to replace current fossil fuel (coal and oil) and nuclear capacity as it comes to the end of its life and to meet anticipated demand growth. At the same time the EU renewable target may require around 50GW of renewable capacity.

- Ensure that there is a calculation and analysis of the need to provide flexible fossil fuelled back up capacity for the increased level of intermittent renewable (e.g. marine and wind) generation. Estimates suggest that this back up capability could amount to over 90 per cent of this intermittent capacity itself. Overall then, that could require an increase in the UK's installed generating capacity from today's 76GW to more than 120GW by 2020.
- Set out the implications for the UK's energy needs and targets in terms of costs – both to make sure that consumers of power are aware of potential bills beforehand, but also to help create conditions in which investors can expect to recover an appropriate reward on their investments. These costs could indeed be massive and the consequences far reaching, but we are as yet not able to assess them accurately.

At every turn – on renewables, on coal and no doubt on nuclear – the siloed, narrow and superficial nature of the current energy debate is hampering our ability to meet the country's future energy needs.

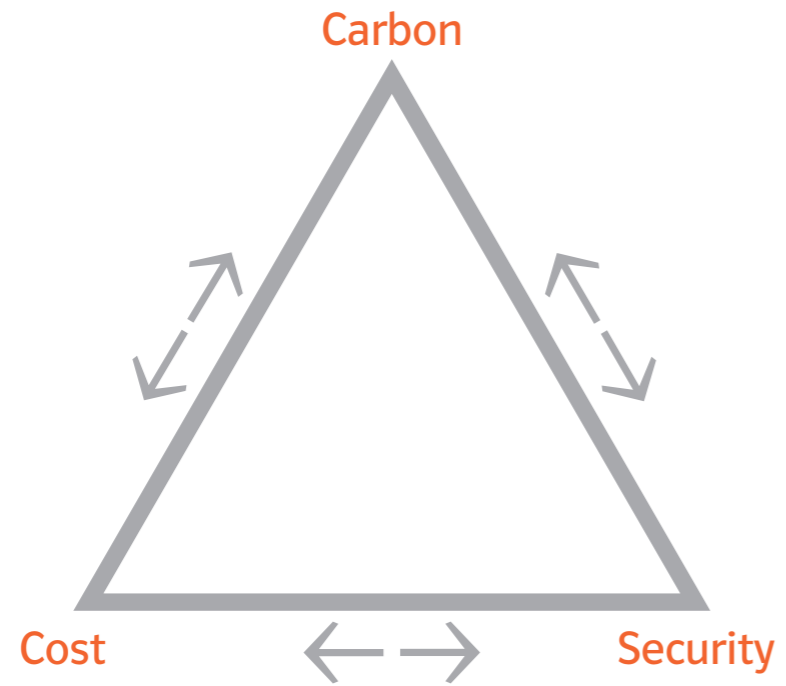
The second of these gaps – in the nature of the energy debate overall – is perhaps even wider. Whereas it is clear that the Government appreciates the extent of the issues faced, too often when these issues are raised publicly the full scale or complexity of the task before us is lost. In reality there are still as many questions as answers. Therefore, we are looking for the Government to use the latest discussion of energy policy to set a new tone for the public energy debate, one that focuses on:

- **Integrating issues:** We want the debate to stop looking only at the issue of the day, be it carbon or cost or energy security – and start to look at the connections and trade-offs between them all.
- **Transparency and honesty on the big issues:** There are difficult and complex issues to address. These issues need to be discussed with the honesty they deserve.
- **Urgency:** The energy debate should not be seen as a policy debate; it's about keeping homes warm and streets lit. Decisions taken over the next twelve months will determine how we make and what we pay for energy in the UK over the next 20 years.

- **Diversity:** Diversity is essential because the challenge of energy policy is to be sure that we will be able to cope whatever the price level or availability of one particular fuel might be.
- **Transition:** We will not get the lowest carbon energy system overnight or over a decade. We need to acknowledge there will be a transition and to make sure that during this transition energy is both secure and affordable.

In brief, we are calling for a new, balanced and honest debate about the UK's energy needs; one that truly assesses the consequence in terms of carbon, cost and security of our energy choices. Our interest in the outcome of this debate – and our willingness to fully participate in it – is driven by the fact that we have already begun to help build the energy infrastructure for the future. And at every turn – on renewables, on coal and no doubt on nuclear – the siloed, narrow and superficial nature of the current energy debate is hampering our ability to meet the country's future energy needs. We must also take the opportunity of the current massive overhaul of its generation infrastructure to make sure that the energy of the future is low carbon, secure and as low cost as possible.

There are three imperatives for energy policy - carbon, cost and security. We need to meet all three in a way which gets emissions down, maintains affordability and keeps the lights on.



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