ENERGY AND THE ECONOMY
THE 2030 OUTLOOK FOR UK BUSINESSES

A report commissioned by RWE npower
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Executive summary</td>
<td>3</td>
</tr>
<tr>
<td>An uncertain economic future</td>
<td>4</td>
</tr>
<tr>
<td>A changing energy situation</td>
<td>10</td>
</tr>
<tr>
<td>Evolving environmental concerns</td>
<td>14</td>
</tr>
<tr>
<td>Three different worlds</td>
<td>20</td>
</tr>
<tr>
<td>Implications for UK businesses</td>
<td>24</td>
</tr>
<tr>
<td>References</td>
<td>26</td>
</tr>
</tbody>
</table>
INTRODUCTION

Five years into the financial crisis, the economic outlook has never been more uncertain. Will austerity ever end? When will growth resume? Will the Euro survive? And when it is all over, what will Britain’s place in the world economy be?

The uncertainties are not just about economics. Social trends, environmental concerns and technology are also in flux. How will an ageing Britain look and how many people will there be? What is the next chapter in the unfolding IT revolution? What about biotechnology and clean tech? Will the world come to grips with environmental threats like climate change, biodiversity loss and global food security?

These questions are fascinating in their own right. In this Future Report we ask them because they have a strong bearing on Britain’s energy outlook. Of course, energy has its own uncertainties. How well will renewable energy work, and when will it get cheaper? Will there be – can there be – a new dash for gas? What of peak oil? But our energy future also depends crucially on economic, social and environmental trends.

Policy makers can help by providing clarity on their objectives and ambitions. This would take a crucial element of uncertainty away.

Many more will remain. The world is changing rapidly and energy prospects are uncertain anyway. There is no need for policy to add to it.
EXECUTIVE SUMMARY

In the npower Future Report, ‘Demanding times for energy in the UK’ published in 2011, we looked at UK energy in 2020. This year we direct our crystal ball further into the future and develop energy scenarios out to 2030. The further ahead one looks, the more outcomes are conceivable. The npower Future Report 2012 - *Energy and the economy: The 2030 outlook for UK businesses* describes many of these possibilities, but ultimately we restrict ourselves to three plausible scenarios.

Scenario One, ‘*Hitting the target*’, involves a high degree of political cohesion and direction, supporting record levels of investment (up to £330bn) in the power sector and driving down carbon emissions to achieve the long-term 2030 target. This is the fulfilment of the current plan, made possible by an eventually recovered Eurozone and UK economy; more trade integration, specialisation; a focus on green growth and productivity gains; and recovered financial institutions. The EU remains a market leader on low-carbon technology.

Scenario Two, ‘*Gas is key*’, resembles the dash for gas scenario from npower’s 2011 Future Report. Short-term price gains by switching into gas power are followed by environmental problems from missed carbon targets. The presence of gas-fired capacity slows down needed structural change, and necessitates costly action when carbon constraints bite. This scenario depends less on what happens economically in the Eurozone and internationally. However, we imagine there might be less committed political action in Europe, fewer productivity gains and more fractured trade patterns. The Eurozone will still eventually recover, but the momentum is with Asia, which is catching up with Europe in productivity and growth.

Scenario Three, ‘*Austerity reigns*’ is less optimistic about the economic and technology outlook. Confidence and therefore investment are low, but less is needed due to ongoing Eurosclerosis and continued stagnation in UK. The grid ages and upgrades are not driven by a need to accommodate renewable energy. Some technologies like carbon capture and storage (CCS) and shale gas fail technologically or otherwise are not delivered. In the meantime, the BRIC countries (Brazil, Russia, India and China) motor ahead.

Of course, many other possibilities and permutations are also conceivable. Fortunately for British energy users, the best way to prepare for this uncertain future is independent of what the ultimate outcome will be:

- manage energy well and make it a senior management issue;
- focus on energy efficiency because energy will be more expensive come what may and being cost-competitive is more important in slack markets;
- take advantage of self-generation opportunities, for example from renewable heat, solar PV or the short-term operating reserve market discussed in npower’s 2011 Future Report; and
- follow policy developments and understand what they mean for each of us.
AN UNCERTAIN ECONOMIC FUTURE

- Fast growth in emerging economies is likely to continue as they catch up with developed countries. But as their incomes rise, their growth will begin to slow.

- The centre of economic activity is shifting eastwards towards Asia.

- As Europe’s population ages, its economic growth rate could slow, perhaps to 1.4 per cent per annum by 2030.

- Meanwhile, global trade volumes are growing faster than GDP.

- More migration could accompany greater trade.

- Wages may become more unevenly distributed, with relative wages falling for unskilled workers.

- Europe’s future is influenced by many choices on regulation of financial markets, labour and competition.

- The shock administered to European growth may lead to more far-reaching supply-side reforms, with greater product- and labour-market competition stimulating innovation and keeping down costs.

- Governments may take the need to tackle market failures, not by more regulation but by smarter regulation, more seriously because of the financial crisis and threat of climate change.

- Exacerbated by the global downturn, European fiscal problems may hold back demand growth, harming the growth of potential supply as unused plant and equipment become obsolete and unemployed workers forget their skills.

- To the extent that emerging markets continue to try to build up foreign exchange reserves, there will be a counterweight to European depreciation.

- The mounting foreign liabilities of some countries e.g. the USA and the UK, would be likely to place doubt on the ability of them to service their debts.

- The UK’s exports are disproportionately sold to nations growing more slowly than the global economy.

- The UK is well placed to benefit from the unbundling of tasks along supply chains, providing high-value-added business services that do not incur high transport costs and can therefore be supplied from wherever the skills are concentrated.

- In the UK, there could be a growth rate of about 4 per cent per annum in nominal terms (assuming the government sticks to its inflation target of 2 per cent per annum).

- Increasing globalisation is likely to lead to an increasing divergence between average incomes and the pay of ‘megastars’.
The **global economy** has slowed unexpectedly sharply in 2012 and is unlikely to take up all the slack in labour and product markets rapidly. Most regions have been affected, although growth rates have continued to be higher in emerging-market economies than in the advanced industrial nations. The way and the speed with which the global economy recovers will have implications on global energy demand and prices.

Over the longer term, it is likely that growth in developing countries will continue to outstrip that in the developed world. However, by 2030, emerging markets are likely to have narrowed the technological gaps between them and the countries with the highest levels of productivity. As the scope for ‘catch-up’ lessens, the gap in growth rates is set to fall. The Organisation for Economic Cooperation and Development (OECD) estimates the trend rate of GDP growth in the developed world – the OECD’s members – to remain at around 2 per cent per year out to the 2030s. Meanwhile, in the developing world it is likely to decline from around 7 per cent per year in the early years of this millennium to around 3 per cent (OECD, 2011).

As a result of the differential growth, the composition of the world economy will look quite different in 2030. In terms of GDP (measured using purchasing power parity calculations), China is likely to have overtaken the United States as the world’s biggest economy, while India is likely to have taken the third spot, moving well above Japan. Germany will probably be overtaken by both Russia and Brazil, with Mexico and Indonesia close on the heels of the UK and France. But the most advanced industrial nations today are likely still to have higher incomes per head in 2030 even though living standards will have converged to a considerable extent.

Economic **growth in Europe** is likely to be held back by slower growth of its population of working age and higher dependency ratios, as pensioners make up a larger and larger share of the total population. The OECD envisages the underlying growth rate of GDP in the euro area falling from around 1.8 per cent per year prior to the onset of the global economic crisis to around 1.4 per cent in the 2030s. The UK’s demographic profile is a little more favourable for growth, and the corresponding projections are for only a small fall, from 2.4 per cent to 2.3 per cent. There is plenty of scope for actual growth rates to be higher for a while once the current downturn is reversed, as slack is taken up in under-utilised capital and under-employed workforces.

However, there are many risks around this outlook. On the upside, the shock administered to European growth may lead to more far-reaching supply-side reforms, with greater product- and labour-market competition stimulating innovation and keeping down costs. The crisis in financial systems, which has hit Europe particularly hard, may lead to better financial regulation, reducing the volatility of growth over the next 20 years, matching saving and investment flows more efficiently, and underpinning greater inward investment.
The financial crisis and the threat of climate change may also make governments take more seriously the need to tackle market failures, not by more regulation but by smarter regulation. That would help promote competition, energy security, appropriate public infrastructure investment and technological progress. The greater integration of the world economy and the tendency towards convergence of per capita incomes may make migration easier overall and more responsive to economic incentives, allowing ageing Europe to recruit a more rapidly growing workforce from other regions. Those countries lagging the more competitive European nations – largely northern European, according to the World Economic Forum’s index of competitiveness – could catch up with the leaders as European economic institutions encourage the spread of best practices (Schwab, 2011).

On the downside, the European fiscal problems have been exacerbated by the global downturn and may hold back demand growth, harming the growth of potential supply as unused plant and equipment become obsolete and unemployed workers forget their skills. This is a particularly high risk in the Mediterranean periphery of the EU. The problem would be made worse if attempts to balance government budgets are punctuated by repeated financial crises triggered perhaps by sovereign debt defaults and weakened banks.

Uncertainty about the future of the euro area could act as a chilling factor on inward investment and stimulate outward flows of funds to non-European ‘safe havens.’ Reluctance to sanction larger and larger financial transfers within the EU could encourage more protectionism, while political pressures from unskilled workers and the increasing numbers of the elderly could slow the pace of fiscal recovery, giving governments less scope for spending on productivity-enhancing public infrastructure and climate-change mitigation.

The UK is not immune to these risks. Although the UK is among the more competitive nations in the EU according to a number of measures, it is highly dependent on the growth of exports to the rest of the EU, its largest trading partner. Its fiscal position and its economic growth are tied more closely to financial stability than most of the rest of Europe.

Economic recovery in Europe depends heavily on the prospects for trade. Global trade volumes will probably increase more rapidly than GDP, as more and more countries seek to exploit their comparative advantages and nations such as China and India have to import larger fractions of their raw materials, especially energy. Supply chains might involve more cross-border transactions, as production tasks are unbundled more and reallocated rapidly to different suppliers in response to changing relative costs, with less regard to their location.

Whether Europe can take advantage of these trends depends on the level and volatility of exchange rates, productivity growth in European industries relative to their competitors and the attractiveness of Europe for inward investment.
The OECD assumes in its central long-term scenario that real exchange rates among advanced industrial countries – that is, exchange rates adjusted for relative changes in overall price levels – do not change out to 2030. As long as these countries maintain their inflation-targeting monetary policy regimes, this should translate into broadly stable nominal exchange rates, too. Emerging-market economies are likely to see some appreciation of their real exchange rates with advanced industrial countries, reflecting the probable more rapid productivity growth across developing countries in industries producing tradable goods and services, as they try to catch up with the current technological leaders. However, stronger monetary discipline and lower inflation targets mean that European currencies may not depreciate in nominal terms to the extent that this mechanism might suggest.

Also, to the extent that emerging markets continue to try to build up foreign exchange reserves, there will be a counterweight to European depreciation. It is unlikely that this tendency will persist through to 2030, as it would imply persistent current account imbalances across the world. The counterparts to emerging-market surpluses are developed-world deficits. At some stage, the mounting foreign liabilities of countries such as the USA and the UK would be likely to call into question the ability of these countries to service their debts. That highlights an important risk, that broad trends in exchange rates could be obscured and drowned out by sharp fluctuations brought about by new European financial crises.

The associated exchange rate uncertainty would discourage trade and investment.

The UK’s position as possessor of its own currency, an independent monetary policy and the ability to sell abroad government debt denominated in its own currency may insulate it from some of the travails of the euro, but it is still vulnerable to the exchange rate fluctuations of its major trading partners and to economic shocks ‘made in Britain.’

With respect to trade in goods and services, the UK’s exports are disproportionately sold to nations that are growing more slowly than the global economy. The UK does appear, however, to have a comparative advantage in some industries such as pharmaceuticals, aerospace and business services for which global demand is growing more rapidly than the average. Some of these industries are likely to maintain their technological edge for longer, because of their dependence on scientific research, proprietary knowledge and the synergies available in geographical centres of excellence. The UK is also well placed to benefit from the unbundling of tasks along supply chains, providing high-value-added business services that do not incur high transport costs and can therefore be supplied from wherever the skills are concentrated.

On the European job market, wages might increase more rapidly than they have recently, and in the long run will probably rise broadly at the same speed as underlying labour productivity, as they have tended to over longer time spans in the past.
In the UK, that could mean a growth rate of about 4 per cent per annum in nominal terms (assuming the government sticks to its inflation target of 2 per cent per annum).

However, the outlook is different across the workforce. In particular, wages for the unskilled are likely to be held back by the increasing integration of unskilled workers from developing countries in the international division of labour and the continuing replacement of unskilled labour by programmable machines.

At the other end of the income distribution, increasing globalisation is likely to lead to an increasing divergence between average incomes and the pay of ‘megastars’ in different professions, as the competition for people with aptitudes in very limited supply is further internationalised. In the lottery for human endowments, the prizes for the winners will get bigger, just as they have in conventional lotteries as their markets have widened.
A CHANGING ENERGY SITUATION

- The global rate of growth in electricity demand has been falling for four decades, but electricity consumption is still set to double between 2010 and 2035.

- It will take trillions of dollars of investment to develop and extract the fuels and build the infrastructure to satisfy expanding consumption while maintaining baseline production.

- The price of gas in Europe remains both higher and more uncertain than in the US, pending policy decisions on allowing the production of gas from European shale reserves.

- Nevertheless, gas will displace coal in Europe, because it is lower carbon per unit energy.

- Despite the growth in gas-fired generation, we expect a much more rapid expansion in renewable power.

- A greater proportion of energy may be delivered as electricity in the future, if transport and heating migrate from hydrocarbons to power.

- There is a global market for coal.

- If fuel sourcing for power continues under current policies, there will be a massive expansion of coal consumption globally and the consequence will be, barring the adoption of carbon capture and storage, a much warmer planet.

- Nuclear power may be less favoured because of its relatively high costs and a lack of political support.

- The UK has a good record internationally, some of it policy driven, some from structural change in the economy, and some due to the adoption of efficient production techniques.

- Working against improvements in efficiency are other factors which push up electricity consumption.
World electricity consumption doubled in the 15 years from 1971 to 1986, growing at 4.7 per cent per year, before slowing to a growth rate of 2.8 per cent and doubling again over the following 25 years to today. Over this period, demand for power was driven by an expanding economy and was tempered by improvements in energy efficiency (International Energy Agency, 2011).

Looking forward to 2035, demand for electricity is expected to grow at a much slower rate, perhaps 1.9 per cent per annum, or around 60 per cent overall, according to International Energy Agency projections. This partly anticipates lower economic growth as described before.

Nevertheless, it will take trillions of dollars of investment to develop and extract the fuels and build the infrastructure to satisfy expanding consumption while maintaining baseline production. Inter-regional competition will ensure that regional energy prices remain strongly linked together but, as Figure 1 shows, some regions are endowed with lower cost access to energy sources than others.

Reflecting the need to attract this investment, forecasts show the cost of gas imported into Europe and other regions rising. Since gas is an important input to power production, this trend will force up the price of electricity.

Figure 1. Gas prices are expected to rise in Europe (blue) and other regions (red and black): In Europe, the rise over the next fifteen years could be as great as it has been over the last fifteen years.

Note: Prices are reported in 2012 money in real terms. Source: IEA and Vivid Economics
Europe did not benefit as much as the USA from the dramatic downward movement in gas prices between 2007 and 2009. Caused initially by the economic recession and followed immediately by massive additional supply from shale gas, the USA has seen gas prices fall and energy production surge. In contrast in Europe, gas prices have fallen by less, and energy output has not expanded, as investors have focused on the US and politics has acted as a brake on development. These conditions may ease, if Europe’s appetite to exploit shale gas and similar tight reserves increases, although the prospects for shale gas in Europe may be more limited than in the US.

In contrast to gas, there is a truly global market for coal, characterised by abundant reserves and a slower pace of technical change. Much of Europe’s coal supply is imported, which makes it politically easier to favour other energy sources, with exceptions such as Poland, which has large coal assets.

However, coal is the most carbon-intensive fuel per unit of energy produced, and so is the most sensitive of all the fossil fuels to climate change policy. If fuel sourcing for power continues under current policies, there will be a massive expansion of coal consumption globally and the consequence will be, barring the adoption of carbon capture and storage, a much warmer planet. In Europe, where governments have addressed themselves to the problem of global warming, coal consumption is likely to decline steeply. Hence gas prices will become the key commodity price in power supply.

**Nuclear power** is now looking less favoured because of its relatively high costs and a lack of political support. This position may change when the costs of decarbonising the power system become apparent. There are pronounced differences across Europe, with countries like Germany, Austria and Switzerland moving out of nuclear, while the UK, for the time being, persists with its nuclear expansion programme. Europe’s largest nuclear generator, France, is reconsidering its approach, but is likely to stick with a technology in which its companies have a comparative advantage EU-wide.

Within Europe, the electricity sector is embarking on a large investment programme of plant construction to replace plant built in the 1950s, 60s and 70s, particularly coal and oil-fired plant with little remaining mechanical life, whose emissions do not comply with modern standards. An ambitious programme of renewable power generation, although still vulnerable to withdrawal of political support, accompanies the fossil-fuel power investment. The new fossil plant is most likely to be gas-fired because, in common with the US, the economics of gas-fired plant are more attractive than for coal, an advantage which grows as the carbon price rises. In the UK, that increase in carbon price is already assured, but in Europe, firmer carbon prices lack all-round political support. The extent to which the resistance of countries like Poland might soften over time depends not least on the economic outlook. Many of them have made economic growth their over-riding policy priority.
Attempts are being made to cut the requirement for new investment in power generation by improving energy efficiency across Europe and in the UK. In this aspect, the UK has a good record internationally, some of it policy driven, some from structural change in the economy, and some due to the adoption of efficient production techniques. The UK has policies in place to promote efficiency, but much of this policy addresses space heating, with little impact on power demand.

Working against improvements in efficiency are other factors which push up electricity consumption. The UK has a rising population, like Europe as a whole, and increasing levels of income per person. Both contribute to rising demand. In the period to 2030, these drivers of higher demand may be joined by other drivers, which may come to dwarf them in the 2030s. This new source is the electricity for light road transport, heating and cooling. It is hard to predict the adoption of a new technology: electric cars, heating and cooling are no exception, in the case of cars in part because of their uncertain future costs. If they were to represent a substantial proportion of passenger distance travelled by 2035, it could significantly alter the total amount of power needed.

This combination of demand effects and fuel choices lead to quite different growth rates in coal, gas and renewable power production across Europe, as illustrated in Figure 2 for a scenario of moderate climate change policy.

**Figure 2.** Coal to gas switching and renewable power growth are the principal trends in Europe.

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*Note: Data is indexed to 2008. CAGR is the compound annual growth rate. RES stands for renewable energy supply. Source: IEA (New policies scenario) and Vivid Economics*
EVOLVING ENVIRONMENTAL CONCERNS

- The UK has committed itself to cutting greenhouse gas emissions by 50 per cent by 2025.

- Electricity generation will have to be all but carbon-free within 15 years.

- A recent survey of 17 countries showed 174 laws on climate change, renewable energy, energy efficiency, clean transport and forest preservation.

- A new global agreement on climate change would create an attractive new market in green technology.

- Even though the UK has tied its hands through legislation, investors remain nervous, since political signals are mixed and future administrations could untie the knot.

- Other countries, including emerging markets, are passing climate legislation, but an international agreement may remain elusive for some time.

- The degree of international cooperation on climate change is an influence of ambition in Europe and consequently in the UK.

- The market for green technology is driven by policy, and the strength of demand, and whether it comes from unilateral, domestic or multilateral, international policy, remains uncertain.

- By the 2020s, observed climate signals, for example, the melting of the Arctic summer ice, could be strong enough to visualise the risks of climate change and trigger an international response.
Britain’s energy outlook is closely linked to environmental policy, and in particular concern about climate change. The Climate Change Act of 2008 clearly stipulates Britain’s climate change objectives: to reduce greenhouse gas emissions from all sources by at least 80 per cent by 2050, relative to 1990. The target is to be achieved through a series of five-year carbon budgets, the first four of which have already been legislated. They foresee a 50 per cent cut in emissions by 2025. According to the independent Committee on Climate Change (Committee on Climate Change, 2011) electricity generation will have to be all but carbon-free within 15 years.

Set over a decade ahead of time, the carbon budgets are intended to provide certainty over the medium-term emissions outlook. Yet many factors remain uncertain, including not least the international and European context in which the UK pursues its climate change policy.

Internationally, the last climate change summit in Durban, at the end of 2011, called for a new global agreement to be reached by 2015. The agreement would be in force by 2020 and curtail global carbon emissions through the 2020s. It would cover all major emitters, including emerging markets like China and countries at the periphery of international climate policy, notably the United States. A comprehensive agreement of this kind would create an attractive new market in green technology – from renewable energy to electric cars, smart grids and low-carbon homes. It would probably involve the international coordination of carbon policies, for example through interlinked carbon markets. The European Union and Australia are already working to link up their emissions trading schemes, creating trading opportunities and operational challenges for electricity producers in equal measure.

However, the success of the international negotiations is far from certain. There was agreement in Durban, but past experience suggests the international process will be slow, piecemeal and incomplete. It is possible that important emitters – notably the US – may remain outside the process for many years. Under this scenario climate change policy would be pushed forward by domestic, rather than international action.

There is already a lot of domestic action. A recent survey in 17 countries found no fewer than 174 laws on climate change, renewable energy, energy efficiency, clean transport and forest preservation (Townshend et al., 2011). These efforts are likely to continue. Countries like China and South Korea – and the European Union – have made ‘green growth’ a strategic priority. Others, like Canada and the US, will promote clean tech primarily as a hedging strategy. By 2030, this investment may support a substantial market in clean tech and cause the breakthrough of technologies like solar photovoltaics.

But a meaningful agreement to coordinate and accelerate international efforts would not be in place before the early 2020s. Further delays are possible, although by the 2020s observed climate signals, for example the melting of the Arctic summer ice, could be strong enough to visualise the risks of climate change and trigger an international response.
The European Union plays an important part in international climate diplomacy. A successful climate agreement by 2015 would almost certainly require strong European commitments on its own emissions, cutting them by maybe 30-40 per cent by 2030 against the base level of 1990. This is an EU-wide average. Under EU burden-sharing rules, southern and eastern European countries would adopt weaker targets, while the UK, Germany and other climate leaders would cut more.

If an international agreement is delayed, the European Union would probably be slower to ratchet up its carbon commitments, particularly if the Eurozone’s financial problems persist. The EU would still tighten its emissions trading scheme, which covers electricity generation, to support the European carbon price. However, countries like Italy and Poland would get their way in postponing tighter targets than the 20 per cent emissions cut already agreed for 2020.

There is pressure on the government to soften its low-carbon commitments, and the international situation will influence the domestic debate. The fourth carbon budget for 2023-27 is subject to a review in 2014 (depending on whether the EU sets tighter emissions reduction targets), and the fifth budget for 2028-33 will be set in 2016. This provides opportunities for the government to alter its stance on climate change, perhaps in response to growing scepticism of its policy among backbenchers and popular opposition to wind energy.

The independent Committee on Climate Change, which recommends the carbon budgets, is likely to maintain its current stance, insisting on cuts of around 50 per cent during 2023-27 and perhaps around 60 per cent for 2028-33 (Climate Change Committee, 2010). However, it is possible that the government may not follow the advice. The result would almost certainly be a judicial review, initiated by green pressure groups, which would bring about an extended period of policy uncertainty. At that point, changes to the 2008 Climate Change Act might be contemplated, although as seen in the international debate, increasingly strong climate signals make this less likely as time goes by.

The Committee on Climate Change insists that to achieve decarbonisation of the electricity sector, there is little scope for additional gas without carbon capture and storage. Nevertheless, ministers may be swayed by vocal proponents of a second dash for gas (see the energy scenarios on page 20). The government may also be slow in providing the support framework required for low-carbon energy such as nuclear or renewables.

The result would be a substantial pool of gas-fired combined-cycle power plants that by 2030 would either have to be retrofitted with CCS technology or used sparingly as back-up to intermittent renewable energy sources.

As a last resort, the government may be forced to enter the international carbon market to offset excess carbon emissions. At the moment, international offsets are not part of the UK’s decarbonisation strategy, but it might be a more palatable departure from current policy than revising the carbon budgets.
Energy and the economy: The 2030 outlook for UK businesses

Three potential scenarios for the UK’s energy future.

**Hitting the target**

- **50GW** renewables capacity
- **10GW** Gas-fired plant fitted with carbon capture & storage
- **£330BN** investment
- **67GW** Total combined controllable output
- **16.5GW** of nuclear plant
- **40.5GW** fossil plant left unabated
- **18%** of 1990 levels

**Gas in instead**

- **20GW** onshore and offshore wind (four-fold increase on 2010 capacity)
- **£180BN** investment
- **42%** of 1990 levels
- **EU remains a market leader in low carbon technology**
- **Asia catches up in terms of productivity and growth**

Carbon emissions of 1990 levels reduced significantly.
Ongoing Eurosclerosis and stagnation in the UK means less investment is required for wind turbine capacity (double 2010 capacity).

The BRIC countries motor ahead...
This section contains results from three possible power market investment scenarios in the UK:

- **Hitting the target**
- **Gas is key**
- **Austerity reigns**

They combine different aspects of the economic, energy and environmental futures discussed so far. All are modelled using DECC’s published pathways tool, with some adjustments.

**Hitting the target**

In the first scenario, ‘Hitting the target’, there is a high degree of political cohesion and direction, which supports record levels of investment in the power sector and drives down carbon emissions to achieve the long-term 2030 target. **Carbon emissions in the power sector are reduced to just 18 per cent of 1990 levels through a massive investment programme. A total of nearly £330 billion of capital investment in generation plant, excluding network upgrades, is deployed by 2030.** In this programme, 10 GW of gas-fired plant is fitted with carbon capture and storage and 40.5 GW of fossil plant capacity is left unabated. This fossil plant is accompanied by 16.5 GW of nuclear plant, giving a combined controllable output of 67 GW, substantially less than today’s thermal fleet, requiring the presence of storage, use of on-site stand-by generation and demand-side management, as described in npower’s 2011 Future Report. There is a further, massive, 50 GW of renewables capacity. It is possible that even more controllable capacity might be needed, pushing the investment figures still higher. This large total capacity is shown in the first column of Figure 3.

This scenario requires determined government action and cross-party support, with political will boosted by similar actions internationally. It involves a financial services sector in good health, that has not only recovered sufficiently to channel higher levels of inward investment and to attract international investment to the UK, but has become more efficient at matching savings and investment than before the 2008 crash, and has raised the supply of savings as a result.

This is consistent with background higher, stable growth, optimism about future economic performance and the solution of the Eurozone’s current problems. This rosy economic outlook might involve contributions from freer international trade, migration of a young, skilled workforce to the UK, increased spending on research and development, a dynamic private sector enhanced by rigorous enforcement of competition law and new models of longer-term shareholding, and reduced spending on defence.

The power industry in 2030 is serviced by a substantial offshore services sector, building and maintaining offshore wind turbines and carbon dioxide pipelines and platforms. **Onshore, domestic shale gas production has made a significant contribution to UK energy supply, a picture reproduced in many northern European countries, although most of Europe’s gas remains imported. The nuclear industry is maintained at roughly today’s levels with a firm plan in place to address legacy and future nuclear waste.**
Gas is key

In the second scenario, ‘Gas is key’, moderate commitments to deal with greenhouse gas emissions and competitively-priced gas supplies are sufficient to dissuade investors from financing new coal-fired power stations, with the result that all fossil plant is gas-fired. Rapid development of shale gas reserves in Europe and its neighbours (including, to a much smaller extent, in the UK), relieves pressure on gas prices. Concerns about nuclear costs and wavering political support put off investors, who see nuclear investments as too risky. While some of the current nuclear generation sites are upgraded, most plans for new stations gather dust.

This moderate policy delivers enough support through carbon prices and technology-specific support for around a quarter of fossil plant to be equipped with carbon capture and storage, and so there is a total of 75 GW of controllable thermal plant available to service demand. To this is added 20 GW of onshore and offshore wind, a four-fold increase on capacity in 2010, as shown in Figure 3. These wind investments remain the domain of specialist investors, with the UK struggling to attract a large enough share of energy sector investment internationally to build more wind turbines. In part, this is because turbine prices remain high while gas prices have fallen, and in part because large power utilities find themselves stretched to meet investment demands across Europe, with investors demanding high and continuous returns. In this scenario, the UK’s initially poor economic growth and uncertain regulatory environment makes it a riskier proposition with poor or moderate returns relative to alternative locations in Europe and the USA.

The investment required to deliver this scenario is much lower than for ‘Hitting the target’. This makes the scenario easier to implement, although the subsequent costs to operate plants and buy fuel are higher. The investment is split equally between conventional fossil and low-carbon plant, whereas in ‘Austerity reigns’, the investment is only in low-carbon generation. The ‘Gas is key’ scenario shows a dash for conventional plant during the 2010s, and for a decade the greening of the power sector is a lower priority than economic growth and competitiveness. The Treasury controls the purse strings and the climate change agenda is put on the back burner.

This direction changes sharply in the early 2020s, after the economy has recovered and the Eurozone has stabilised, in response to committed international agreement to tackle global warming, creating a galvanised political will in the UK to address climate change. This is in part because of changes to the climate which have become more obvious to the lay person, including the loss of the Arctic summer ice, the retreat of glaciers, and the occurrence of heat waves and droughts in Europe, the USA, India and China.

The result is a programme to retrofit the relatively new gas-fired power stations with carbon capture and storage which, by the end of the 2020s, has converted up to a quarter of the conventional plant. Few additional wind turbines are built, since the conventional plant are already in existence and additional generation capacity is only required to make up for the power consumption of the carbon capture units.
Austerity reigns

The third scenario, *Austerity reigns*, represents an absolute prioritisation of economic growth and fiscal stability in a UK economy which has seen stagnation followed by anaemic growth. This poor long-term performance is symptomatic of general under-investment not only in energy, but also in public infrastructure and private enterprises. The financial services sector and corporate ownership has been inadequately reformed, trade barriers remain in place, and populist pressure has prevented the UK from allowing inward migration to boost its workforce and stimulate innovation. There is little investment in carbon capture and storage beyond a demonstration programme, and a mere doubling of wind turbine capacity from the 2010 figure. The lowest cost options are pursued, with carbon prices remaining in place at a low level, ensuring that no new coal-fired power stations are built but being insufficient to support any low-carbon technologies, including nuclear power.

In this scenario, there is 75 GW of controllable thermal plant of which nearly 70 GW is without CCS. The capacity figures are shown in Figure 3. Capital investment replaces old plant with new, but the investment total is around £50 billion below the *Gas is key* at around £130 billion.

The scenarios illustrate how necessary favourable investment conditions are to allow both the financial flows to the energy sector to take place, and for the commitment to higher-cost low-carbon generation to be established and maintained. Any weakness in the investment chain, from political determination, through the financial services sector, to the power generation companies compromises the chances of hitting the carbon dioxide emissions target. The whole system has to be in good health to deliver the outcome which the Committee on Climate Change has recommended. As Figure 4 shows, while the first scenario exceeds the target, both the other scenarios, where there is some dysfunction, fall considerably short, leaving emissions at 42 per cent and 54 per cent of 1990 levels in 2030.

Further afield, the distress of the Eurozone has eroded political will and European countries have been unable to sustain their resolve to deal with global warming, and thus have been unsuccessful in leading international discussions towards action on climate change. The USA has remained resolved against international action to deal with climate change, having failed to address its structural fiscal deficit and at last found its cost of borrowing rising, and is preoccupied with domestic economic concerns.
**Figure 3.** Different scenarios result in varying generation capacity needs by 2030

![Diagram showing generation capacity in 2030 for different scenarios: Hitting the target, Gas is key, Austerity reigns.](image)

*Note: Carbon capture and storage applies to thermal plant fired by coal or gas. The electricity supplied in each scenario is the same, but scenarios involving more intermittent wind and solar power require more capacity to generate the same amount of electricity.*

*Source: Vivid Economics*

**Figure 4.** Decarbonising electricity generation requires timely action to lower the emissions path.

![Graph showing emissions from 2015 to 2030 for different scenarios: Hitting the target, Gas is key, Austerity reigns.](image)

*Note: The Climate Change Committee’s recommendation of 80 per cent decarbonisation of UK power generation by 2030 from 1990 levels is shown in red.*

*Source: Vivid Economics*
IMPLICATIONS FOR UK BUSINESSES

The future of UK energy is uncertain. This report paints a picture of an integrated web of issues and influences in economic growth and finance, in energy supply and regulation, and in low-carbon technology development and deployment. The scenarios we outline are only three of many possibilities and permutations.

Fortunately for British energy users, the best way to prepare for this uncertain future is independent of what the ultimate outcome will be. In this section we outline the key measures businesses may take. Some of them have to do with the way energy is managed within a company. Others concern the involvement of business in the public debate on energy policy. Both are important.

Manage energy well and make it a strategic issue

UK energy users may prepare for a wide range of possible power prices over the next two decades, as the scenarios in this report have shown. This is a product of uncertainty in the cost of the principal fossil fuel, natural gas, and the scale of ambition and technology cost for decarbonisation.

Future uncertainty makes energy a more strategic issue than it has been in the past. Energy supply and demand management in energy-intensive businesses should be of interest not only to the energy team, but also to senior management and the board. For those with direct interests in the power sector and its technologies in particular, there is advantage in being positioned flexibly to cope with both feast or famine, although policy might in due course provide more certainty about the market opportunity.

Focus on energy efficiency

For most energy users, the main choices under management control are investments in energy efficiency: incorporating a full-range of electricity power price scenarios into the assessment of options for new assets and maintenance programmes, selecting more power-efficient plant and fittings where available and economically justified. The uncertainty in the cost of power makes these choices more complicated to assess and the investments more risky to undertake, and is likely to lead to less investment than is socially optimal.

Make good use of own generation

In addition, there are opportunities to become more energy self-sufficient by taking advantage of still-generous support programmes on small-scale renewable electricity and renewable heat. Flexible energy users may participate in the market that manages short-term operating reserve. It is evident in 2011’s Future Report that there are potential benefits to sophisticated companies from moving demand peaks, for example, by temporarily reducing heating or cooling demand or making their back-up generators available to the system operator.
Follow political developments and understand what they mean

The future composition of UK power supply is not merely a question of carbon prices and the energy market regime constructed by the UK government, although these are of crucial importance. It depends upon a much wider set of issues. These relate to the general investment environment in the UK, and in particular the relationships between bankers, investors and energy companies. They also extend well beyond the UK to include the extent of international trade liberalisation and migration, the economic performance of the Eurozone and the climate change and economic policies of the USA and the BRIC countries.

Energy users would also do well to understand these issues. They can also assist the process by supporting government in attempts to improve the investment environment for energy investment in the UK, to encourage investment across the economy to stimulate economic growth, and to reach international agreement on climate change action. These outcomes would bring the needs of society and of companies more closely into alignment.

Be ready to commit

All that has been discussed in this document matters because energy supply is one of the foundations of the economy and society, and is just as important as education, healthcare, communications, defence, transport or justice. The fundamental, revolutionary and urgent reforms that will decarbonise energy supply demand great commitment from managers, investors and government. Only through political commitment will the investment flow, and only through agreement on the path to follow will consumers and investors be committed.

Call for a level playing field

The best remedy for higher costs, which undermine the competitiveness of energy-intensive firms, is if those higher costs are faced by all of a firm’s rivals. To create this level playing field, more thought could be given to the introduction of border carbon adjustments for imported and exported energy-intensive goods. In the meantime, the managers of some energy-intensive businesses will have to consider where regionally to invest in production capacity. If European governments tackle the financial, economic and environmental challenges ahead in a sober and thoughtful manner, the environmental challenge can be met without discouraging investment in energy-intensive industries. If they do not, then it may cause some investment to flow elsewhere.
REFERENCES

Climate Change Committee. (2010). The fourth carbon budget reducing emissions through the 2020s.


