



Department
of Energy &
Climate Change

Energy Security Strategy



November 2012



Energy Security Strategy

Presented to Parliament
by the Secretary of State for Energy and Climate Change
by Command of Her Majesty

November 2012

© Crown copyright 2012

You may re-use this information (excluding logos) free of charge in any format or medium, under the terms of the Open Government Licence.

To view this licence, visit <http://www.nationalarchives.gov.uk/doc/open-government-licence/>
or e-mail: psi@nationalarchives.gsi.gov.uk.

Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.

Any enquiries regarding this publication should be sent to us at correspondence@decc.gsi.gov.uk

This publication is also available for download at www.official-documents.gov.uk

This document is also available from our website at www.decc.gov.uk

ISBN: 9780101846622

Printed in the UK for The Stationery Office Limited

on behalf of the Controller of Her Majesty's Stationery Office

ID P002519328 11/12

Printed on paper containing 75% recycled fibre content minimum.

Department of Energy and Climate Change

3 Whitehall Place

London SW1A 2HD

URN 12D/349

Ministerial Foreword



Energy is vital to our quality of life: we need it for heat, transport, and to power our homes and businesses. Our comfort and prosperity depend on energy security, so it is one of my key priorities.

Great Britain has a strong record of energy security, but its importance to economic growth and to consumers is too great for us to take it for granted.

From the short to long term, the Government is working to minimise the risk of any unplanned interruptions, whether from severe weather, malicious attacks, technical failure or industrial action. In the unlikely event of disruption, we have plans in place to help the UK recover quickly.

In the longer term, energy security goes hand in hand with climate security. Both demand action to avoid unacceptable economic and human costs. Our energy system needs to be ready for a future in which we have smaller domestic reserves of fossil fuels, international competition for oil and gas intensifies, and much of our existing plant is replaced with lower carbon alternatives.

This document sets the direction for energy security policy. It provides a clear assessment of our current position, the risks we face, and the actions we are already taking – and it sets out our strategy for the future.

Our security will come from a broad, diverse and flexible energy system, supported by the right infrastructure.

We will ensure we have access to the imports we need, while minimising the scale of these imports by reducing our energy needs and maximising production of our domestic energy resources.

We know that electricity will play a far greater role in future, not least as we use more electric transport. So we are putting in place frameworks that will encourage the market to shape a broad spread of generation, including renewables, gas and nuclear.

The substantial investment required will be attracted from private funds, with consumers paying only on delivery. This investment will help get our economy moving, spurring the development of new markets, and will help insulate consumers from volatile global fossil fuel prices.

Energy security is central to ensuring that the UK remains an attractive place to live and do business. I am proud of our track record so far, and committed to maintaining this in the future.

A handwritten signature in black ink, appearing to read 'Edward Davey', with a horizontal line underneath.

Edward Davey
Secretary of State for Energy and
Climate Change

Contents

Ministerial Foreword	1
Executive summary	5
1. UK demand trends	13
2. Energy security: our policy response	17
3. Cross-cutting energy security risks	25
4. Electricity	31
5. Gas	45
6. Oil	55
7. Delivering energy security	67
Annex A – Methodology for considering energy security	70

Executive summary

It is tempting to take it for granted that UK consumers have access to the electricity, gas and oil they need to keep their lights on, their homes warm and their transport moving. However, in recent years there have been serious power failures in several countries including parts of the US and India caused by system and human error, and significant disruptions to gas flows to Europe for geopolitical reasons. Storms, floods and industrial action can also threaten our energy supplies. It is essential that we have a robust strategy to maintain the energy security we need for domestic and business consumers in the UK.

There is no perfect definition of energy security. When discussing energy security the Government is primarily concerned about ensuring that consumers have access to the energy services they need (physical security) at prices that avoid excessive volatility (price security). Energy security must be delivered alongside achievement of our legally binding targets on carbon emissions and renewable energy. And, while the Government cannot control world energy market prices, which are largely responsible for recent bill increases, we are doing everything we can to ensure that energy services are as affordable as possible, both for consumers and businesses, and in the long term to reduce our dependence on imported fossil fuels.

There is also no perfect timescale to apply when assessing the challenges of energy security. There are short-term challenges, such as the potential for disruption arising from technical failures in infrastructure, industrial action and severe weather conditions. There are longer-term challenges arising, for example, from changes to market structure, geopolitical patterns and climate change. This strategy considers both the short and longer term, looking ahead as far as 2050.

The UK has experienced strong energy security in recent years from a combination of our liberalised energy markets, robust regulation and extensive North Sea resources. However, we now face some significant new challenges as we look ahead:

- Around a fifth of power stations are due to close within this decade, as they come to the end of their working life or are deemed too polluting for modern standards;
- Our energy system will need to adapt to ensure that we can meet ambitious legally binding carbon emission reduction targets, requiring significant investment in low carbon technologies; and
- Declining reserves of fossil fuels in the UK Continental Shelf (UKCS) are making the UK increasingly dependent on imports at a time of rising global demand and increased resource competition.

This Energy Security Strategy considers energy security in the context of all the challenges we face by setting out how the Government assesses energy security; analysis of our energy security outlook in the short and longer term; and an overview of the policy measures we are taking to ensure that energy security is maintained while we decarbonise the energy system.

Energy security: our policy response

Our energy security strategy is based on competitive energy markets combined with effective regulation to deliver diversity of supply and robust infrastructure for consumers. The Government is taking forward activities in a number of areas which will enhance energy security further while also delivering wider energy goals:

- **Resilience measures** to prevent possible disruptions ranging from flooding through to industrial action, and to reduce the impact of incidents if they do occur.
- **Energy efficiency** measures lower our exposure to domestic and international energy market risks.
- **Maximising economic production** of our oil and gas reserves to provide reliable energy supplies which are not exposed to international energy supply risks.
- **Working to improve the reliability of global energy markets** to help ensure that, where the UK does require the supply of energy from overseas, it is dependable and affordable.
- **Reliable networks** ensure that the energy we need is delivered, where we need it.
- **Decarbonising our supplies** to help reduce our dependence on international fossil fuel markets in the longer term.

The Government's current programme of activities to maintain energy security is set out in more detail in Chapter 2.

Assessing energy security

The Government has three complementary approaches for assessing the sufficiency of current and future levels of energy security. Our assessments have shaped the policies set out above and are used to monitor how effective these policies are proving. The three assessment approaches are:

Considering cross-cutting risks – The Government uses research and stakeholder consultation to explore ongoing risks to our energy security. Chapter 3 sets out key cross-cutting risks to energy security and discusses their relative impacts and probability.

Assessing the characteristics of the energy system from the perspective of each of the consumer fuels – We have developed indicators and considered the system against four key characteristics of energy security: adequate capacity; diversity; reliability and demand side responsiveness. Chapters 4 to 6 set out the results.

Stress testing our energy system – We regularly model our energy system and subject these models to stresses (such as a 1 in 20 peak winter day)¹, to ensure that our system is robust, and to highlight any areas where issues can be addressed. Stress testing complements the other approaches discussed and stress-testing studies are referenced throughout this document. Annex A contains a list of these studies.

Energy policy is largely reserved in Scotland and Wales. Energy security is a priority for the Scottish Government and it has powers and roles on onshore and offshore planning, consenting of energy infrastructure and generation, and responsibility for resilience, response handling, and civil contingencies. We therefore work closely with the Scottish Government to align the exercise of both reserved and devolved powers to deliver the policy approaches and shared aims set out in this report.

In Northern Ireland energy policy is largely transferred and therefore the responsibility of the Northern Irish Executive. Furthermore NI gas and electricity markets operate separately from those in GB, in particular NI share a market with the Republic of Ireland (the Single Electricity Market). Therefore this report is primarily focused on Great Britain, although it does still make reference to the UK as GB makes up a large proportion of UK and many of the issues apply across all of UK.

Our key findings

Considering cross-cutting risks

Our energy system faces a range of potential risks. Many of these are specific to a particular sector, and are discussed in that context. However, our analysis and discussion with a range of external stakeholders has identified four key cross-cutting risks which need particular attention on a cross-sector basis.

(i) Sudden shocks are risks that could emerge at any point in time.

Major domestic disruption to energy supply

As with all countries, the UK is constantly exposed to a range of potential domestic disruptions to energy supplies, including: natural disasters; industrial disputes; technological failure; malicious attacks; or the failure of a major energy company. The Government takes extensive action to reduce the vulnerability of our energy system and has developed emergency response arrangements to reduce the impact of a disruption if it does occur.

¹ A 1 in 20 peak winter day is the exceptional demand on a winter day which statistically occurs once in 20 years.

Major international and EU disruptions to supply which are damaging to our security

The UK is reliant on global markets for imported energy supplies. Disruption to supplies could expose the UK to price spikes and potentially in the most serious cases to physical supply disruptions. As set out in the Strategic Defence and Security Review, the Government works with international and EU counterparts to mitigate the impact of such disruptions, for example through the International Energy Agency (IEA) oil stocking mechanism and with neighbouring Member States in respect of sharing gas emergency and preventive plans under requirements in the EU Security of Gas Supply Regulation.

(ii) **Slow burners** are risks that could emerge in the future depending on how our energy system develops.

Increased level and volatility of international fossil fuel prices

Irrespective of disruptions to oil and gas supply, increased international demand for energy resources combined with limitations on production is likely to drive up prices if there are not corresponding increases in supply. Consensus forecasts show rising oil prices and continued high gas prices over the coming decades, whilst price volatility may create uncertainty for investors and consumers alike. The Government works with international partners to encourage energy production and energy efficiency, and to maintain and develop international mechanisms to respond to supply shocks.

Insufficient investment in UK energy infrastructure

Investment will be needed over the coming decades to maintain a secure, affordable and sustainable energy system in the UK. Indeed, it has been estimated that £200 billion² of investment will be needed between now and 2020 alone. This is particularly challenging in the context of wider global economic uncertainty. The Government therefore needs to work to ensure a stable and attractive investment climate, addressing both financial and non-financial (e.g. regulatory) issues.

Assessing the characteristics of our energy system

To complement the approach set out above the Government analyses each of the consumer fuels in the light of the four components of energy security: Adequate capacity; Diversity; Reliability and Demand Side Responsiveness. These assessments include indicators to illustrate trends for key aspects of energy security, set out in blue boxes in Chapters 4 to 6 of this document. These indicators are not targets but support understanding of our current and possible future position.

² £200 billion comes from Ofgem's 'Project Discovery' Energy Market Scenarios, published in October 2009, and was Ofgem's estimate of the cumulative investment required in energy infrastructure to 2020. 'Energy infrastructure' includes electricity generation, transmission and distribution, renewable heat, energy efficiency, smart meters, gas storage and Liquid Natural Gas (LNG) terminals and selective catalytic reduction (SCR) technology.

Electricity

We currently have **adequate capacity**, but there are risks to security of supply over the medium term as around a fifth of capacity available in 2011 has to close within this decade. The Government is therefore taking powers in the Energy Bill to run a Capacity Market. The Government is minded to run the first auction in 2014 for delivery of capacity in the year beginning in the winter of 2018/19. A final decision will be taken subject to evidence of need. This will be informed by updated advice from Ofgem and National Grid which will consider economic growth, recent investment decisions, the role of interconnection and energy efficiency, as well as consideration of the outcome of the review of the 4th Carbon Budget.

The market to date has delivered a relatively **diverse** electricity infrastructure, capable of providing electricity with different levels of flexibility. As existing infrastructure comes to the end of its life the Government will work to ensure that the market continues to incentivise diversity in future generation. We have a wide range of existing and planned policies that enable investors to bring forward not only conventional thermal plant but also new renewable, nuclear and – in time – Carbon Capture and Storage (CCS) technology. We are also keen to ensure we maximise the benefits of greater interconnection with non-UK sources.

Historically the electricity network has been extremely **reliable** in the UK. We face new challenges as more intermittent renewable generation is brought onto the system alongside nuclear, which provides a low carbon option for consistent, although inflexible, generation. Capacity is provided by the market, but the moment to moment balancing of the system is provided by the system operator. The Government and the system operator will work together, and with industry, to improve the range of balancing options available to meet these intermittency challenges, including through options set out in Ofgem's Electricity Balancing Significant Code Review.

Working to improve the levels of **demand side responsiveness**, including smart grids and smart meters, will help ensure that the electricity system can remain balanced in the future.

Gas

We currently have **adequate capacity** in terms of gas import infrastructure. However, further infrastructure is likely to be needed as production from the UK Continental Shelf declines and intermittency of gas demand to generate electricity increases.

UK gas supplies are relatively **diverse** compared with the Continent. However, declining production from the UK Continental Shelf means our net import dependency of around 50 per cent today is expected to increase to nearly 70 per cent by 2025. The Government will continue to work to maximise the economic production of UK gas resources and aid the development of diverse international markets.

Our gas supply is currently **reliable** and will stand up to all but a very low probability combination of events. However, increased exposure to international markets will

increase the importance of these markets working effectively. The IEA has described the global gas resource base as “vast and widely dispersed geographically”, with estimated remaining recoverable reserves of conventional gas equivalent to 130 years of current consumption and unconventional gas potentially doubling this. Nevertheless there still remains uncertainty around future levels of global gas available for import. Global demand is projected to rise rapidly over the coming decades, which will drive increased competition for resources. LNG markets are expected to tighten towards the end of the decade. Furthermore, the supply of gas could also be subject to disruption by external events. The extent, timing and cost of unconventional gas exploitation outside the US remains an unknown. We are therefore strengthening our bilateral trading links and promoting liberalisation of EU gas markets, to help secure the imports we need. Domestically, Ofgem has made proposals to sharpen the incentives on gas suppliers to meet their supply obligations.

UK gas supply currently benefits from **demand side response**, provided through fuel switching (power generation switching from gas stations to coal stations when gas prices are relatively high, and interruptible contracts between gas shippers and customers). This demand side responsiveness may decrease as the number of coal-fired power stations decreases.

Oil

The make-up of its refinery **capacity** means that the UK currently has a surplus of petrol and a deficit of diesel and aviation fuel. The UK imports products to meet this deficit from continental Europe and the Middle East. UK refineries face a challenging business environment and the Government is working with the sector to consider how it is likely to evolve and the potential implications for the UK’s energy security.

Oil within the UK is currently resourced predominantly from the UK Continental Shelf. As UK production declines we will be increasingly dependent on oil imports, for both crude and refined products. The global market is well integrated and **diverse**, so participation will bring considerable diversity to our oil supply.

At the same time, the **reliability** of the UK’s oil supply will be determined increasingly by global oil market developments. Global demand is predicted to rise substantially over the coming decades, increasing competition for resources. Technological advances are creating a more diffuse global supply and this is changing the patterns of energy trade. It is likely that these trends will lead to increasing levels and volatility of oil prices. This underlines the importance of our domestic and international work to restrain oil demand, encourage sustainable development of new oil production, and enhance oil price stability.

We currently have minimal **demand side response** for oil because the majority goes straight to the consumer. However, this is likely to increase alongside uptake of some low carbon technologies, including hybrid vehicles.

Conclusions and future actions

While there is no single objective way to measure energy security, our view on the UK's energy security is a matter of judgement informed by the numerous measures that we use to assess trends and identify risks. Even in our assessment of the characteristics of the energy system, the indicators we have used do not provide a straightforward measure of how great a risk exists, or when change is needed: they are rather a way of flagging potential issues and a stimulus to debate.

Overall it is our view that, from the information available including the anticipated effects of policies Government is bringing forward, the outlook for our energy security is reassuring. A recent Energy Index compiled by the US Chamber of Commerce placed the UK second overall for energy security³. At the same time there are always risks that need to be managed or mitigated, and we face a great deal of change that will pose new longer-term challenges for our energy security in the years ahead.

The global energy picture is increasingly diffuse and diverse. The UK is increasingly becoming part of more interconnected networks in the EU and beyond. This has potential benefits for energy security and prices, provided that the necessary infrastructure and regulatory arrangements are in place to ensure that markets operate effectively, predictably and transparently. The Government will continue to press for an effective single European energy market and for the development of interconnection arrangements which enhance the UK's energy security.

To ensure we maintain our energy security, and in the context of the work the Government is already pursuing, we are:

- Maintaining our competitive market framework, and complementing this with more effective regulation to ensure security. For electricity, the Government is therefore taking powers in the Energy Bill to run a Capacity Market. The Government is minded to run the first auction in 2014 for delivery of capacity in the year beginning in the winter of 2018/19.
- For Gas, Ofgem has consulted on sharpening the incentives on gas suppliers to ensure security of supplies, is investigating the effectiveness of gas interconnector flows, and intends to work with the industry to further consider the case for proposals to improve transparency of information, and facilitate demand side response. We have also asked Ofgem to consider the case for further measures to ensure our gas security, and will be considering further whether there is a case for measures to promote gas storage.
- Taking powers through the Energy Bill to introduce new incentives to aid efforts to decarbonise our supplies by using Contracts for Difference which will promote the diversity of our energy mix and reduce our exposure to fossil fuel markets.

³ <http://www.energyxxi.org/2012-international-index-energy-security-risk>

This is in addition to our ongoing work to ensure energy security through energy resilience measures, working with our international partners and ensuring access to connected, efficient and well run networks.

This is the first time that a UK Government has produced an energy security strategy. It is intended to complement the Statutory Security of Supply Report⁴, which provides a purely factual and technical account of energy security. It is, of course, not the last word, but should provide the framework for future discussion and debate. We propose to provide an annual update and commentary on the indicators set out in this document.

⁴ Statutory Security of Supply Report, produced jointly by DECC and Ofgem, 2012 http://www.decc.gov.uk/en/content/cms/meeting_energy/en_security/sec_supply_rep/sec_supply_rep.aspx

1. UK demand trends

- 1.1** This Energy Security Strategy provides a detailed and open assessment of the UK's current energy security, outlines work already underway to safeguard our energy security, and sets out the policy Government is putting in place to ensure that our energy supplies remain secure. These issues are considered in the short and longer term, looking ahead as far as 2050.

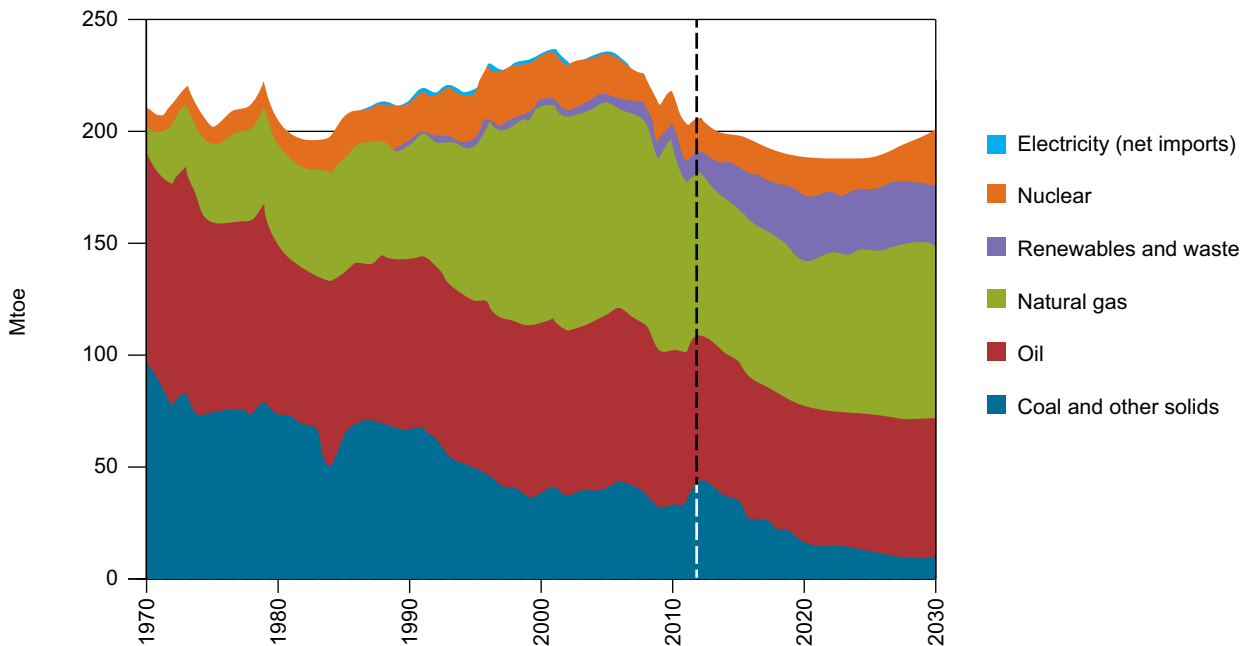
Defining energy security

- 1.2** At its heart, energy security is about ensuring that we have access to the energy services we need (physical security) at prices that avoid excessive volatility (price security). Energy security is a complex issue and any definition must be flexible. Securing energy services should not be limited to securing energy supplies, but mean delivering the end products UK consumers need: heat, power and transport.
- 1.3** Energy security also needs to be considered in the context of our other energy objectives of sustainable energy supplies (in particular reducing our carbon emissions) and affordable energy supplies. These objectives will often align. However, tensions may emerge, for example as new sustainable technologies raise previously unforeseen challenges to the delivery of secure and reliable supplies. We need an approach that meets our three core objectives of security, sustainability and affordability.
- 1.4** The methodology used by the Government for considering energy security is set out in detail in annex A.

The UK energy system – current and future

- 1.5** Figure A shows the UK's past and projected future primary energy demand.

Figure A: Inland primary energy consumption, million tonnes of oil equivalent



Source: DECC, *Digest of UK Energy Statistics and Updated Energy Projections*, October 2012

1.6 Our energy needs in the UK are currently predominantly provided in one of three ways⁵:

- **Electricity** meets 20 per cent of our energy needs. It is a secondary fuel and produced primarily from coal, gas, nuclear and renewables in the UK. Its versatile nature means it is used across all sectors: 30 per cent is used domestically, 28 per cent by industry and 21 per cent commercially.
- **Natural gas** makes up 34 per cent of the fuel that UK consumers use directly and 52% of total gas use goes to providing heating in buildings and industrial processes. Natural gas also has a significant role to play as a primary fuel for electricity generation, producing 40 per cent of the electricity generated in the UK in 2011.
- **Oil** meets 45 per cent of our energy needs, processed into oil products and used primarily for transport purposes: 22 per cent is used for petrol, 40 per cent diesel, 18 per cent used for jet fuel, with the remainder being used for a range of other fuels. A small proportion, 4 per cent, is used by households directly.

1.7 Energy supplied in other forms currently meets less than 5 per cent of consumer demand⁶.

⁵ All figures up until 2012 are derived from DUKES 2012.

⁶ These include coal (1.2 per cent), manufactured fuels (0.6 per cent), and heat provided directly to the consumer from combined heat and power (0.9 per cent) and renewables such as solar thermal (1.8 per cent). Coal and renewables play a much more significant role in electricity generation and so the security of their supply is discussed under electricity.

- 1.8** The UK's market-based approach to energy supply has encouraged diversity among suppliers and helped deliver a relatively benign supply situation to date, in which private investment has delivered adequate capacity and a high degree of resilience.
- 1.9** Past resilience of energy supply does not of course mean that there is any cause for complacency. We face continuing risks – e.g. geopolitical unrest, industrial action and severe weather which is likely to be increasingly problematic as the climate changes. Moreover, major changes to our energy systems need to be undertaken at speed and scale to deliver the future investment we need and to meet our carbon targets. Security issues must be designed in from the start. At the same time, we must recognise the uncertainties inherent in predicting the future while necessarily preparing for a range of different scenarios.
- 1.10** DECC set out a series of four futures to 2050 in the Carbon Plan⁷ and has just updated projections to 2030⁸. From these documents, and other analysis conducted by the department, we can say that:
- **Total UK energy demand** is projected to fall by 7 per cent between 2011 and 2020. The Carbon Plan scenarios require savings in terms of final energy consumption per capita of between 31 per cent and 54 per cent between 2007 and 2050. Meeting these scenarios will have a major impact on our future energy needs.
 - **Electricity** use is likely to increase by at least 30 per cent and potentially by 100 per cent as much of our heating and transportation becomes electrified. We may see more seasonal demand (caused by electrification of heating) and different peaks in demand (from electric vehicles). These changes to demand patterns, alongside an increased use of renewables and nuclear (less flexible supply), will increase the challenges of balancing the system and also present opportunities to embed demand side response (DSR) and distributed capacity (e.g. night charging of electric vehicles).
 - **Natural gas** fuels around 80 per cent of all the heat used in the UK in homes, in commercial buildings and in industrial processes, and will continue to play a significant role in heating for at least the next two decades.

In 2011 gas fuelled 40 per cent of our electricity generation⁹, and it will replace a significant proportion of the coal and nuclear capacity that is due to close over the coming decade, as well as facilitating renewable deployment by providing flexible back-up generation. Deployment of Carbon Capture and Storage (CCS)

7 DECC (2011) Carbon Plan: Delivering Our Low Carbon Future. See: <http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/carbon-plan/3702-the-carbon-plan-delivering-our-low-carbon-future.pdf>

8 DECC (2012) Updated Energy Emissions Projections 2012. See: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx#2012

For the fourth carbon budget period and thereafter, the projections represent a baseline scenario in which the Government did not develop any new energy efficiency policies or policies to increase take up of renewables outside the power sector. They therefore do not update the futures presented in the Carbon Plan.

9 Derived from DUKES 2012 – table 5.5.

technology would allow a significant long-term role for base load gas (and coal) generation as part of our overall low carbon energy mix.

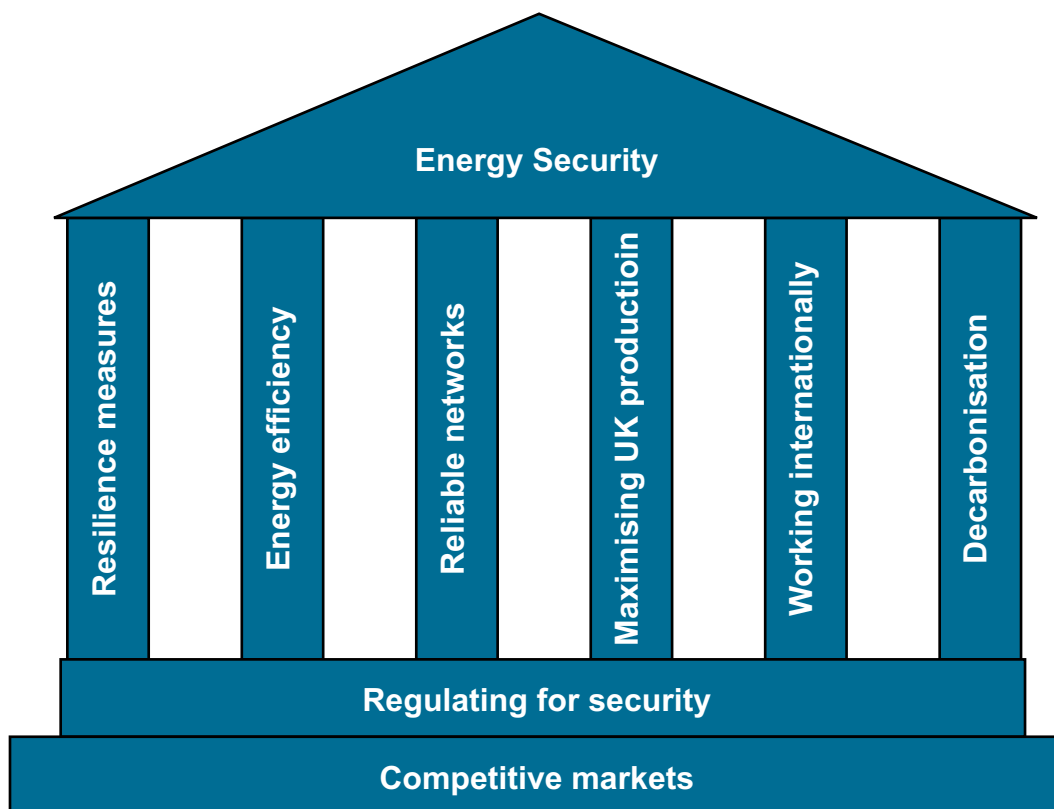
- **Oil** is likely to continue to play an important role in meeting our transport needs well into the 2030s. Overall demand for oil is expected to remain relatively constant in the short term, but low carbon futures estimate at least 65 per cent of our transport fleet will need to be electrified by 2050 to meet carbon targets. Our exact levels of oil use in 2050 will be dependent on innovations in the transport sector.

1.11 In addition to the three fuels described above, the future potentially holds a bigger role for heat being sold directly. There is likely to be an increased role for renewables being used to provide energy services directly, including solar thermal and bioenergy which could sustainably substitute up to 12 per cent of the energy we currently consume by 2050.

2. Energy security: our policy response

- 2.1** Our energy security strategy is based on competitive energy markets combined with effective regulation to deliver diversity of supply and robust infrastructure for consumers. Six policy areas, set out in the pillars of Figure B, contribute towards these aims.

Figure B: Policy areas contributing to energy security



Competitive markets

- 2.2** Competitive markets incentivise companies to provide reliable supplies to attract and retain customers. The Government sets the framework for the delivery of energy supply through competitive markets, providing transparency, stability and an attractive fiscal regime which encourages businesses to invest, as well as by regulating to ensure effective competition.

- 2.3** The Government is working to remove barriers to the functioning of effective markets. For example, the Energy National Policy Statements (NPSs) in England and Wales set out a clear framework for decisions on development consent for major energy infrastructure, providing a planning system for energy infrastructure which is as rapid, predictable, accountable and as transparent as possible.

Regulating for security

- 2.4** The role of markets is complemented by robust regulation to protect energy security by ensuring that: appropriate standards are maintained; markets can react sufficiently quickly to meet consumer demand; the investment we need is delivered; and, measures are in place in the case of company failure. It is the responsibility of the Government to establish strategic goals within the electricity and gas markets, and to ensure that an appropriate framework is in place to enable delivery.
- 2.5** In Great Britain, regulatory oversight of the electricity and gas market is provided by Ofgem, whose main aim is to protect energy consumers' interests. Gas and electricity companies need a licence to operate within the market framework and are required to abide by industry codes. Ofgem plays a central role in this regulatory framework. Their key functions include: issuing, modifying, enforcing and revoking licences; setting price controls in the natural monopoly licensed sectors; and, investigating and penalising those in breach of licence conditions.
- 2.6** Parliament has given Ofgem, via the Energy Act 2011, a new power to direct National Grid to implement changes to the Uniform Network Code where Ofgem considers these will reduce the likelihood of a gas supply emergency. Ofgem has been conducting the Gas Security of Supply Significant Code Review (Gas SCR) to consider how current market arrangements could be improved to give further reassurance about security of supply. Ofgem has also launched an electricity balancing Significant Code Review.
- 2.7** In addition to market framework adjustments, a large volume of safety regulation is in place in each industry to ensure that the highest standards are maintained. Ofgem also has responsibility for monitoring the financial health of energy companies. There is a special administration regime in place to ensure continued supply of gas and electricity in the event of an electricity network transmission and distribution company or gas distribution company becoming insolvent. In the event of suppliers becoming insolvent, Ofgem has in place a Supplier of Last Resort process and Government is introducing a special administration regime for energy supply companies as a backstop to these arrangements.

Resilience measures

- 2.8** Energy resilience measures are in place to reduce the likelihood of "sudden shock" events affecting energy supplies within the UK and to reduce the impact of any event that might occur. The Government works with industry, Ofgem, the

Health and Safety Executive, National Grid and others to mitigate the risk of major domestic disruptions by ensuring that the regulatory regime supports robust arrangements to maintain supplies and safety, underpinned by wider industry best practice and shared learning.

2.9 At the same time, the Government accepts that we cannot completely remove the possibility of disruption and maintains capabilities to lead a national response to emergencies of all kinds, including those that affect energy supplies. These arrangements are tested through regular exercises. For Electricity and Gas the following are in place:

- DECC works collaboratively with industry to maintain and update contingency plans for managing energy emergencies, including the National Emergency Plan for Downstream Gas and Electricity and the National Emergency Plan for Fuel (NEP-F). DECC also works with the Devolved Governments of Scotland, Wales and Northern Ireland¹⁰, to ensure a joined up and coherent response across all Governments across all parts of the UK.
- DECC has a number of options to minimise the impact of an electricity or gas supply emergency, from instructing power stations to use alternative fuel sources to imposing electricity rationing in the case of a serious or sustained supply shortage. The Electricity Supply Emergency Code outlines the process for ensuring fair distribution nationally while still protecting those who require special treatment.
- Government has policies in place to ensure we minimise the risk of, and are prepared in the event of, civil nuclear emergencies domestically or internationally. We continue to identify lessons from real incidents – such as Fukushima in Japan – and through an extensive exercise programme led by the Office for Nuclear Regulation.
- In addition, for oil, the UK as a member of the EU and the IEA is required to hold emergency stocks. Under the EU obligation, the UK holds 67.5 days of oil consumption in stocks. An IEA coordinated release of strategic oil reserves remains our primary tool to combat a significant supply disruption to international oil markets.
- Government is also reviewing its contingency arrangements in the case of a disruption to fuel distribution, such as through a tanker drivers strike. We will seek to enhance these arrangements and the NEP-F where necessary – building on lessons learnt from the potential strike in early 2012 and working closely with other Government departments and local partners. This will help ensure that in future we can minimise the impact of possible disruption by maintaining as near normal supplies as possible.

¹⁰ In Northern Ireland the Department of Enterprise, Trade and Investment is the Lead Government Department for emergency planning, and facilitating industry involvement in the response and recovery phases for supply chain disruptions affecting oil, gas and electricity.

Energy efficiency

- 2.10** Increasing our energy efficiency lowers our exposure to domestic and international energy market risks, and could reduce the need for investment in new infrastructure.
- 2.11** The Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK¹¹, published earlier this month, sets out this Government's mission to make the most of the UK's energy efficiency opportunity. As part of this we have to connect knowledge and technology with access to finance across all sectors of the economy, as we are doing under the Green Deal. The Energy Efficiency Strategy sets out a range of initiatives that we are taking forward now, and also addresses the long-term direction needed to deliver a more sustainable and secure energy system, through initiatives such as smart meters and smart grids. This builds on existing policies, including product and building regulations.

Maximising economic production of UK oil and gas resources

- 2.12** Exploitation of our North Sea oil and gas reserves has brought significant energy security as well as commercial benefits, and will continue to do so. It provides a large and reliable source of energy supplies, thereby reducing our exposure to geopolitical supply risks.
- 2.13** Although UK production still provided the equivalent of 72 per cent of our oil use (including bunkers) and 55 per cent of our net gas use in 2011, UKCS production is on a downward trend. By 2020 we expect to be net importers of 43 per cent of our oil demand and 53 per cent of our gas demand. Nevertheless, UK production will remain a significant contributor to our energy needs for many years to come, and we maintain a fiscal and regulatory environment designed to maximise the benefits from our extensive remaining reserves.
- 2.14** The Government works to maximise economic production of UK oil and gas resources through:
- Licensing rounds, which ensure this reliable source can continue to deliver supplies for as long as possible;
 - Providing a fiscal regime that encourages further investment and innovation in the North Sea, while ensuring a fair return for UK taxpayers; and
 - Considering the potential for UK unconventional gas production, and whether it will prove technologically, environmentally and economically sustainable.
- 2.15** The Government is also working with the UK refining sector to develop a strategic policy framework for the sector.

¹¹ The Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK, DECC 2012.
http://www.decc.gov.uk/en/content/cms/tackling/saving_energy/what_doing/eedo/eedo.aspx

Working internationally

2.16 Developments in international energy markets have major implications for the UK's energy and economic security. As North Sea oil and gas production declines, the UK's import dependency will grow and we will become increasingly exposed to the pressures and risks of global markets. These are in a period of significant change. The next two decades will see global energy consumption increase substantially, driven by the rapid expansion of Asian economies. The patterns of trade are shifting accordingly and the UK will likely face greater competition for more expensive resources. Global supply is also undergoing a quiet revolution as technological developments bring new resources on-stream and the map of global energy production becomes ever more diffuse. The UK must stay ahead of these trends to secure reliable imports of oil and gas. Energy diplomacy plays a vital role in achieving this. Our approach focuses on a number of areas:

- Government promotes low carbon technologies and energy efficiency to restrain rising oil and gas demand; for example, the UK hosted the 2012 meeting of the Clean Energy Ministerial.
- Government encourages global investment in oil and gas production, and maximises UK commercial opportunities in doing so, through a range of bilateral relationships and multilateral initiatives. For example, the UK/Saudi Energy Dialogue in May 2012 was an opportunity to share analysis of oil markets; and we continue to work through the IEA to ensure robust analysis on investment needs and outlook.
- To ensure reliable supplies, Government encourages greater liberalisation of energy markets, and strengthened trading links and infrastructure – again working bilaterally and multilaterally. This includes work at a European level, in particular to implement the requirements of the Third Package of legislation on the internal energy market. This is the latest suite of European legislation aimed at establishing a single market in energy across the EU, and will help to improve EU market integration and increased cross-border trade for both electricity and gas. It should improve security of supply by reducing each country's vulnerability to supply and price shocks. In addition, under requirements in the EU Security of Gas Supply regulation, we work with neighbouring Member States to share gas emergency and preventive plans to help mitigate (and understand) the impact of gas disruptions.
- To enhance energy price stability, Government continues to support producer/consumer dialogue and greater market transparency. The UK is an active member of the International Energy Forum (IEF), which brings together all the main oil producing and consuming countries.

Reliable networks

2.17 Reliable networks are key to the delivery of the energy we need. Measures that help to ensure reliable networks include:

- The transmission price control (RIIO-T1) for 2013-21. Ofgem has approved up to £6.1 billion of electricity network investment in Scotland and is proposing to allow around £11.6 billion in England and Wales. For gas Ofgem is proposing a total of £5.5 billion of investment in the national transmission system, and around £13 billion of investment in the gas distribution networks.
- National Grid is currently undertaking a project 'Grid Operations 2020' to assess the risks posed to the electricity and gas networks, and identify solutions to ensure they can continue to be managed securely.
- DECC, jointly chairs with Ofgem the Electricity Networks Strategy Group which receives quarterly progress updates from Transmission Owners on their major projects.
- The Smart Grid Forum (which DECC co-chairs with Ofgem) is working to ensure the distribution network investment plans facilitate the increased electricity demand and distributed generation envisaged in the Carbon Plan, without jeopardising network security. In addition, DECC and Ofgem provide support for innovation in 'smart grid solutions'. Solutions such as DSR and storage can reduce reliance on electricity supply by providing more flexibility to electricity demand.
- The Government is also taking steps to prevent delays to the development of our energy system caused by the time needed to gain grid access, through policies such as the 'Connect and Manage' grid access reforms and reforms to the Planning Framework in England and Wales for considering energy infrastructure to enable the necessary network investments to be made on time.

2.18 UK energy supply could be further diversified through additional interconnection and there are a number of projects that may come forward over the next few years. DECC will be undertaking further work to improve the evidence base on the impacts on GB of further electricity interconnection, taking into account security of supply, and exploring the most appropriate way of developing our interconnection capacity.

Decarbonising our supplies

2.19 Emission reductions will reduce our dependence on international oil and gas markets. It is a fundamental pillar of our energy security strategy, as well as being necessary to avoid dangerous climate change.

2.20 The Government's plan for Electricity Market Reform (EMR) will help implement our vision of a low carbon energy future where low carbon technologies compete for market share on price. Emission reductions will help reduce our dependence

on international oil and gas Markets, as well as being necessary to avoid dangerous climate change.

- 2.21** The Government is committed to supporting the commercialisation of CCS, to help ensure it can compete in this race. It is doing this by providing £1 billion in capital investment for commercial scale projects under the UK Government's CCS Commercialisation Programme, open to both coal and gas generation. If these projects are successful, deployment of CCS will boost the diversity of supply by enabling fossil fuels to continue to form a key part of the electricity generating mix, and to provide firm back-up for intermittent renewables and inflexible nuclear.
- 2.22** The Government remains firmly committed to its efforts to ensure that the conditions are right for investment in new nuclear power in the UK. Nuclear is expected to be cost competitive with other generation technologies. Contracts for Difference will ensure that low carbon technologies, including nuclear, can compete for market share in our low carbon future.
- 2.23** The Renewable Energy Strategy will drive the deployment of renewable energy in the UK. As part of this the Government provides the framework for significant financial support for renewable technologies, through both the Renewables Obligation and the small scale Feed-in Tariff scheme. The Government is also creating a Green Investment Bank to fund the scaling up and infrastructure development of green technology and clean energy projects.
- 2.24** In addition, low carbon policies will move the dependence of our heating and transport systems away from predominantly being reliant on fossil fuels:
- The Renewable Heat Incentive and Renewable Heat Premium Payments will encourage diversification of our heat supplies and reduce our demand for fossil fuels. As set out in 'The Future of Heating: A Strategic Framework for Low Carbon Heat', published in March, decarbonising heat is key to meeting our low carbon objectives. To do this we will need to move to a system where heat is used more efficiently and delivered through a diverse range of low carbon technologies.
 - Policies to decarbonise transport include Plugged-in Places schemes and Plug-in power car and van grants. These policies alongside others will help shift demand from oil to electricity and other fuel types, reducing our dependence on the international fuel markets. Changes towards a low carbon transport system will present significant energy security benefits, reducing our exposure to, and dependence on, an increasingly tight global oil supply. In the longer term, increased take-up of electric vehicles will mean increased demand on the electricity sector. The Government's work to ensure our electricity system is able to respond to these changes is set out in the electricity chapter.

Devolution

- 2.25** The UK Government and the Devolved Administrations have a shared interest in ensuring energy security across the United Kingdom. The UK Government works closely with all Devolved Administrations, in line with their respective roles and responsibilities as set out in the devolution settlements, drawing on local knowledge and expertise, to ensure a safe and secure energy supply.
- 2.26** With respect to Great Britain, energy policy is largely a reserved matter and the responsibility of the UK Government. However, due to the complexities of the devolution settlements this is not always clear-cut and some of the areas discussed within this strategy overlap with the competencies of the Welsh and Scottish Governments.

Scotland

- 2.27** In Scotland, the Scottish Government works in close partnership with UK Government to deliver energy security both at UK and Scottish level. Scottish Ministers have devolved powers relating to consents of electricity generation and transmission infrastructures under s36 and s37 of the Electricity Act 1989. In practice, Scottish Ministers exercise these powers in ways that both meet Scottish needs and priorities and help meet both Scottish and UK energy targets and security of supply considerations. The Scottish Government also has responsibility for resilience, response handling, and civil contingencies. Where particular security or emergency circumstances require co-ordination and mutual support of both Scottish and UK Government, both Governments deliver close partnership working between Governments, agencies and our emergency services on resilience and response handling.

Northern Ireland

- 2.28** In the case of Northern Ireland, the majority of energy policy is transferred and the responsibility of the Northern Ireland Executive. Furthermore, the Northern Ireland energy markets are distinct from Great Britain and it shares an electricity market with the Republic of Ireland – the Single Electricity Market. In practice this means that there are a range of risks particular to Northern Ireland that are less relevant for Great Britain. Specifically, Northern Ireland has a much higher dependence on heating oil for domestic use (close to 70 per cent), it has no refining capacity and is reliant on all petroleum imports by ship. All of Northern Ireland's natural gas supply is obtained from Great Britain, with significant dependence on this imported gas for power generation. Northern Ireland is also relatively isolated from the regional electricity grid in terms of interconnection. Given these differences, whilst many of the risks outlined in this document and steps to mitigate them also apply to Northern Ireland (hence many of the references in this document referring to the United Kingdom as a whole), they do so to a greater or lesser extent, and, as noted, a number of other risks must be managed separately.

3. Cross-cutting energy security risks

3.1 The UK's energy system needs to be resilient to a range of potential risks. Some of these are specific to particular sectors, and are discussed within the relevant chapters later in this document. This chapter focuses on four key cross-cutting risks. Two – major domestic disruption to energy supply and major international disruptions to energy supply – can be categorised as “sudden shock” events; the other two – increased international energy prices and insufficient investment in UK energy infrastructure – are more “slow burn”.

Sudden shocks

Major domestic disruption to energy supply

3.2 Major domestic disruptions to our energy supply could potentially arise from a number of causes, such as natural hazards (e.g. very low temperatures, heavy snow, severe flooding, storms/gales, severe space weather, pandemic flu); malicious attack (e.g. physical terrorist attack on assets or networks, cyber attack on electronic systems); accident (e.g. fire/explosion); and industrial action across all sectors.

3.3 The National Risk Assessment (NRA) assesses the most significant civil emergencies which could affect the UK in the next five years, and the impact on essential services including energy. A public summary of the NRA – the National Risk Register¹² – identifies the highest priority risks to the UK as: pandemic influenza; coastal flooding; catastrophic terrorist attack; and severe effusion (gas rich) overseas volcanic eruption. The Government's Climate Change Risk Assessment¹³ outlined that the impacts of climate change will result in the increased frequency and magnitude of a number of the natural hazards, including flooding, and highlights the importance of ensuring that energy infrastructure is climate resilient.

¹² The National Risk Register can be found here:

http://www.cabinetoffice.gov.uk/sites/default/files/resources/CO_NationalRiskRegister_2012_acc.pdf

¹³ Defra's Climate Change Risk Assessment can be found here:

<http://www.defra.gov.uk/environment/climate/government/risk-assessment/>

3.4 Hazards can impact our energy system at a range of points:

- Supply – by affecting our ability to receive imports into the UK (e.g. LNG terminals); or our ability to produce our own energy from the UKCS; our ability to refine oil or generate electricity.
- Transmission/distribution infrastructure – a failure in the gas or electricity transmission or distribution networks or the electronic systems which manage them, or a lack of key personnel, which leads to loss of supply to the consumer up to the possibility of a complete failure of the National Transmission System and a Black Start¹⁴. Similarly disruption to oil and oil products (e.g. due to wider disruption, industrial action or pandemic ‘flu’) could quickly result in widespread shortages of fuel.

Mitigating actions

3.5 The Cabinet Office leads across Government, and where necessary with the Devolved Governments, on planning and responding to emergencies. Overarching policy and the key programmes to deliver and maintain preparedness and to mitigate risk are set out in the “UK Resilience” section of the Cabinet Office website. The National Adaptation Programme¹⁵ will include key activity to further embed climate resilience into the design, construction and operation of infrastructure, including energy, which in turn will offer wider energy security.

3.6 DECC works, in particular, to mitigate the risk of major domestic disruptions by:

- Ensuring that the regulatory regime supports robust arrangements to maintain supplies and safety, underpinned by wider industry best practice and shared learning; and
- Working closely with industry, the regulators (Ofgem and HSE), the Devolved Administrations and sector bodies to ensure that there are risk mitigation plans along with robust plans in place to recover from any incident. If a serious disruption does occur, the Government will act to manage the impact of this, including (where appropriate) through working with major producers to increase production, releasing oil stocks through the International Energy Agency, co-ordinated demand response, and implementation of the “National Emergency Plan for Fuel” and “National Emergency Plan for Downstream Gas and Electricity” as necessary.

¹⁴ Black Start is the process by which electricity generation and transmission would be restored in the event of a complete transmission system failure. It is based on a number of power stations which have the capability to restart independently, power islands are created around those stations allowing other generators to restart until the whole system can be restored. This takes 3 to 5 days to complete.

¹⁵ The National Adaptation Programme can be found here:
<http://www.defra.gov.uk/environment/climate/government/nap/>

Major international disruption to supply damaging our security

3.7 International energy markets can be shaped by the same range of disruptions that can impact the UK's domestic energy security. In addition, political disruption and conflict either within or between countries can significantly alter international energy markets. For example:

- Conflict in Libya in 2011 saw the removal of 1.6 mb/d from the global market, and a 10-20 per cent increase in oil prices.
- Closure of a major energy choke point such as the Strait of Hormuz would affect 17.5 mb/d of oil (20 per cent of global supply) and one-third of global LNG supply.
- The Fukushima nuclear accident, initially caused by a natural hazard, has had international repercussions on the gas markets as Japan and other countries reconsider the role of nuclear.

3.8 In the current international energy market, a key consequence of any disruption to oil or gas supplies will be on global prices. Substantial price spikes in oil or gas are likely to have knock-on impacts on UK inflation, GDP and business confidence. Historically oil price spikes have had a bigger impact, but the rise of gas as a primary energy source means that this disparity is decreasing. Sustained physical disruptions, while possible, are unlikely in all but the most extreme scenarios.

3.9 The impact of oil and gas disruptions on the UK are expected to remain relatively constant in the short to medium term. In the longer term, the impact of oil and gas disruptions will decrease as we gradually decarbonise our transport sector and continue to decouple economic growth from carbon consumption, but it is possible that new international dependencies will emerge, for example around interconnection. Disruptions may well increase in frequency and magnitude, particularly for oil, if increased demand outpaces supply. Further disruptions may also be caused by climate change, which is expected to result in more frequent extreme weather incidents and potentially increased political tensions.

Mitigating actions

3.10 The Government engages actively to influence international energy supply. For example, we work to:

- Liberalise energy markets in order to ensure we have a range of supply alternatives, strengthen trading links and infrastructure, uphold global norms such as freedom of navigation and provide robust physical protection of supply routes;
- Ensure the UK has access to a diverse range of international energy supplies, minimise the impact of disruption to any one route and incentivise diversity. Details are set out under 'diversity' in the following sector chapters; and

- Develop contingency plans to mitigate the impact of any disruption through the resilience measures outlined above.

Slow burners

Increasing level and volatility of international fossil fuel prices

- 3.11** It is difficult to predict future demand, supply and price as they depend on a broad range of variables such as economic growth, geology, technology and geopolitical developments. Nonetheless, the findings from the high scenarios in DECC's oil and gas price projections¹⁶ are set out below.
- 3.12 Oil:** supply growth is likely to be slow and eventually shift to decline (indeed some consider that a "peak" in global oil production is imminent). Oil extraction is likely to become harder and more expensive. Under DECC's high price scenarios:
- By 2020, the Brent oil price benchmark rises to above \$150/barrel in 2012 prices (equivalent to in excess of \$180/barrel at 2.5 per cent annual inflation over this period).
 - By 2030, prices rise to \$190/barrel in 2012 prices (nearly \$300/barrel at 2.5 per cent annual inflation).
- 3.13 Gas:** supply is expected to remain strong, and this may be further assisted by increased shale gas production. However, demand is also forecast to rise rapidly. Under DECC's high price scenarios:
- By 2020, gas prices will reach 102p/therm in 2012 prices (adjusted for inflation at 2.5 per cent then this would be the equivalent of 125p/therm).
 - Beyond 2020, further increases in oil prices are not currently expected to result in additional gas price increases.
- 3.14** In addition, volatile prices have the potential to create damaging uncertainty for both investors and consumers. Energy price fluctuations would become a more significant issue for consumers if rising prices mean that energy is a greater overall proportion of their expenditure.
- 3.15** The likelihood of DECC's high price scenarios for oil and for gas is relatively low, but the probability of a more moderate level of increased prices (as represented by DECC's central oil and gas prices scenarios) is high. Gas prices have historically been indexed to the price of oil. While this link has been weakened in recent years by gas-on-gas pricing and the emergence of the National Balancing Point as a trading hub, there is a realistic chance that tighter supply conditions might cause this link to be re-established as the UK draws on more expensive marginal sources of supply. This therefore forms part of the central price scenario as well as the high case. Factors such as the speed and effectiveness of European gas market liberalisation, gas demand in the UK,

¹⁶ See: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/ff_prices/ff_prices.aspx

Europe and the rest of the world and the availability of alternative sources (such as LNG) will be important drivers of the extent to which the oil link is prevalent in UK markets.

- 3.16** Future demand cannot be predicted with certainty, although the IEA estimates a 40 per cent increase in energy demand from 2010-2035. Global demand for oil and gas is unlikely to be significantly reduced by price increases while the global economy continues to rely on current technologies and behaviours. Long-term price rises may lead to the development and deployment of alternative low carbon technologies, but the rate of such change is extremely difficult to gauge and there is a high likelihood that it will lag behind, and be driven by, price rises.

Mitigating actions

- 3.17** This risk is driven by global developments in supply and demand, and there are limits to what can be achieved by the UK Government's activity. The UK Government does, however:
- Work internationally to encourage investment in oil and gas production, improve the transparency and workings of markets, and encourage reductions in demand growth.
 - Promote actions which will reduce the UK's own dependence on oil and gas by increasing energy efficiency and promoting low carbon alternatives such as renewables and nuclear.
- 3.18** The Government's options to manage rapid, short-term price volatility are the same as the relevant resilience measures for gas and oil, set out above.

Insufficient investment in UK energy infrastructure

- 3.19** £110 billion¹⁷ of investment in new power stations and grid infrastructure is needed by 2020, primarily to replace the UK's old or more polluting plants that are closing. That represents double the investment rate of the last decade. In addition although new gas storage is coming on line, and significant levels of gas import infrastructure have been built over recent years, additional investment is needed to ensure that our gas system remains secure¹⁸.
- 3.20** The impact to the UK of a lack of investment in electricity could be to reduce capacity margins to levels which cause electricity supply to fall below demand at peak times. In most circumstances this will not result in noticeable impacts on customers, but this has the potential to result in involuntary disconnection of some customers.

¹⁷ This figure reflects investment needed in the electricity market:

http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/emr_wp_2011.aspx

¹⁸ Ofgem's 'Project Discovery' Energy Market Scenarios, published in October 2009 estimates cumulative investment required in energy infrastructure to 2020 to be £200 billion. 'Energy infrastructure' includes electricity generation, transmission and distribution, renewable heat, energy efficiency, smart meters, gas storage and LNG terminals, and selective catalytic reduction (SCR) technology.

- 3.21** The impact of insufficient gas infrastructure investment depends on future levels of gas demand and how the global gas supply/demand position evolves. At present the gas system appears adequate, but more gas infrastructure could be needed in the medium to long term, as the UK Continental Shelf declines and if the role for gas generation remains substantial. Potentially, gas supply or transport capacity could reach a point where gas-fired power stations are not able to access the required gas supplies as quickly as necessary.
- 3.22** The likelihood of a lack of investment will be influenced by a number of subsidiary risks including:
- **Policy uncertainty:** policy signals given by the Government and more widely the EU may not be clear enough or provide sufficient long-term certainty to induce the market to make the necessary investment decisions;
 - **Regulatory:** investors might anticipate government intervention to prevent the short-term price rises that may be necessary for a given investment to be profitable; and
 - **Finance:** it may be hard to secure project finance on the basis of uncertain revenues and overall economic conditions.

Mitigating actions

- 3.23** The Government is taking a range of actions to mitigate the risk of insufficient investment, the most significant of which include:
- Electricity Market Reform will provide a strong and transparent policy framework which will provide greater long-term certainty for investors in generation assets and demand side response measures and reflect energy resources and devolved responsibilities in each part of the UK.
 - The next transmission price control (RIIO-T1) will operate over 2013-21, and is expected to enable substantial new investment in networks.
 - Designated energy National Policy Statements in England and Wales will help to ensure that the UK has an attractive market for investors in energy infrastructure by ensuring that we have a planning system that is faster, predictable and accountable. In Scotland, planning is a devolved function¹⁹.
 - The Green Investment Bank will help to provide financial solutions to accelerate private sector investment in the UK's transition to a green economy.

¹⁹ In Scotland a coherent and spatial approach to offshore planning is delivered through Marine Scotland. The Scottish Government delivers onshore spatial planning through the Scottish National Planning framework. This delivers an attractive market for investors through identifying a range of generation and grid upgrade and reinforcement projects deemed to be national priorities in Scotland.

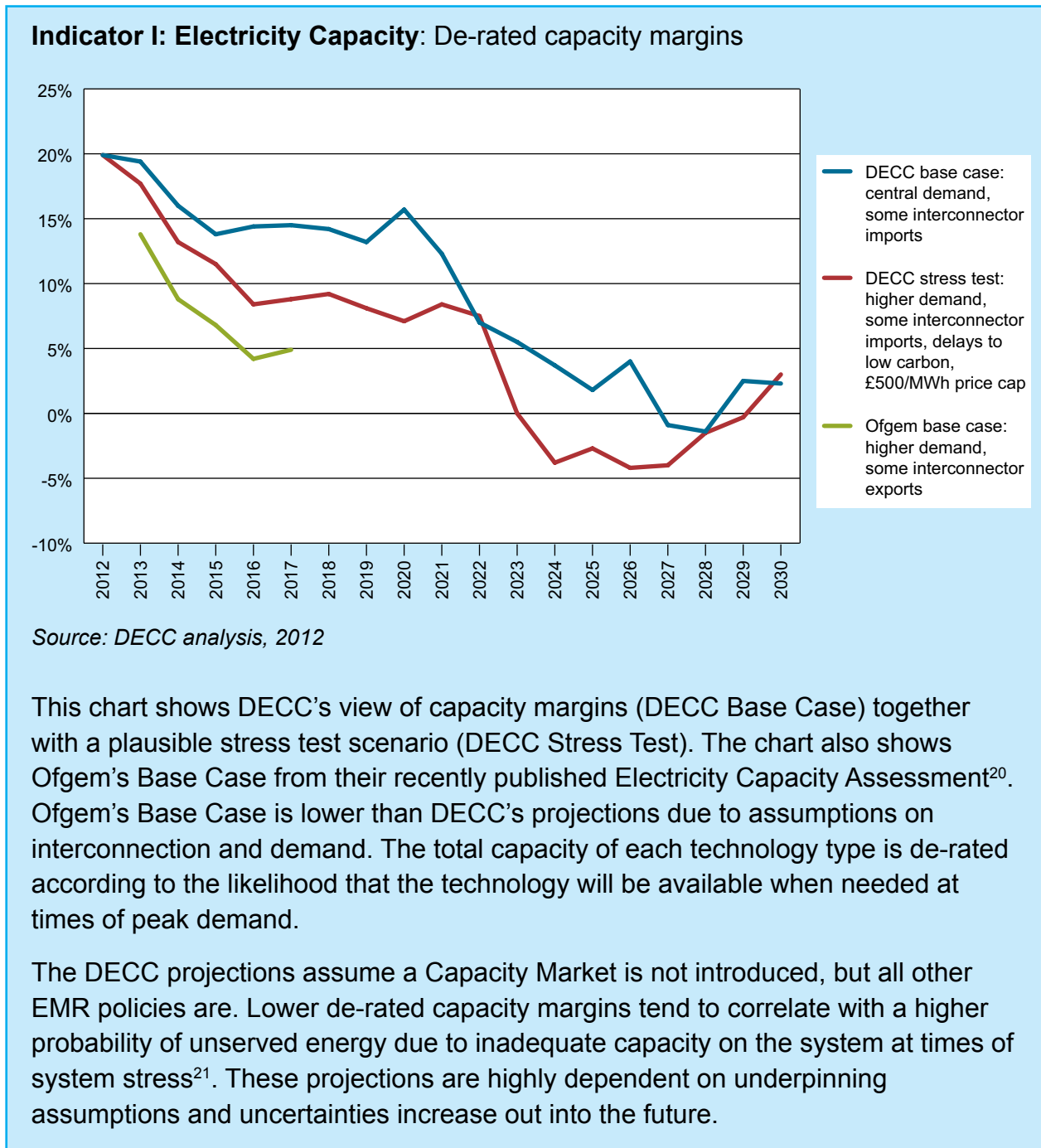
4. Electricity

Key messages:

- The overall outlook for our electricity security is robust but there are potential future risks. Electricity capacity will need to grow as demand is likely to increase by between 30 and 100 per cent by 2050. In the short term, de-rated capacity margins are expected to tighten due to around a fifth of capacity available in 2011 having to close within this decade.
- Additional capacity and balancing challenges may come in the medium term as existing generation is replaced by more intermittent (renewables) and less flexible (nuclear) generation, and as demand becomes more varied as our heat and transport systems become increasingly electrified. To remain balanced, our system will need sufficient reliable capacity to meet demand as well as a variety of non generation technologies, including storage, interconnection and demand side response.
- Mindful of these challenges, the Government is taking powers in the Energy Bill to run a Capacity Market. The Government is minded to run the first auction in 2014 for delivery of capacity in the year beginning in the winter of 2018/19.
- The Government has a range of current and planned policies that enable market participants to invest in low carbon generation technologies – nuclear, renewables and CCS. These generation types will enhance the diversity of our generation mix, bringing some important security benefits in addition to helping tackle climate change.
- In addition, the Government is working to ensure the GB System Operator can continue to balance the system with the future generation mix and demand profile, through; reform of electricity cash-out, led by Ofgem; work to make the planning and consenting process more predictable; and, work to achieve greater integration of EU markets.
- The electricity network is currently absorbing the challenges posed by changes to our generation mix to ensure no delay to investment in generation infrastructure. DECC is working with Ofgem to ensure that investment now takes place and reliability is maintained, including through the introduction of the RIIO regulatory framework.

Our strategy for delivering electricity security

Adequate capacity



4.1 In 2011, we used 374 terawatt-hours (TWh) of electricity. Electricity was 18.6 per cent of the final energy consumption in the UK²² and peak demand was

²⁰ The exact relationship between capacity margins and the probability of energy unserved depends on the specific generation mix.

²¹ Electricity Capacity Assessment, Ofgem, 2012 <http://www.ofgem.gov.uk/Markets/WhIMkts/monitoring-energy-security/elec-capacity-assessment/Documents1/Electricity%20Capacity%20Assessment%202012.pdf>

²² DUKES 2012 tables 1.1 and 5.1.

57.1 GW²³. As shown above by our relatively healthy de-rated capacity margins, the system currently has adequate capacity to meet this demand.

- 4.2** We do not anticipate demand to increase significantly in the near future. However, in the longer term as we move to electrify new sectors of the economy such as heat and transport, demand is likely to increase by between 30 and 100 per cent by 2050.
- 4.3** These estimates would be higher still without our plans for energy efficiency to reduce demand, and the recently published ‘Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK’ sets out how we plan to make the most of the UK’s energy efficiency opportunity.
- 4.4** To date the UK electricity market has managed to deliver sufficient spare capacity to meet its needs. At the end of 2011, the UK had a total of 89.1 GW of electricity generating capacity across a range of technologies²⁴. Capacity is expected to decrease over the coming years, as existing generation is taken offline as a result of environmental regulation, age, changing market conditions and limited investment. This will cause de-rated capacity margins to tighten in future years.
- 4.5** A tightening of margins is to be expected in a competitive market with an oversupply of generation capacity. A reduction in capacity or an increase in demand for electricity would reduce the generation oversupply that currently exists, which would in turn be expected to increase the case for investment. However, the current investment climate including levels of uncertainty around likely future generation on the system, as well as the challenges posed by the new low carbon technologies, mean that the market may not provide the generation we need.
- 4.6** The Government is taking powers in the Energy Bill to run a Capacity Market²⁵. The Government is minded to run the first auction in 2014 for delivery of capacity in the year beginning in the winter of 2018/19. The regulator is also working to address other potential risks through: proposed reform of cash-out²⁶ in the electricity and gas markets; changes to the planning regime in England and Wales; and the identification of developments as national priorities in Scotland, to ensure that projects critical to electricity system security can be progressed within more predictable timeframes. The UK continues to work within the EU to implement the Third Package of EU energy market reforms and develop a more integrated EU energy market.

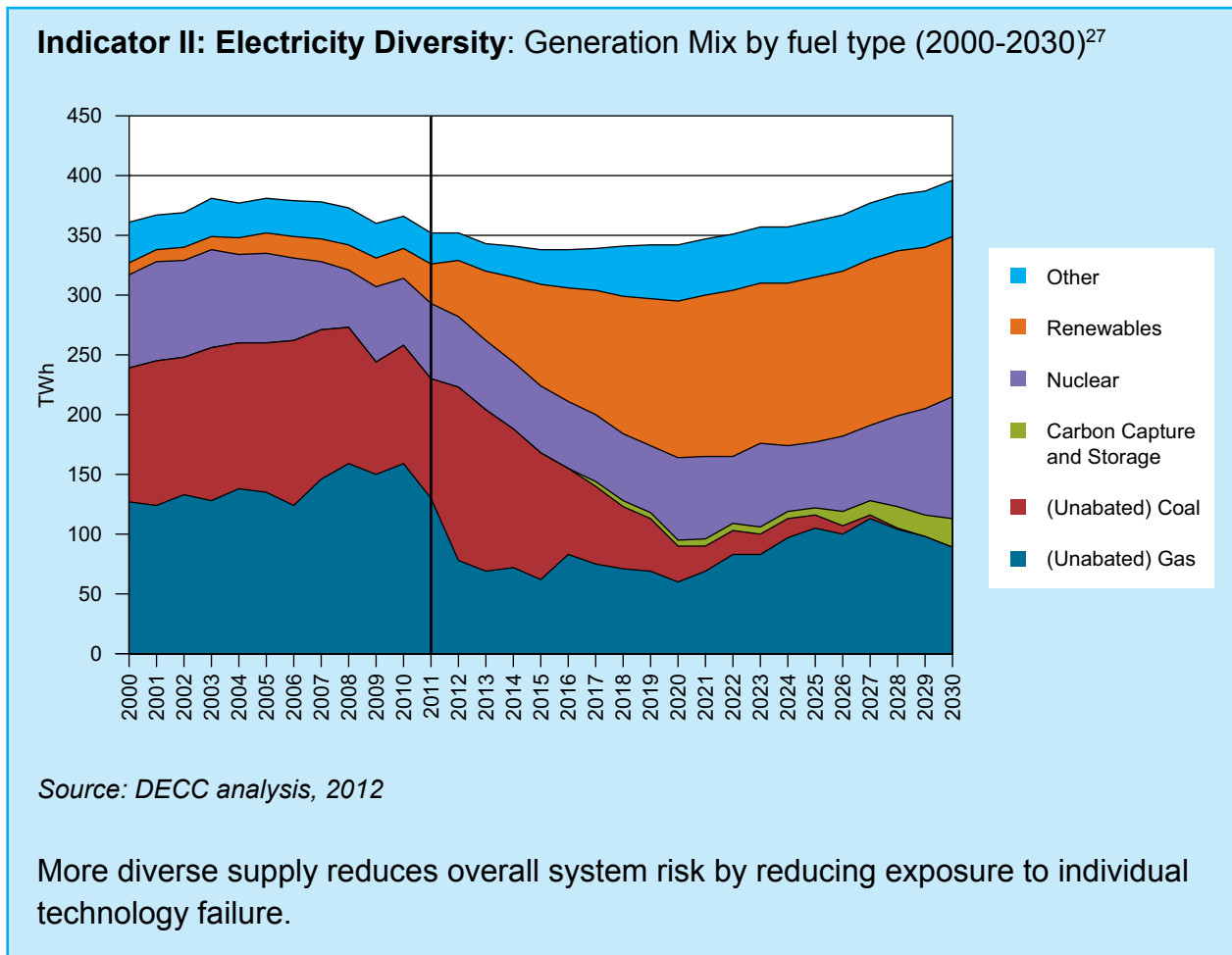
23 DUKES 2012, table 5.10. The figure relates to year ending March 2012. This is maximum simultaneous load met on the transmission network. It does not include demand that is met from small scale embedded generation.

24 DUKES 2012, table 5.7.

25 <http://www.decc.gov.uk/en/content/cms/legislation/energybill2012/energybill2012.aspx>

26 These are the arrangements for pricing the cost of energy in real time.

Diversity



4.7 To date, we have largely relied on competitive markets to deliver a diverse electricity mix. The nature of electricity and the fact that it cannot be stored cheaply means that we need a mix of baseload plants which run all year round and at all times of the day, combined with more flexible plants that can operate on a “mid-merit” or “peaking” basis as needed. Different technologies suit these different purposes and the market price signal has provided the incentives for these different technologies to come forward.

4.8 From a technology perspective, our current generation mix is drawn from a diverse range of fuel sources: in 2011 the electricity generation mix was 40 per cent gas, 30 per cent coal, 19 per cent nuclear, 9.4 per cent renewables and 2.5 per cent other fuels²⁸. Electricity generation is spread across a range of infrastructure, such that a breakdown in one piece of important physical infrastructure would normally be insufficient to disrupt overall supply if it occurs in isolation.

²⁷ The chart shows electricity generation supplied to the grid. ‘(Unabated) coal’ and ‘(unabated) gas’ includes Major Power Producers only, while other coal and gas generators are included in ‘Other’. ‘Other’ also includes supply from auto-generation and pumped storage and for the projections from 2012 also interconnection. Data up to 2011 is based on DUKES and is for the UK. Data from 2012 onwards is from DECC analysis for GB.

²⁸ DUKES 2012, table 5.6. The UK also has around 4 GW of interconnection capacity with surrounding European countries, which is not included in the historic ‘other’ category in the chart.

- 4.9** There will be a regulated closure of part of our coal and nuclear fleet over the coming decade. Looking to the future, this means that we will need new sources of electricity, from a diverse range of technologies. The Government does not have targets for particular generation technologies for 2030, and different combinations of low carbon technologies (renewables, nuclear, or coal or gas with CCS) – combined with an ongoing role for unabated gas – are all plausible. The Government’s aim is therefore to allow these three technologies, over time to compete on cost. This will help to hedge against the risk of one technology failing to deliver affordable electricity supplies or losing public acceptability.
- 4.10** The Government will achieve this through measures within our Electricity Market Reform. To help ensure that all CCS, new nuclear and new renewable generation can compete for market share, and that a diverse energy mix is developed, the Government has committed to introducing Contracts for Difference for low carbon technologies. This policy will provide increased price certainty, aiding investment decisions in low carbon technologies.
- 4.11** In addition, the Government has committed to supporting full scale demonstration of CCS technology in the UK to help the industry bring this technology to market. On 3 April 2012, DECC launched a new CCS Commercialisation Programme, including a competition with £1 billion capital funding available, in order to support practical experience in the design, construction and operation of CCS. The aim of the programme is to enable private sector electricity companies to take investment decisions towards building CCS equipped fossil fuel power stations in the 2020s without Government capital subsidy. This will be done at an electricity market price that is competitive with other low carbon generation technologies. From an initial eight bids in the competition, four have been shortlisted and decisions on which projects to support further will be taken in the early new year. DECC is committed to sharing the knowledge from the Programme to accelerate potential cost reductions, ultimately supporting CCS deployment in the UK and globally.
- 4.12** The Government provides the framework for significant financial support for renewable electricity deployment, through both the Renewables Obligation and small scale Feed-in Tariff scheme, alongside a range of policies to address non-financial issues such as grid connection, planning consents and supply chain support. These financial incentives and supporting activity have driven a huge increase in renewable energy deployment over the last few years and will increase deployment to 2020 and beyond. We are currently on track to meet our target of 15 per cent of energy from renewable sources by 2020.
- 4.13** These measures will help the UK move to a low carbon future whilst maintaining electricity security and affordability, from the starting point of the electricity mix currently in place.
- 4.14** **Nuclear** power stations currently play an important role in ensuring our energy mix security. New nuclear generation also has a critical role to play in future, with each new 3.3 GW twin reactor nuclear power plant having the potential to provide

reliable baseload electricity to over 5.7 million homes per annum. Nuclear generation is also a low carbon, proven technology which is expected in the future to be the cheapest low carbon source of electricity.

- 4.15** The characteristics of nuclear power are different from those of conventional fossil fuel and provide specific advantages with regards to energy security. The supply chains of nuclear fuel, gas and coal are not interdependent. An interruption in the supply of gas or coal is unlikely to affect the supply of uranium. Consequently, including new nuclear power stations in the generating mix increases the diversity of fuels on which we rely. Fluctuations in fuel prices do not significantly affect the cost of electricity from nuclear power stations, and the power stations themselves can continue to operate for long periods of time without refuelling. International sources indicate that adequate uranium resources exist to fuel a global expansion of nuclear power, including any new nuclear power stations constructed in the UK. New nuclear power stations will therefore reduce exposure to the risks of fossil fuel supply interruptions and of sudden and large spikes in electricity prices that can arise when a single technology or fuel dominates electricity generation.
- 4.16** **Gas** currently forms an integral part of the UK's generation mix. For instance, in 2011 combined cycle gas turbines (CCGTs) generated around 40 per cent of our electricity. Gas plants are quick to build, have relatively low capital costs, emit around half the carbon of coal power stations, and are a reliable and flexible source of electricity.
- 4.17** The Government expects that gas will continue to play a major role in our electricity mix over the coming decades, alongside low-carbon technologies as we decarbonise our electricity system. The role gas plays will be determined by the market, whilst keeping emissions within the limits set out in the carbon budgets. Unabated gas will continue to play a crucial role in our generation mix for many years to come and the amount of gas capacity we will need to call on at times of peak demand will remain high. In the long term, the development of cost competitive CCS should ensure gas (and coal) can continue to play a full role in a decarbonised electricity sector.
- 4.18** **Coal** has a number of positive security of supply related attributes at both domestic and global levels, as it is abundant, relatively cheap and easy to store. Coal generation is flexible, and able to provide constant 'baseload' output as well as respond to short-term fluctuations in electricity demand. This will become increasingly important for ensuring stability of the GB grid as we see a significant increase in variable renewable generation and less flexible nuclear.
- 4.19** There are currently 17 coal power stations operational in GB which constitute around a third of the UK's electricity generation capacity. In 2011, coal accounted for 30 per cent of overall electricity generated, a proportion that can rise to nearly 50 per cent at peak periods during winter²⁹. However, given the higher emissions associated with electricity production from coal (around twice that of gas), and the

²⁹ 2011 winter figures.

long lifetime of coal power station assets, the Government has a policy that no new coal-fired power stations can be built unless equipped with CCS:

- As set out in the Energy National Policy Statements in England and Wales, any new coal plants are required to demonstrate CCS on at least 300MW net of its total capacity in Scotland, the Scottish Government has made clear its expectation that new build power stations will not be permitted to operate without implementation of suitable CO₂ abatement in the future; and
- This will be reinforced by the introduction of an Emissions Performance Standard in the forthcoming Energy Bill.

4.20 Equipping new coal-fired power stations with CCS provides an additional fuel option in a decarbonised world, and means we are not overly reliant on gas. This not only contributes to security of supply but enables generators to fuel switch in response to fuel prices, helping to minimise costs to consumers.

4.21 In addition, a key feature of coal and oil-fired power stations is their ability to store coal and oil in quantities which allow months of autonomous operation. This has been a vital part of our electricity security in the past. Coal power stations with CCS will mean our energy system maintains some ability for autonomous operation, however expected closure of power stations in the medium term has resilience implications.

4.22 Renewables including wind, hydropower, photovoltaic, tidal and biofuels are currently only a relatively small proportion (9.4 per cent) of UK electricity generation capacity. However, their market share is already growing rapidly as new technologies become familiar and more affordable and this is expected to expand substantially in future. The 'Renewable Energy Roadmap'³⁰ sets out the UK's plan for renewable energy to contribute 15 per cent of UK energy demand by 2020. The UK has become the world leader in offshore wind and boasts some of the best natural resources for renewable energy in the world. This renewable energy will help safeguard the security of our energy system by reducing our reliance on fossil fuels and the mixture of technologies being developed will enable constant and intermittent technologies to complement each other.

4.23 In addition to domestic UK generation our electricity supply can be further diversified through **interconnection with the continent**. To the extent that scarcity in the GB market does not always occur at the same time as scarcity in the country it is connected to then both markets are likely to benefit, from a security of supply perspective, as the country with surplus will be able to sell to the country with scarcity.

³⁰ DECC (2011) The UK Renewable Energy Roadmap, <http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/renewable-energy/2167-uk-renewable-energy-roadmap.pdf>

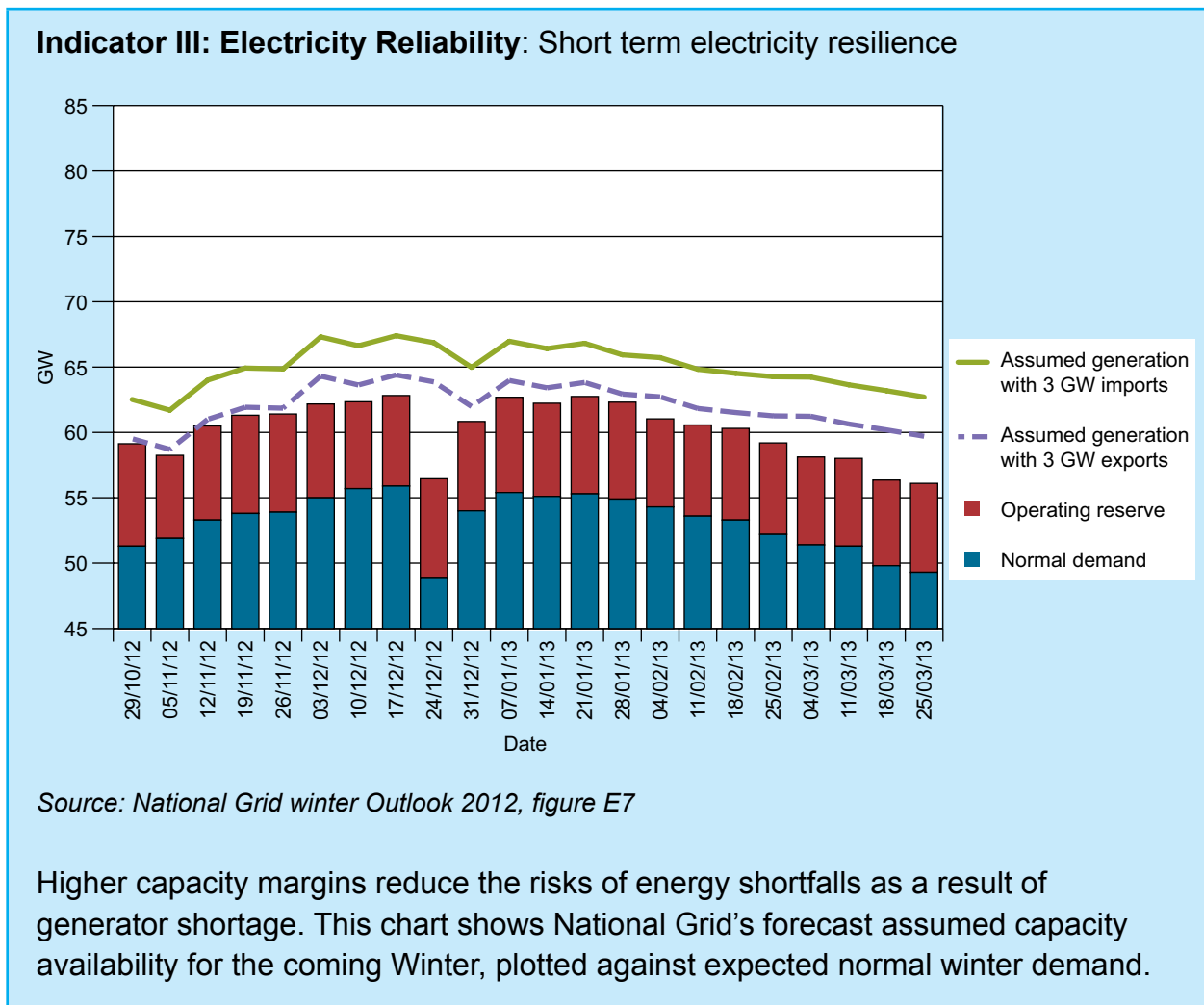
- 4.24** Recent analysis undertaken for DECC³¹ indicated that interconnection could provide a considerable reduction in the need for domestic back-up generation as generation from the other side of the connection could be used to help meet security, although the level of cost-effective interconnection varied greatly with different assumptions on DSR take-up.
- 4.25** This analysis focused on EU-wide costs and benefits. DECC will be undertaking further work to understand the costs, benefits and risks to GB of greater electricity interconnection, including on electricity prices and security of supply.
- 4.26** In a competitive market it is as important for there to be a number of different players as for there to be a number of technologies. Competition is our key tool for delivering diversity amongst electricity companies, regulated by Ofgem and the Competition Commission to ensure the market is working effectively.
- 4.27** From a market participation perspective, there are currently six major, vertically integrated electricity companies operating within Great Britain, along with a diverse range of smaller generators and suppliers. Around 70 per cent of capacity is owned by these six electricity companies with the remainder provided by independent players such as Drax. In 2010 seven companies had market shares exceeding five per cent with the three largest companies generating nearly half of electricity consumed³². The changing energy system will present opportunities for innovative and efficient companies to take market share. It is important that barriers to entry for new participants are minimised.
- 4.28** Ofgem has identified low levels of liquidity in the wholesale market as an important barrier to entry and has consulted on potential interventions – they are expected to make further progress on their reforms before the end of the year. Industry has also taken some steps to improve liquidity and we have seen traded volumes on day ahead exchange auctions increase significantly in the last year which is positive for transparency. The key issue of forward market liquidity, however, remains unaddressed and regulatory intervention may therefore be justified – Ofgem remains the primary vehicle for delivering any regulatory intervention. However, given the importance of liquidity to competition and the effective delivery of EMR, the Government is seeking backstop powers in the Energy Bill to enable it to act should industry actions and Ofgem reforms not secure the necessary improvements.
- 4.29** Independent investors have also raised concerns about their route to market and, in particular, access to the long-term contracts (power purchase agreements) that are needed to underwrite investments. The Government issued a Call for

31 Imperial College and NERA Consulting, 2012, Understanding the Balancing Challenge': <http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/future-elec-network/5767-understanding-the-balancing-challenge.pdf>

32 http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202011/NR_En/C11_NR_UK-EN.pdf

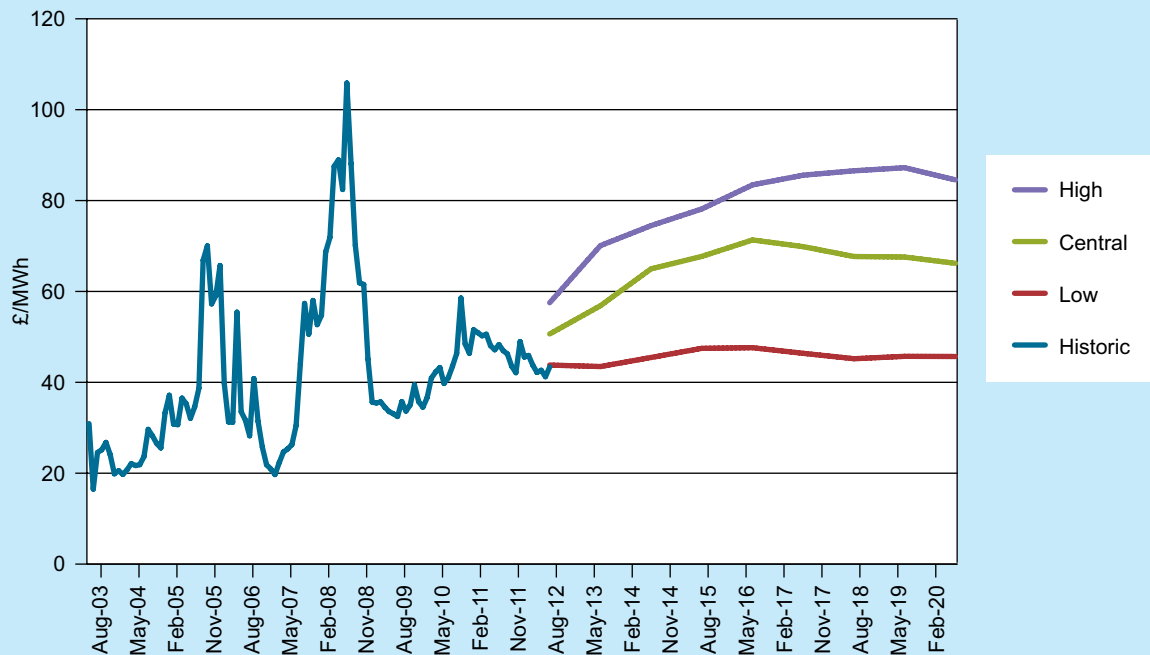
Evidence on this issue in July 2012, and is publishing a response to the Call for Evidence in the technical annexes to the Energy Bill³³.

Reliability



33 <http://www.decc.gov.uk/assets/decc/11/consultation/call-for-evidence-barriers-independent-renewable-generation-investment/5684-call-evidence-barriers-ind-ren-gen-inv.pdf>

Indicator IV: Electricity Reliability: DECC wholesale market price forecasts (£/MWh)



Source: DECC calculations, based on LEBA data (www.leba.org.uk); DECC DDM Modelling

Consistently high prices could be a sign of resource inadequacy. Volatile prices might deter investment.

Scheduled fossil fuel plant closures pose medium-term upside risks to prices, whereas increased low carbon generation, as well as the implementation of a capacity market, could put downward pressure on wholesale prices.

- 4.30** National Grid as the System Operator (SO) is responsible for maintaining the short-term resilience of the system in GB while the various Transmission Owners (TOs) and Distribution Network Operators (DNOs) are responsible for maintaining the resilience of the network.
- 4.31** The electricity wholesale market ensures that there is enough capacity on the system. Individual market participants are incentivised through cash out to balance their own position in each half hour (on average).
- 4.32** In its role as residual balancer, the SO procures services and takes various actions to maintain the frequency and voltage on the whole network within security and quality of supply standards. These balancing actions are taken to manage system events such as: surges in demand (e.g. TV pickups); failure of a generating unit; loss of a large demand consumer (e.g. interconnection); or the wind suddenly falling or gusting (leading to over speed wind cut out).

- 4.33** The System Operator plans for these potential events, by maintaining reserve capacity, yet flexibility of capacity remains vital as some changes to demand or supply can be instantaneous. As greater amounts of renewable generation is added to the system, National Grid expects that the level of required reserve will increase, due to the need to cope with real time unexpected changes in these technologies in addition to existing challenges.
- 4.34** Balancing technologies, in conjunction with smarter networks, will have a key role to play in ensuring the supply of, and demand for, electricity match in a cost-effective way. There will continue to be a key role for the Government in helping to ensure market frameworks and networks develop in a way that is fit for purpose, and in removing barriers to widespread deployment of balancing technologies. The Government's Electricity System: Assessment of Future Challenges³⁴ set out in more detail the challenges associated with balancing the system in future.
- 4.35** Ofgem has launched an electricity balancing Significant Code Review, which will review the cash out arrangements. These are the arrangements for pricing the cost of energy in real time that create an incentive for electricity suppliers and generators to ensure the volumes of electricity they sell or consume balance the volumes they have contracted to sell or consume. Current cash-out prices are dampened because they are calculated based on an average of actions the system operator takes to balance the system. Some of the potential reforms to cash out that are set out in Ofgem's initial consultation³⁵ have the potential to enable sharper cash-out prices, better reflecting the system operator's cost of balancing the system at the margin and providing more efficient price and scarcity signals at times of system stress.
- 4.36** Our electricity networks are currently extremely reliable. In 2011/12, National Grid transmitted electricity in Great Britain at a reliability level of 99.99972 per cent³⁶. However, they face significant challenges over the medium and long term as new generation is brought online and as the geographic distribution of electricity generation changes. Based upon Ofgem's Project Discovery 2009 projections, approximately £35 billion³⁷ of additional investment may be needed up to 2020 to ensure these challenges can be met. As part of the next transmission price control (RIIO-T1) that will operate from 2013-21, Ofgem has agreed up to £6.1 billion of network investment in Scotland and its Initial Proposals in July 2012 were to allow up to £11.6 billion in England and Wales, that could double the value of the existing network. Final proposals are expected in December.

34 <http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/future-elec-network/6099-elec-system-assess-future-chall-full.pdf>

35 <http://www.ofgem.gov.uk/Markets/WhIMkts/CompandEff/electricity-balancing-scr/Pages/index.aspx>

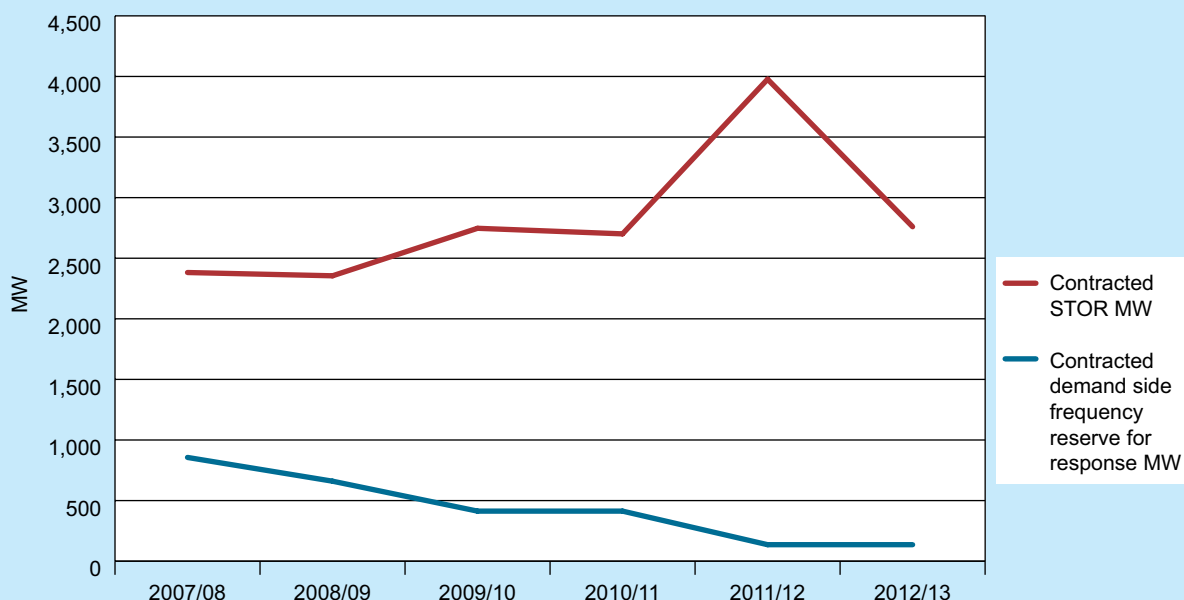
36 See page 19 of NETS Performance Report 2011-12: <http://www.nationalgrid.com/NR/rdonlyres/FB8E72DA-6286-4C0F-AB53-9EB9DD80594C/56380/NationalElectricityTransmissionSystemPerformanceReport20112012.pdf>

37 DECC's projections will be updated in due course to reflect Ofgem's publication of its final proposals for National Grid under the RIIO process and detailed business plans from the distribution companies for the period from 2015.

- 4.37** Distribution network investment will also be crucial, ensuring we meet increasing electricity demands and to connect new low carbon technologies, such as electric vehicles and heat-pumps, and distributed generation, such as solar photovoltaic panels. These changes may cause local stresses or constraints but also make estimating the capacity and demand on the system much more difficult. Investment in a “smarter” grid can help to reduce the cost of reinforcement and ensure security of supply. The Smart Grid Forum, which is co-chaired by DECC and Ofgem, has assessed the value of “smart” technologies ahead of the upcoming distribution price control (RIIO-ED1). Initial findings suggest that they could offer savings of £5 billion to £11 billion up to 2050.
- 4.38** The development of a “smarter” grid involves a greater reliance on information and communications technologies. To ensure that any emerging organisational and technical risks are addressed, a working group of network operators and the Centre for the Protection of National Infrastructure (CPNI) has been established. The mass rollout of smart metering technology will act as an enabler of a ‘smarter grid’. Smart meters will give consumers near real time information, and energy networks will have better information upon which to manage and plan current activities and the move towards smart grids.
- 4.39** Timely grid connection for new generation projects will be essential over the next decade if security of supply is to be maintained. Until recently, getting access to the transmission network represented a major barrier, with some new generation projects being offered connection dates as late as 2025. To address this, DECC introduced an enduring ‘Connect and Manage’ grid access regime in August 2010. This allows new generation projects to connect to the network as soon as their local connection works are completed rather than waiting, as under the previous ‘Invest and Connect’ regime, for wider network reinforcements to take place. ‘Connect and Manage’ has so far reduced the connection timescales for 125 large generation projects (with a total capacity of around 30 GW) by an average of 6 years.
- 4.40** Our exposure to European electricity markets through interconnection should reduce the cost of our electricity security, where those interconnections are cost-effective, by decreasing the amount of GB capacity that is needed. We are working with the European Commission to ensure the development of liberalised and secure European electricity markets and to ensure that the new European Network Codes, due to be agreed in 2014, maintain current levels of reliability, despite new technical challenges.

Demand side responsiveness

Indicator V: Electricity DSR: Demand side response in National Grid STOR and frequency reserve



Source: National Grid

Increased demand side response can contribute to energy security. Current changes in fuel types have led to a reduction in DSR used in National Grid's Short Term Operating Reserve (STOR). However, this is expected to increase in the mid to long term in light of Electricity Market Reform.

- 4.41** Demand side response (DSR) is an active, short-term reduction/shifting in consumption of energy demand at a particular time. DSR can reduce the need for peaking plants and network reinforcement. Currently there is limited demand side responsiveness in the electricity system, making up about 1 per cent of National Grid's balancing services.
- 4.42** The Electricity System: Assessment of Future Challenges report, published in July 2012³⁸, set out the Government's work to ensure that non-generation balancing technologies, including electricity storage and DSR, can contribute to the responsiveness challenges.
- 4.43** We intend that DSR and storage would be eligible to compete in the main/primary auction for the Capacity Market, alongside generation. However, some DSR and storage providers face barriers that conventional generation does not. DECC and National Grid are designing transitional arrangements for DSR and storage that are intended to assist the industries in building their capacity and capability ahead of competing with other capacity providers in 'live' auctions, allowing them to play

³⁸ <http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/future-elec-network/6098-electricity-system-assessment-future-chall.pdf>

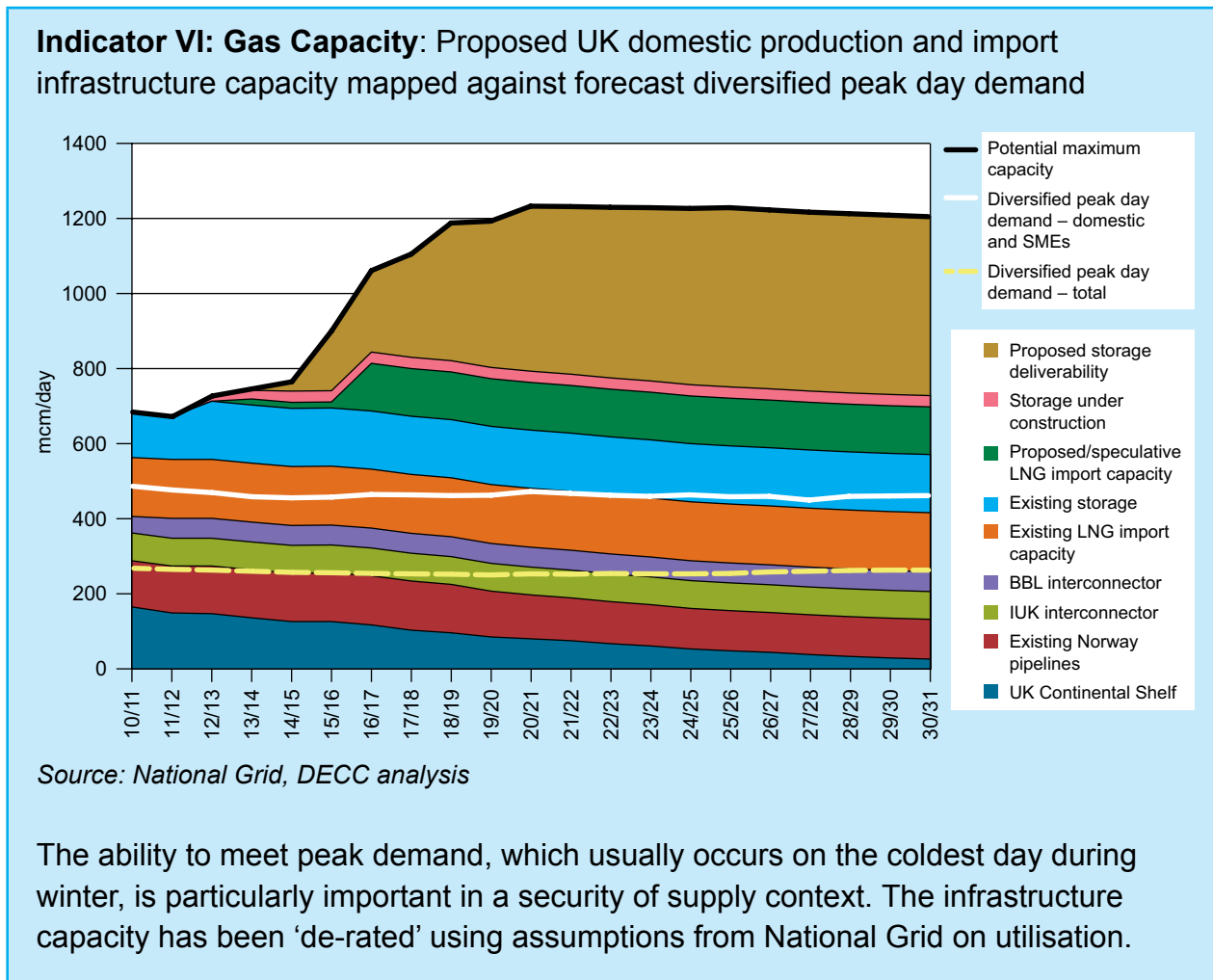
an increasing role in security of supply. If implementing the Capacity Market, the Government also intends to run pilot auctions for the delivery of DSR and storage from 2015-18 to provide additional capacity during this period.

5. Gas

Key messages:

- Gas will continue to play a crucial role in our energy mix for many years to come, both for power generation and for heat. The UK's domestic production is expected to continue to decline. Unconventional gas may mitigate this but the extent, timing and costs of UK shale gas production are as yet uncertain.
- The IEA estimates remaining global recoverable reserves of conventional gas are equivalent to 130 years of current consumption, this total could double if unconventional gas potential is added. However, global demand is expected to increase rapidly, and increasing UK reliance on global markets, as well as possible tightness in global Liquefied Natural Gas (LNG) markets towards the middle of this decade, brings new risks to supply and prices.
- The UK has the largest and most liquid gas market in Europe with an extensive range of import infrastructure and a diverse range of gas supply sources. We are therefore well placed to manage gas supply risks. Recent assessments have judged that our gas market is resilient to all but the most extreme supply disruptions. However, there remains a risk of low probability but high impact events.
- Ofgem is therefore consulting on sharpening the incentives on gas shippers to manage gas supply risks, and launching (with the Dutch and Belgian regulators) an investigation into the price responsiveness of interconnector flows between Great Britain and North West Europe. The Government will be considering further whether there is a case for providing support for gas storage, and will continue to work internationally to promote: easier gas trading through our work to enhance market liberalisation and integration in EU and beyond; and, gas supply to the global market through international organisations and our bilateral links with gas exporters.

Capacity



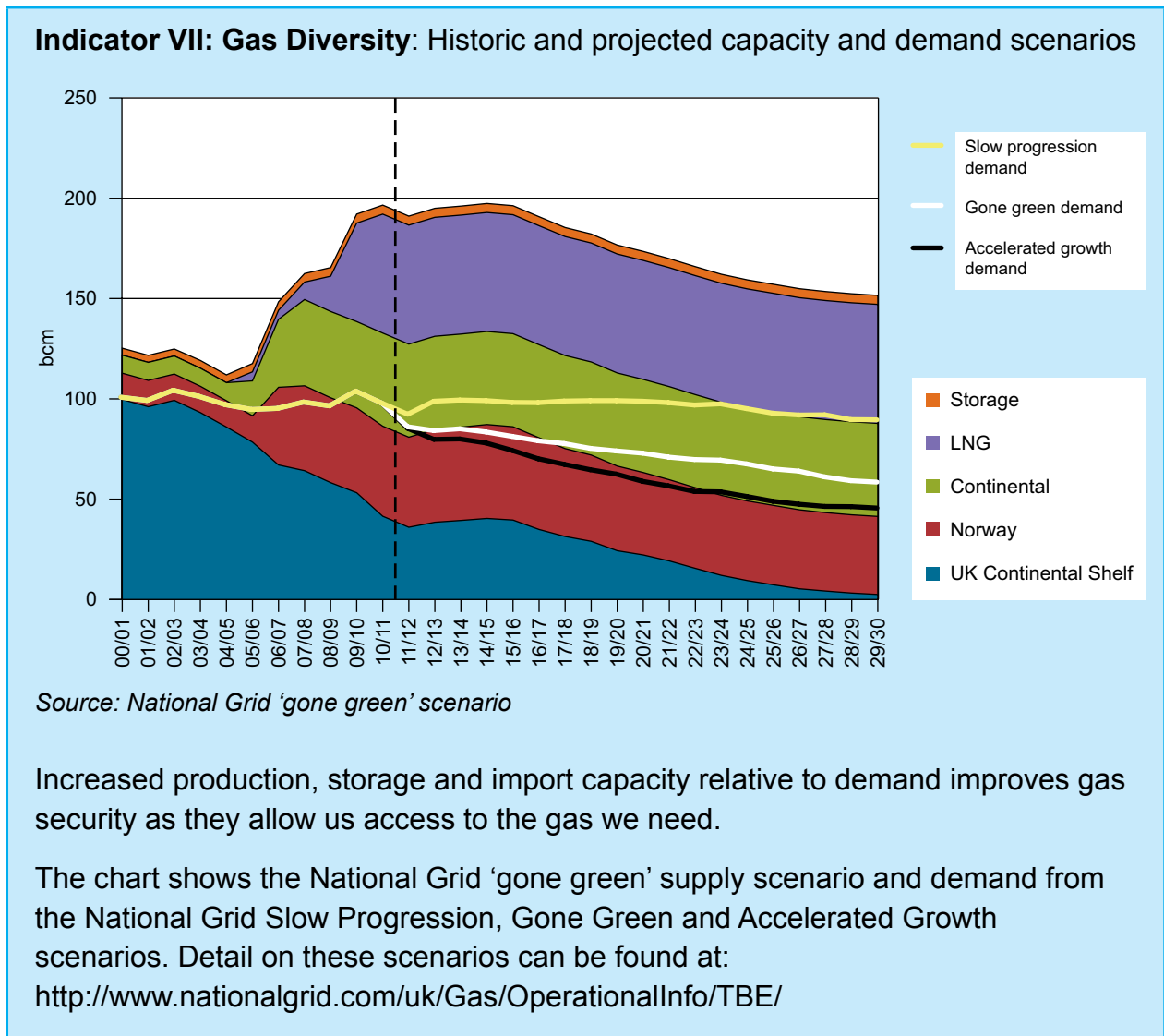
- 5.1 Gas security of supply is dependent on having both adequate supply infrastructure capacity, and being able to secure enough gas supply through that infrastructure to meet annual and peak demand.
- 5.2 UK gross demand for gas in 2011 was 101 bcm, of which 82 bcm was used within the UK, 77 bcm by end consumers and 5 bcm for production and transport. The remainder was exported to Ireland and the Continent.
- 5.3 DECC analysis as set out in the Heat Strategy indicates that by 2050, we need to remove all direct greenhouse gas emissions from heating our buildings. This is challenging, and means replacing fossil-fuel based heating technologies within individual buildings, such as natural gas or oil-fired boilers, with low carbon alternatives.
- 5.4 Nevertheless gas will continue to play a crucial role in our generation mix for many years to come. Modelling by Government suggests significant new gas plant investment could be required by 2030. Our Electricity Market Reform package takes this need into account: the Capacity Market, if implemented, will allow us to ensure adequate reliable electricity capacity, including gas-fired power stations, and the Emissions Performance Standard has been set at a level which

will allow new gas stations to be developed. In the long term, the development of cost-competitive CCS should ensure gas (and coal) can continue to play a full role in a decarbonised electricity sector.

- 5.5** Having been a net gas exporter from 1997 to 2003, the UK has been a net importer of gas on an annual basis since 2004. UK production currently supplies around half of UK gas demand, and this proportion will reduce as UK production declines. It is important that the UK maximises economic recovery of our indigenous hydrocarbon reserves, both from an energy security and an economic perspective. Analysis by the industry estimates that there are around 350,000³⁹ jobs directly and indirectly within exploration and extraction, plus another 100,000 in exporting goods and services. Of the 350,000, over 30,000 are direct jobs and the remainder are in supply industries or supported by expenditure by employees. In July 2012, the Chancellor announced a new field allowance of up to £500 million for large shallow-water gas fields. This facilitated the announcement of the development of the Cygnus gas field, the largest new gas development in the Southern Basin for a decade.
- 5.6** The last 10 years have also seen a 500 per cent increase in our import capacity to 156 bcm/y, sufficient to meet up to 188 per cent of our annual demand on its own. Capacity is split into three near equal sources: Continental pipelines (46 bcm/y); Norway (54 bcm/y); and LNG (56 bcm/y). There is significant spare capacity for import. In addition, there are nine commercial gas storage facilities in Great Britain, with a total capacity of 4.4 bcm. Three new facilities are currently under construction, which will add a further 0.9 bcm to total capacity. The role of gas storage in our security of supply is discussed in more detail under the reliability section of this chapter.
- 5.7** Overall, we have ample capacity to meet demand so long as all sources of supply are able to deliver in line with this. However, as discussed in the reliability section below, there are a range of reasons why actual deliverability may fall short of the actual capacity. Furthermore, the nature of our gas demand and supply is shifting over time. This is discussed further below.

³⁹ <http://www.oilandgasuk.co.uk/cmsfiles/modules/publications/pdfs/EC026.pdf>

Diversity



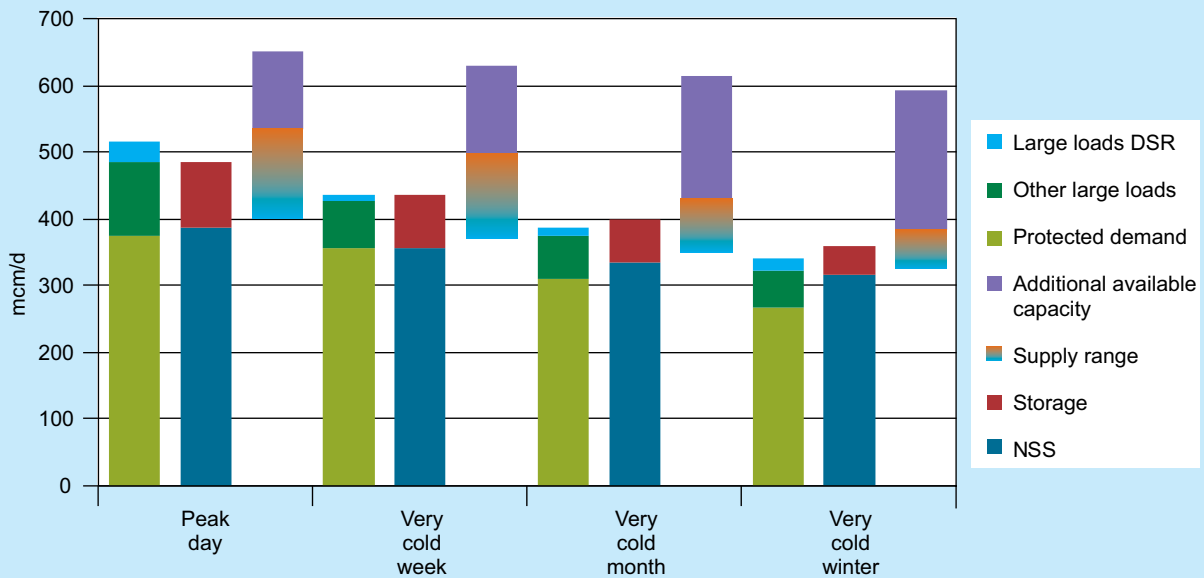
5.8 The UK has diverse gas supply routes compared to other European countries, being able to draw on domestic production, imports via four separate pipelines from Norway, imports of gas from North West Europe via two interconnectors with Belgium and the Netherlands, imports of LNG from a growing global market and gas storage facilities. In recent years the UK's LNG regasification capacity has increased significantly, LNG imports have risen from less than 5 per cent of total imports in 2005 to almost half of the UK's total commercial imports of gas in 2011.

5.9 Current UK gas production comes overwhelmingly from conventional gas extraction offshore, as set out above. However, global high prices for gas and improved extraction techniques have begun to make other sources of gas, including gas from coal bed methane, shale and biomethane more economically viable.

- 5.10** Exploration for shale gas in the UK remains at a very early stage and the production potential is not yet known. DECC will support new ways of tapping our indigenous resources, where this proves economic and can be carried out safely and with full regard for protection of the environment. DECC is also supporting new work by the British Geological Survey to better delineate the extent of the resource.
- 5.11** Biomass and waste can also be converted to gas and upgraded to biomethane, a gas that can directly replace or blend with natural gas in the grid and is compatible with existing boilers. The Renewable Heat Incentive supports biomethane injection to the gas grid at all scales. A number of barriers to biomethane injection into the grid were recently identified by an Ofgem led review group. We are working with Ofgem and industry to remove these.
- 5.12** In 2011, our largest international gas suppliers were Norway, Qatar and the Netherlands, supplying 41 per cent, 40 per cent and 12 per cent of our gross gas imports respectively. In recent years we have also received LNG cargoes from a range of different gas exporting countries, including Algeria, Trinidad and Tobago, Nigeria, Egypt, Yemen and Australia. Our extensive LNG import infrastructure will enable us to draw cargoes from other sources as the number of liquefaction plants worldwide increases.

Reliability

Indicator VIII: Gas Reliability: National Grid Cold Spell analysis, Winter 2012/2013 (severe winter conditions)

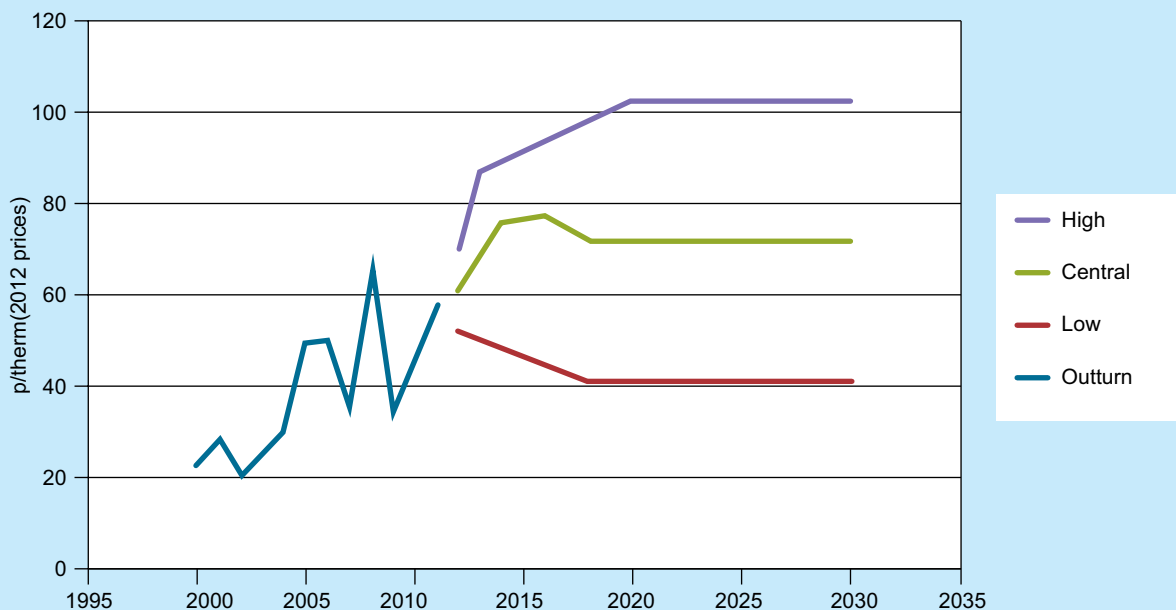


Source: National Grid Winter Outlook 2012, figure G20

In addition to sufficient capacity, it is essential to ensure sufficient availability of gas.

- The chart above shows three bars for different levels of demand. The first bar shows demand as three components:
 - Protected demand: including domestic consumers;
 - Other large loads: large loads whose demand levels are not expected to respond to a short-term increase in gas price; and
 - Large Loads DSR: large loads that are expected to respond to a short-term increase in the gas price (further details on demand side response below)
- The second bar represents Non Storage Supply (NSS) and storage.
- The third bar shows the range of supply for NSS, and an assessment of storage use. In addition, this bar shows an estimate of additional available capacity based primarily on import capacity with smaller contributions from UKCS and storage. The wide range of NSS highlights the significant amount of supply flexibility that is available within the UK.

The analysis shows that even on a peak day in severe winter conditions, all demand could be met by the central case supply assumptions apart from a 30 mcm/d requirement for either additional NSS or storage or an equivalent demand side response. The wide range of the NSS and storage at peak, and the potential for a modest demand side response indicates that peak demand should, in principle, be met.

Indicator IX: Gas Reliability: Gas prices

Source: DECC Fossil Fuel Price Projections, ICIS Heren

Despite the potential for unconventional gas production, most central forecasts show gas prices remaining firm to 2030, reflecting expectations of rising global gas demand, rigidities in gas markets, and uncertainties about the scale, timing and cost of unconventional gas production.

5.13 The IEA has described the global gas resource base as “vast and widely dispersed geographically”, and estimated that remaining recoverable reserves of conventional gas are equivalent to 130 years of current consumption, and that unconventional gas reserves could be equivalent to another 125 years. However most analysts suggest that a range of factors are likely to make unconventional gas more costly and harder to access in regions outside of North America, these include: population density, environmental regulation, operating costs and geology. Although there is considerable potential, particularly in Australia and China, the extent, timing and costs of production remain subject to considerable uncertainty. Global gas demand is also forecast to rise dramatically, by 55 per cent by 2035 according to the IEA, driven especially by demand growth in Asian economies. Reduced nuclear power use in some countries could add to this rising demand. Ofgem’s Gas Security of Supply Report highlights the risks associated with global LNG markets: the possibility of market tightening towards the middle of this decade, the risk of closure of critical LNG shipping lanes, and the potential for markets to be distorted by political influence or other factors.

- 5.14** To promote gas supply into the global market and to ensure the UK has access to a range of sources of gas supply, we are working with our international partners to support environmentally sound exploitation of gas sources and UK firms seeking to invest. We also seek to increase reliability of gas supply through supporting strengthened infrastructure and trading links, including long-term contracts.
- 5.15** The Government is working within the EU to help ensure that the implementation of the Third Energy Package, and in particular the development of EU Network Codes drives forward both market and physical integration of the European gas markets. This should not only help to keep prices as low as possible and increase standards of service, but also provide enhanced security of supply for Member States. We are also working closely with the Commission on new legislative proposals on infrastructure which aim to help deliver necessary investment over the next ten years at EU level. These proposals aim to remove barriers to investment such as long delays in planning and permitting for cross-border interconnection and agreeing regulatory framework arrangements for cost allocation between Member States. This will improve physical integration of European gas markets, in turn enabling greater ease of gas trading.
- 5.16** Great Britain has a market-based regulatory regime which encourages competition between gas market participants, and demand and supply to balance in the most cost-efficient way. Ofgem regulates the market to promote competition in Great Britain. Our regulatory regime limits the potential for anti-competitive behaviour, for example by preventing the same company holding both a gas shipper (wholesale gas supplier) and gas transporter (network operator) licence as well as allowing third party access to gas infrastructure which helps promote entry and competition along the gas supply chain.
- 5.17** The flexibility of the GB's gas market helps it to respond to the uncertainties around global gas supply and demand, and rapid changes in the nature of the global market. Our gas market is characterised by competition between gas suppliers, and has yielded the lowest wholesale gas prices in Europe.
- 5.18** The decline of the UKCS increases our exposure to geopolitical risks and lengthening supply chains. Analysis for DECC in 2010 on the future risks to the security of Great Britain's gas supplies over the medium term showed that, while the GB gas market is largely robust to a range of adverse events, we cannot rule out the risk of shortfalls in supply, nor the risk of significant rises in wholesale gas prices. Further infrastructure, beyond that which exists or is under construction at present, is likely to be needed in future in order to reduce these risks. Gas storage is likely to become more important to the UK's energy security as the contribution to electricity generation from intermittent renewable sources (particularly wind) increases, causing the operational profile of gas-fired plants to evolve to play a more flexible role.

- 5.19** In response to these changes, the Government took steps through the Energy Act 2011 to give Ofgem power to implement measures to sharpen the incentives on GB gas market participants to prepare for and respond to a gas supply emergency. In parallel, Ofgem launched a review of the arrangements underpinning gas deficit emergencies. They announced their proposed final decision in July 2012 to reform the emergency cash out arrangements so as to sharpen the incentives on gas shippers to ensure reliable supply.
- 5.20** The Government also asked Ofgem in November 2011 to report on whether there was a case for further intervention in the gas market to enhance gas security of supply. Ofgem's analysis concluded that the GB wholesale gas market has functioned well against a background of significant domestic supplies and well supplied global LNG markets. The GB market has attracted significant investment in gas import infrastructure in response to declining indigenous supplies. However, the decline in UK Continental Shelf production has inevitably resulted in increased reliance on international gas markets, which exposes Great Britain to a range of additional risks. However, Ofgem's analysis shows that only very extreme circumstances would result in physical interruption to domestic customers and small businesses. While the likelihood of such events is very low, their impacts would be severe.
- 5.21** In the light of Ofgem's report and given the importance of gas to our energy mix and the need to maintain security of supply, Government is considering further whether there is a case for further measures to encourage gas storage, and will publish our findings in Spring 2013.
- 5.22** Ofgem will be working with industry to consider the case for further interventions to enhance gas supply security through improving the operation of the market, via increased transparency and measures to promote the standardisation of interruptible contracts, and has (with the Dutch and Belgian regulators) launched an investigation into the price responsiveness of interconnector flows.
- 5.23** The Gas Safety (Management) Regulations (GS(M)R) provide the framework under which gas emergency arrangements are set. The GS(M)R requires parties across the gas industry to cooperate with a Network Emergency Coordinator (NEC) and each other. The GS(M)R also places a duty on gas conveyors and the NEC to hold a safety case accepted by the Health & Safety Executive (HSE) and makes it an offence not to conform with an accepted safety case. The NEC safety case sets out the role and responsibilities of the NEC in the event of an emergency. It also sets out the stages of a gas deficit emergency (GDE) that the NEC may declare in order to minimise the risk or impact of a supply emergency.
- 5.24** The GB gas transmission network achieved 100 per cent reliability in 2010/11, where system reliability is assessed as no supply losses to firm supply points. However, the National Transmission System (NTS) faces a number of future challenges. Whereas ten years ago we could rely on a steady flow of gas supply from the North Sea, today we are more reliant on imported and variable gas

supplies. At the same time demand is becoming more variable, given increasing reliance on gas-fired power stations as back-up for renewable generation, reduction in coal generation capacity, and the closure of gas holders on the gas distribution network.

- 5.25** Increased volatility of supply and demand will require operation of the NTS over the course of the decade to develop new capabilities to ensure it can respond flexibly to challenges arising from this changing environment. The gas industry and Ofgem have powers to develop codes and licences to address this, and consider the need for grid infrastructure through the price control process for network investment.

Demand side response

Indicator X: Gas Demand Side Response

Currently estimated demand side response of 6 per cent⁴⁰ of total gas demand on a peak day during Winter 2012/2013 (severe winter conditions).

Source: National Grid

Increased levels of demand side response (DSR) can contribute to security of supply. The greater the percentage of DSR as a ratio to total demand, the greater flexibility within the GB market to act in response to high prices and limited gas supply. Many large consumers can respond to price signals at times of peak gas demand by switching to other fuels, scaling back gas use or even ceasing operations. This would reduce overall gas demand.

- 5.26** Demand side response (DSR) is an important tool to balance gas demand and supply at short notice. Historically most demand side response for gas has been provided by the power generation sector, primarily through switching between gas and coal-fired generation. However, due to relative prices favouring coal in generation, the ability of the power sector to provide DSR for the gas market is currently fairly limited.
- 5.27** By the end of 2015 the scope for switching from gas to coal will have been reduced as around 8 GW of coal-fired power generation capacity closes due to the Large Combustion Plant Directive. In the longer term, further coal plants may close as a result of the requirements of the Industrial Emissions Directive. DSR in the power sector could in future also be provided by biomass plants/co-firing. Some large industrial users of gas sign interruptible contracts with gas suppliers, taking favourable commercial terms in exchange for agreeing to scale back gas use when the market is tight. Ofgem have considered how to maximise DSR availability as a gas balancing tool through their Significant Code Review process, and we will continue to monitor levels of DSR.

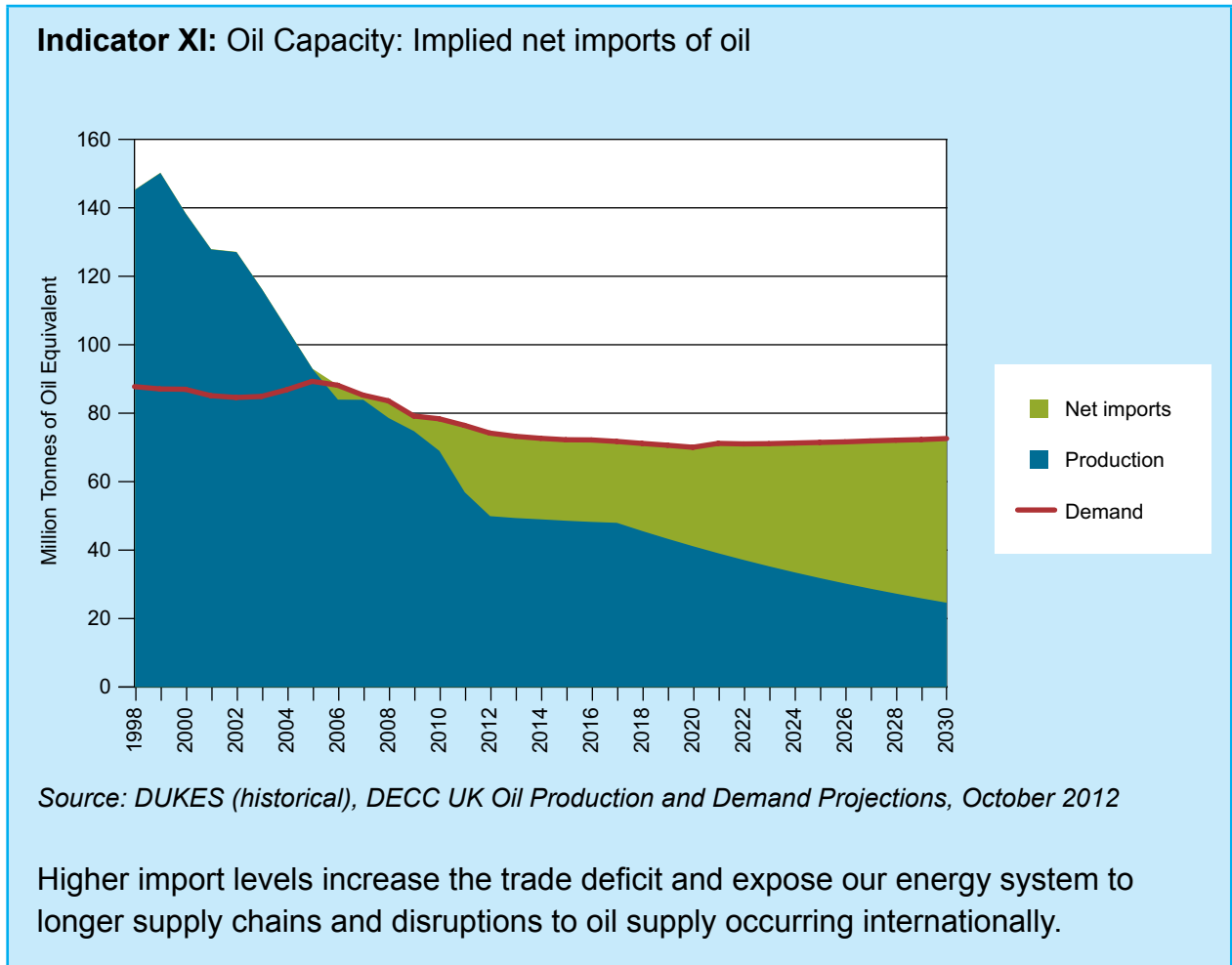
⁴⁰ This is on the basis of large loads DSR (30 mcm/d for peak day), being around 6% of 516 mcm/d (peak day demand)

6. Oil

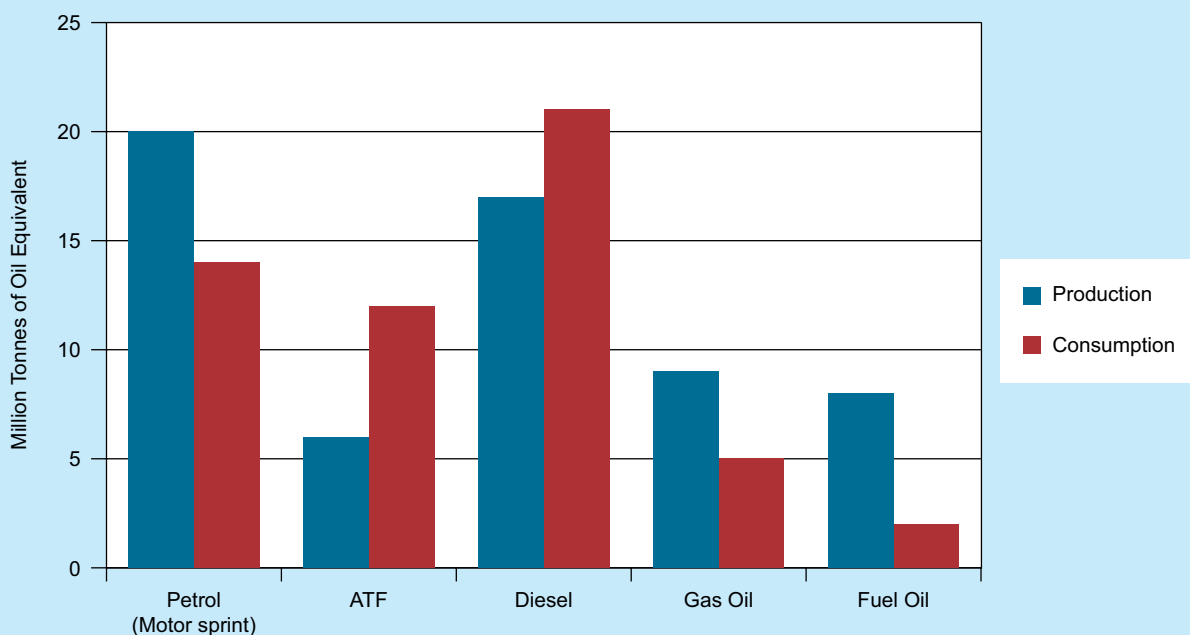
Key messages:

- Oil currently constitutes around 34 per cent of the UK's energy mix. Demand for oil in the UK needs to decrease in the long term so we can meet our climate change objectives and focus our economy on more secure energy supplies. The Government is working to promote technologies which use oil efficiently and act as substitutes for oil, particularly low emission vehicles and biofuels. Nevertheless, oil will continue to be a major part of our energy mix for the next few decades.
- Government is working to maximise economic production from the UK Continental Shelf to ensure the UK continues to benefit from these secure supplies. However, UK continental shelf production is expected to decrease at a rate of around 5 per cent a year, and our exposure to international oil markets is set to rise.
- Global oil demand is expected to increase by around 15 per cent in the run up to 2035, largely driven by growth in the transport sectors of Asian economies. Over the same period global production is expected to become more challenging, requiring higher levels of investment. Increasing levels and volatility of oil prices are likely.
- The Government is therefore working internationally to restrain oil demand, encourage investment in oil production, promote market efficiency and to develop strong relationships with key suppliers.
- There is an imbalance between the refined oil products we use in the UK and those we produce, so the UK is working internationally to ensure we have access to the imports we need, and to reduce demand respectively. The Government is working with industry to develop a strategic policy framework for the UK refining industry.
- The UK economy is exposed to disruptions to oil markets, whether to international oil markets or markets for domestic delivery of refined oil products. The Government has contingency plans in place to ensure supplies will be maintained if disruptions occur, including emergency stocks that can be released and the National Emergency Plan for Fuel.

Capacity



Indicator XII: Oil Capacity: UK production and consumption of key petroleum products



Source: Dukes 2012

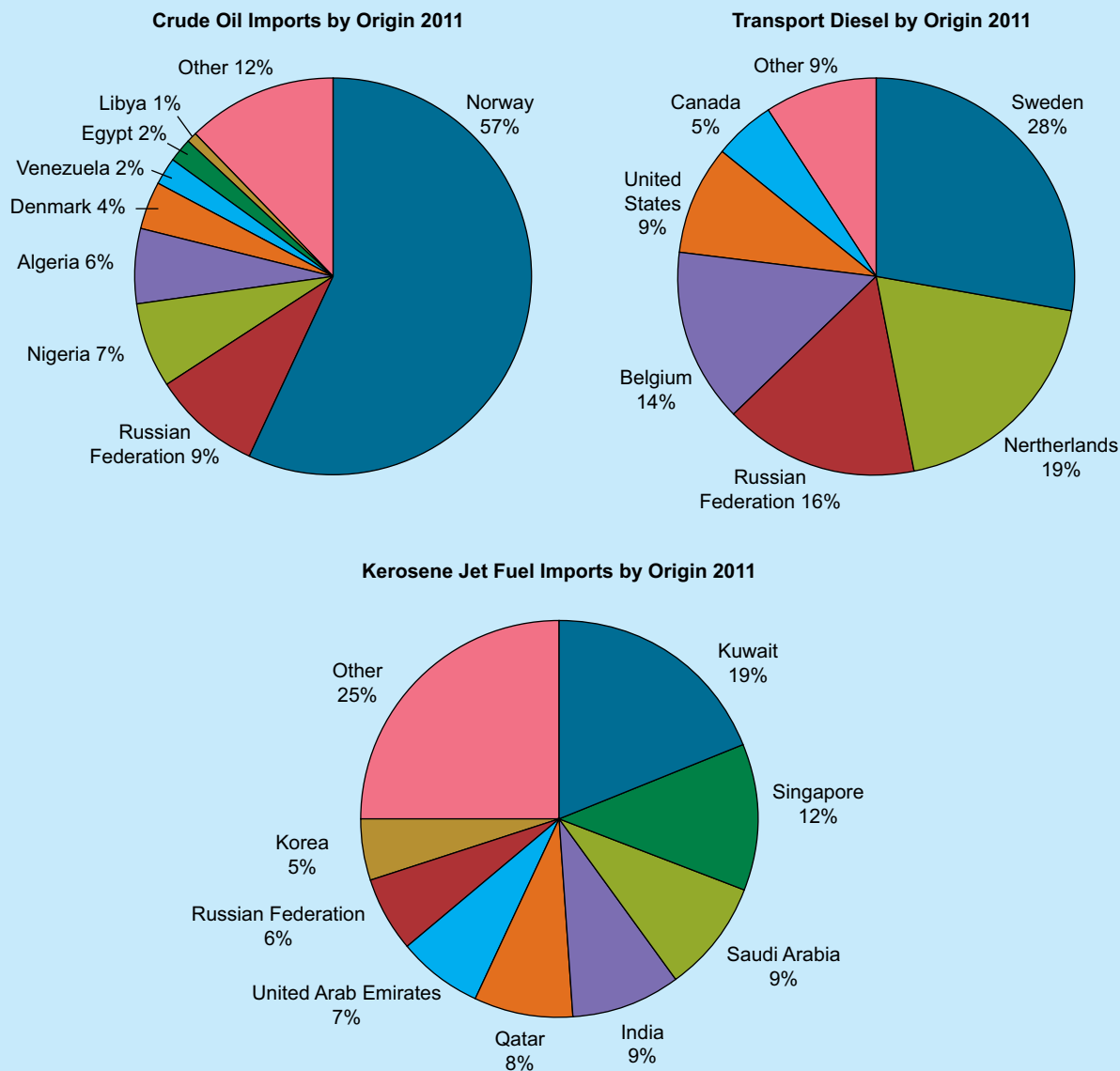
The UK depends on imports of refined products including aviation fuel and diesel. Without significant investment in domestic refineries, reliance on imports of refined products will grow, exposing the UK to longer supply chains and international shortages.

- 6.1** In 2011 the UK consumed 68 million tonnes of oil, representing around 34 per cent of the UK's total energy consumption. Of the UK's current final consumption of oil products, 21 million tonnes is diesel, 14 million tonnes is petrol, 11.5 million tonnes is aviation turbine fuel and 5 million tonnes is gasoil with the remainder made up of other products. It has been estimated⁴¹ that diesel and gasoil demand is expected to increase by around 6 million tonnes from 2012 to 2030. However, reducing the UK dependence on oil and petroleum products is a key coalition priority. As part of the UK's obligation under the Renewable Energy Directive, biofuels are blended into the UK's petrol and diesel transport fuels.
- 6.2** The UK's domestic oil production capacity will decrease as output from the UK Continental Shelf reduces, increasing our exposure to international markets. However, we have plentiful import capacity allowing us to meet our oil demand from these markets.

⁴¹ "Developments in the International Downstream Oil Markets and their Drivers: Implications for the UK Refining Sector", Purvin & Gertz: <http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/energy-security/2259-int-downstream-oil-mkts-drivers.pdf>

- 6.3** Through PILOT, the Oil and Gas Government/Industry taskforce, we are working in partnership with industry to address barriers to success and bringing forward initiatives which will help achieve the best overall outcome from the basin. The Government is also committed to a fiscal regime that encourages further investment and innovation in the North Sea, while ensuring a fair return for UK taxpayers.
- 6.4** The UK oil refining industry, with its good links to other European refiners and access to North Sea oil (from both the UK and Norwegian sectors), provides the UK with a secure, reliable and economic source of transport fuels, and other petroleum products. In the domestic market for oil products, the UK has seven refineries and three petrochemical refineries, where a significant proportion of the UK's primary oil is processed into petroleum products. However, with the demand for refined products changing substantially over the last 15 years, UK refineries have not matched the changing pattern of consumption. Most are configured to match higher demand for petrol and fuel oil relative to a lower jet and diesel demand and require major investment to change specifications.
- 6.5** In addition, the UK's refineries face challenging conditions through a combination of low financial returns, additional investment requirements to meet tightening environmental standards and product specifications, and increased competition from refineries in Asia and the Middle East. Coryton refinery closed in June 2012 and while this may have provided some initial respite for other UK refineries, the challenging global market conditions that played a significant part in Coryton's closure have not disappeared. This is why the Government is working with industry to develop a strategic policy framework for the UK refining industry. This strategy will be published at the turn of the year and will look at how the current policy framework needs to evolve to create the conditions to retain existing refining capacity and incentivise the necessary investment diversity.

Diversity

Indicator XIII: Oil Diversity: UK oil product imports

Source: DUKES 2012

A diverse set of sources for refined products helps mitigate against security of supply issues.

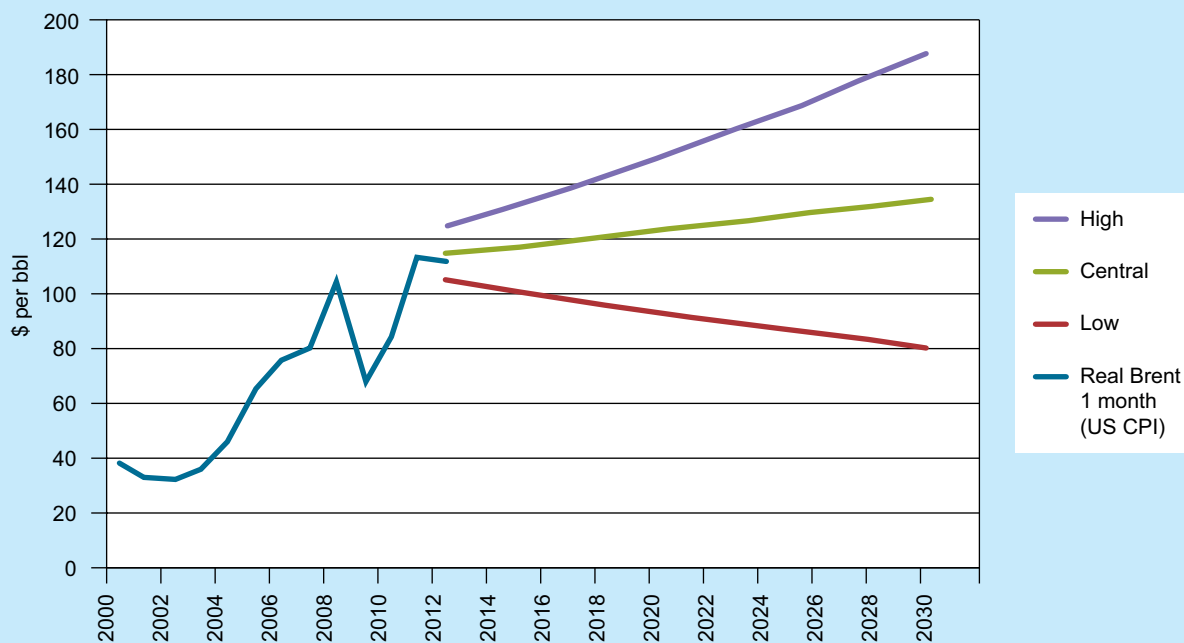
- 6.6** As illustrated by Indicator XIII, the UK has a wide variety of import sources. Most of the UK's crude imports come from Norway, given its proximity to the UK and the similarity in its crude types. The remainder is supplied by Russia and various OPEC countries. Although supplies tend to be sourced nearby in order to minimise transport costs, the UK imports from a diverse range of sources which reduces the impact of a disruption to any one source of supply.

- 6.7** The UK is heavily dependent on imports for diesel fuel and aviation fuel. Net imports meet over half of the UK's demand for aviation fuel, and over a quarter of the demand for diesel fuel. The main source for imports of aviation fuel is Kuwait, newer refineries in Asia and the Middle East are an increasingly important source. Diesel fuel is predominantly supplied by Sweden and via the Netherlands (which is a major transport hub).
- 6.8** This wide variety of import sources for oil, transport diesel and kerosene highlight the liquidity of global markets. Disruption or shortage in a particular country or area may increase prices, but due to the current diversity of supply it is unlikely to result in physical shortage. Going forward, our reliance on OPEC countries for our oil imports is likely to increase as OPEC's share of global production increases. For oil products, the growing market share for non-OECD refining is likely to see further shifts towards reliance on non-OECD countries.
- 6.9** In terms of diversity of infrastructure, independent research carried out for DECC by Lane Clark and Peacock showed that in addition to the UK's seven refineries, there are also 19 import terminals⁴² with diverse coastal locations with two in the East of England, two in the South East, two in the North East, two in the North West, five in Scotland, two in Wales, two in the Yorkshire and Humber region and one in Northern Ireland.

⁴² Excluding Coryton from both the number of refineries and number of import terminals.

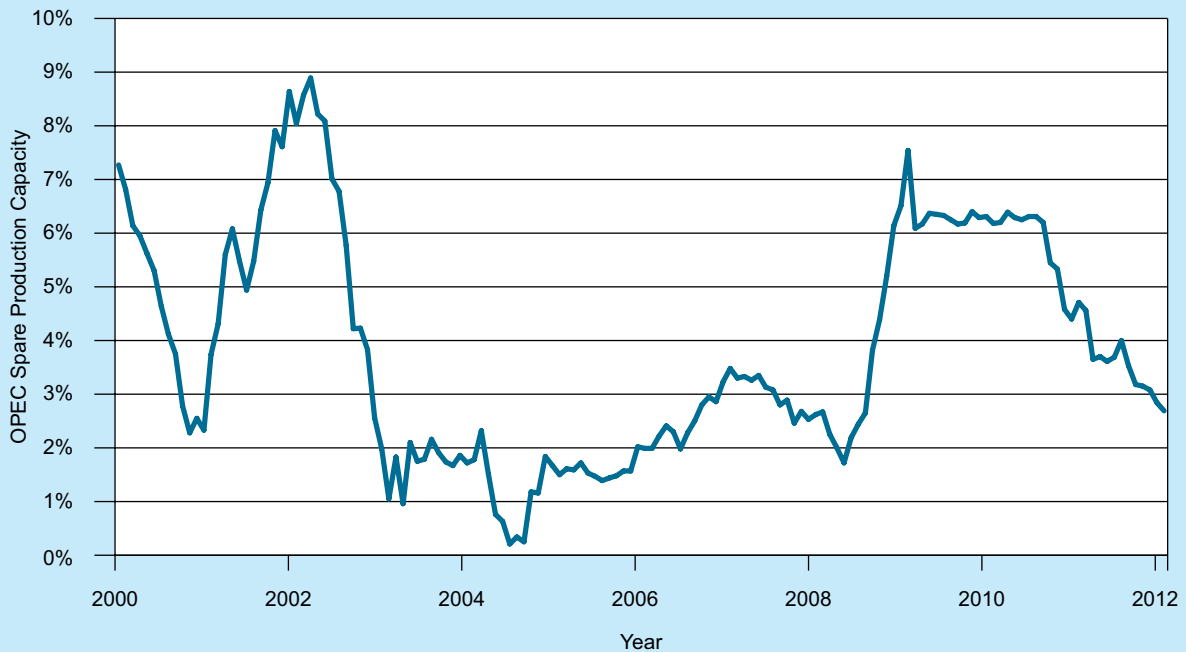
Reliability

Indicator XIV: Oil Reliability: Brent oil price 2000 onwards & DECC fossil fuel price projections, \$ per barrel (2012 prices)



Source: adapted from Bloomberg and DECC fossil fuel price assumptions

High and volatile crude oil prices damage investor confidence and make affordable energy harder to achieve.

Indicator XV: Oil Reliability: OPEC spare production capacity as a percentage of global demand


Source: IEA data

Demand growth is likely to reduce spare capacity if production capacity does not grow in line with demand. OPEC spare capacity provides an indicator of the world oil market's ability to respond to potential crises that reduce oil supplies. Low spare oil production capacity tends to be associated with high oil prices and high oil price volatility.

- 6.10** UK oil production is currently equivalent to around 70 per cent of our oil demand. This domestic resource is relatively secure, but declining. By 2020, net imports of oil are expected to represent 43 per cent of UK oil demand, increasing our dependence on global markets.
- 6.11** Global demand for oil is set to continue growing. The expectation is that net growth in demand for oil will come mainly from transport sectors in emerging economies. As markets mature, oil demand in OECD countries is likely to reduce over the long term.
- 6.12** The overall health of the global economy will be a key determinant of demand, as will the future extent of long-term fuel switching away from oil. Additions to capacity are required simply to mitigate the affect of declining production at existing oil fields. Meeting this demand is likely to become increasingly difficult over time, requiring high levels of investment between 2010 and 2035, and exploitation of increasingly challenging oil reserves such as deep offshore and sources of unconventional oil such as oil sands. Many analysts consider that global production of conventional oil is likely to be close to its peak (see box).

Box – Peak Oil

- We use the term “Peak Oil” to refer to the level and timing of global maximum oil production, although the term can also be used to describe the point of maximum production in a single field or region.
- In 2011, DECC’s Chief Scientist sent out a Call for Evidence, which received an excellent response. From this and other research, we have looked at a variety of sources that assess oil demand and oil depletion, including the outputs of international bodies, industry, other research organisations and academia. Although there is considerable uncertainty surrounding future oil supply, these sources reach the conclusion that conventional oil production is unlikely to grow in the future as it has in the past.
- The IEA, who give attention to both above-ground and geological factors, focused on the issue of peak oil in their 2010 World Energy Outlook. In their central scenario (the “New Policies” scenario), their modelling suggests that production of conventional crude oil production has already peaked (in 2006) but total oil production peaks sometime after 2035. However, in their 450 Scenario (consistent with keeping global warming below 2 degrees) there is a demand-led peak in oil production before 2020, with production falling due to falling demand due to action to tackle climate change rather than geological constraints. This range in predictions for the timing of peak oil highlights the importance of above-ground factors and the definition of oil considered (whether narrowly conventional crude oil or a broader measure that includes natural gas liquids and unconventional oil).
- The Government does not subscribe to a particular view on when oil production is likely to peak and at what level, although there is a recognition that it is inevitable that oil production will peak and then begin to decline. Geological uncertainty, economic, geopolitical and environmental factors make it difficult to predict future oil reserves. At present, many small or difficult-to-access oil fields are commercially unviable and trends in the price of oil and technological advances will determine whether it becomes feasible to exploit these fields.
- The fact that oil production is likely to peak needs to be reflected in policy-making, although predicting the exact timing and level of the peak is not crucial to this process. Whatever people’s views on peak oil, there remains a risk of significant rises in oil prices and volatility that needs to be tackled.

6.13 Oil prices are therefore likely to rise over time, with the International Energy Agency (IEA) expecting average prices to reach \$120/barrel (in year 2010 dollars) by 2035. Tight oil capacity margins are also likely to exacerbate oil price volatility.

6.14 The global nature of oil markets creates a situation in which disruption to local supply or demand anywhere in the world can have security of supply and price implications for all countries. The majority of oil producers, whether International

Oil Companies (IOCs) or National Oil Companies (NOCs) operate at, or very close to, maximum production capacity. This is not the case for some OPEC members, most notably Saudi Arabia, who maintain spare capacity for the production of crude oil. OPEC's market share is projected to increase to over 50 per cent by 2035, predominantly driven by Saudi Arabia and Iraq while non-OPEC supply is forecast to decline slightly.

- 6.15** At present, the vast majority of our imports come from countries with only low or moderate political risk⁴³. However, despite this lack of direct exposure to trading partners in regions of high geopolitical risk, the price the UK pays for oil is set in global markets and therefore is affected by the actions of, and events in, all oil producing and consuming nations. In 2011, OPEC countries accounted for 40 per cent of world oil production and are expected to increasingly dominate world production as OECD supplies continue to decline.
- 6.16** Government takes a range of actions internationally to help to ensure that we can access the oil imports we need at stable and affordable prices. We encourage environmentally responsible oil production; we look to enhance price stability, by increasing transparency of oil markets and deepening producer-consumer dialogue including shared analysis of future market trends; and we seek to restrain international demand for oil by encouraging fuel efficiency and the development of low carbon alternatives.
- 6.17** The UK works internationally to improve the efficiency of global oil markets, particularly through greater transparency (in order to make market signals more efficient) and enhanced producer-consumer dialogue. A key way we do this is through active participation in the International Energy Forum (IEF), which has around 90 member countries, representing 90 per cent of global oil demand and consumption. The IEF hosts regular Ministerial meetings (the UK will co-host the next meeting in 2014) as well as facilitating dialogue on market trends and the interaction between physical and financial markets. The IEF hosts the Joint Organisations Data Initiative (JODI) which collects oil production, consumption and stock data from member countries, improving market transparency. The UK has been a strong supporter of JODI, promoting greater compliance and scope in bilateral relationships and through the G20.
- 6.18** Government also has policies in place to mitigate any potential, or actual, market disruption. During disruptions, the UK works alongside key countries and organisations to ensure that the market receives clear messages about potential market issues, and how the international community intends to respond. The UK works with key partners to encourage increases in production if loss of supply in one country could lead to disruption. Most significantly, as a member of the International Energy Agency (and EU) the UK maintains emergency oil stocks and stocks of refined oil products that can be released in response to a serious domestic or global supply disruption. The UK is currently working closely with

⁴³ As defined by the Economist Intelligence Unit's Political Instability Index.

industry to prepare a strategic and legal framework that will enable the downstream oil sector to establish an oil-stocking agency that is owned and operated by industry and which will have the potential to provide greater security and resilience for the UK's stocks.

- 6.19** For the longer term, we are acting internationally to encourage reduction in demand, which is ultimately the best way to ensure that there is sufficient spare capacity, as well as contributing to global climate change objectives. We do this by securing political commitments, sharing expertise and providing financial assistance. For example, we promote the development and deployment of low carbon technologies and measures to improve energy efficiency through direct funding through the UK's International Climate Fund, and via Multilateral Development Banks or encouraging private sector investment such as through the Capital Markets Climate Initiative (CMCI). We work via the G20 and bilaterally to encourage the removal of inefficient fossil fuel subsidies that encourage wasteful consumption. We also support the development and implementation of policies to drive international low carbon technology deployment through institutions such as the International Renewable Energy Agency (IRENA), the Renewable Energy and Energy Efficiency Partnership (REEEP) or processes such as the Clean Energy Ministerial (CEM).
- 6.20** Petroleum products are transported across the UK through industry and Government-owned pipelines, by rail and over the road network. The importance of oil to the UK economy means disruptions to this private supply network can have serious implications. However, the system is robust and the downstream oil sector has effective business continuity plans to manage a wide range of disruptions and to mitigate disruption to the supply of fuel.
- 6.21** The Government has systems in place to ensure that a secure supply is maintained if disruptions to refined products occur. In the event of an actual loss of supply, the National Emergency Plan for Fuel could be activated to control the available supply around the UK by prioritising fuel for emergency and essential users.

Demand side response (DSR)

Indicator XVI: Oil Demand Side Response

Estimated reduction in demand for a 10 per cent increase in the oil price (relative to other prices).

UK oil consumption, as in other countries, is relatively insensitive to price changes. HMT (2008)⁴⁴ provide estimates that a 10 per cent increase in oil prices (relative to other prices) would be expected to have reduced UK oil consumption by only 1.6 per cent after five quarters after the price rise with a long-term reduction of only 2.2 per cent.

- 6.22** Demand side response (DSR) in UK oil and oil products markets occurs via the price mechanism, with increases in prices leading to reductions in demand.
- 6.23** The Government relies primarily on market mechanisms to determine the level of DSR in UK oil and oil product markets. However, as discussed above under the reliability of UK oil markets, in the case of a very severe disruption, the National Emergency Plan for Fuel can be used to control the remaining supply around the UK, ensuring that the main burden of DSR does not fall on emergency and essential users
- 6.24** The National Emergency Plan for Fuel has been developed by DECC with stakeholders to identify how the resources of the downstream oil industry and the Government can be used in an emergency. It outlines a suite of tools that can be implemented as required independently or in combination – ranging from voluntary options, to changes in Regulation, to measures that require the use of Emergency Powers. The tools that the Government implements are proportionate to the situation and what is happening on the ground. In the process of continuing to improve the Government's contingency planning, the NEP-F will be reviewed in light of lessons learned from the potential tanker drivers strike in early 2012.

⁴⁴ Macroeconomic Model Documentation, March 2008 Public Model: <http://www.parliament.uk/deposits/depositedpapers/2009/DEP2009-2901.pdf>

7. Delivering energy security

7.1 Policies are already in place to ensure that the UK energy system remains secure. However our system still faces challenges which it is not possible to mitigate fully, and continuing work to maintain the resilience of our energy system is necessary. We also face new challenges: our increasing import dependence in the context of rising global demand; the fact that much of our electricity generation infrastructure is coming to the end of its working life; and, the need to replace this infrastructure with plant which will allow us to meet the emission reduction agenda.

7.2 These challenges, combined with other more sector specific issues, impact the energy security outlook for each of the three key consumer fuels in different ways:

- Our **electricity** supplies are likely to remain secure in the short term. In the medium term capacity margins will tighten. Because of the role of the market there is uncertainty over how the electricity mix will develop. However, our future electricity system is likely to experience higher demand, fulfilling more of our energy service needs, including heat and transport. Our future electricity system is also likely to be significantly more challenging to balance with more seasonal demand and more intermittent supply, due to the increased deployment of renewables.
- Our **gas** supplies are also likely to remain secure in the short to medium term, thanks to our diverse range of supplies and high levels of import infrastructure. However declining UK Continental Shelf production, the increasing global demand for gas and the more intermittent role gas is likely to play in our future energy mix mean that our existing system for delivering secure gas supplies will come under new pressures.
- **Oil** is likely to continue to play a key role in our economy for many years to come. UK Continental Shelf production is declining, as are many international reserves. Demand internationally will increase in line with economic growth. In the long term we will need to transition away from dependence on oil to ensure UK energy supplies remain affordable and to meet our decarbonisation goals. We also have a range of activities to support international markets, and measures to deal with any specific short term disruptions.

7.3 In most cases the market will act to address the challenges set out above in the light of our existing policy frameworks as set out in Chapter 2. Nevertheless, in a number of areas where the Government believes there are market failures, or the

incentives for market operators could be improved, further actions are being taken to ensure our energy security.

Competitive markets

7.4 The Government is facilitating effective market functioning through its planning reforms, such as setting clear national planning guidance in the National Planning Policy Framework in England and Wales and the identification of developments as national priorities in Scotland. Further improvements to the planning framework for considering energy infrastructure are proposed in the Growth and Infrastructure Bill laid before Parliament on 18 October. These measures will contribute to the rapid and effective consideration of development consents applications.

Regulating for security

7.5 The Government is taking powers in the Energy Bill to run a Capacity Market. The Government is minded to run the first auction in 2014 for delivery of capacity in the year beginning in the winter of 2018/19.

7.6 We are encouraged by the analysis in Ofgem's Gas Security of Supply Report of the robustness of the GB gas market, the further reforms they have planned and potentially helpful developments within EU and global gas markets. However, given the importance of gas to our energy mix, we need to ensure that our gas security of supply arrangements are adequate. We will therefore consider whether there is a case for measures to encourage gas storage development, and will publish our findings in Spring 2013.

7.7 In addition, The Energy Bill will introduce provisions for a new statutory Strategy and Policy Statement (SPS). Under the provisions the Secretary of State will have powers to designate a SPS setting out the Government's strategic priorities for energy policy and its (unchanged) roles and responsibilities, and defining policy outcomes that Government considers Ofgem to have an important role in delivering. Ofgem will be required to have regard to these priorities. Security of supply is expected to be reflected in the SPS when it is developed for consultation following Royal Assent, alongside the Government's other major priorities.

Increasing the energy efficiency of the UK

7.8 The recently published 'Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK' sets out our mission to seize the energy efficiency opportunity in the UK. By reducing energy use and cutting down on waste, we can reduce energy bills, make our energy system more sustainable, and drive down greenhouse gas emissions. The Energy Efficiency Strategy sets out a range of initiatives that we are taking forward now, and also addresses the long-term direction needed to deliver a more sustainable and secure energy system.

- 7.9** In July this year we published an initial assessment of the potential around Electricity Demand Reduction (EDR)⁴⁵. This assessment concluded that there was significant technical potential to make efficiency savings beyond those incentivised by existing policy. DECC therefore set out its intention to consult on measures to best unlock this potential.

Maximising economic production of UK oil and gas

- 7.10** In 2012 the Chancellor announced changes to the fiscal regime to promote investment in commercially marginal fields and projects and committed to introduce a contractual approach giving companies greater certainty on decommissioning tax relief. These measures have been welcomed by industry. Treasury has also established a new Fiscal Forum, to provide for ongoing discussions on oil and gas tax issues between the Government and industry. This complements the continuing dialogue through PILOT on non-fiscal actions to secure the future of this critical industry.

Decarbonising our supplies

- 7.11** The Government is also taking powers through the Energy Bill to introduce new incentives to aid efforts to decarbonise our supplies by using Contracts for Difference (CfD), which will promote the diversity of our electricity mix and reduce our exposure to fossil fuel markets. Further detail on how the CfD will support investment in low carbon electricity generation is set out in the CfD Operational Framework accompanying the Energy Bill. This provides information on areas including the application process, terms and conditions of the CfD, and the supporting institutional framework.

Next steps

- 7.12** This strategy summarises the Government's current assessment of our current and future energy security outlook, and our policy responses to this. The energy environment is constantly changing and consequently there is a need for the Government to continually review our energy security. For these reasons we intend to build on existing Government publications to provide clear updates on our energy security situation. This will ensure that information on energy security indicators, the Government's understanding of energy security risk and the actions the Government is taking to address our energy security risk are available in the public domain.

⁴⁵ <http://www.decc.gov.uk/en/content/cms/emissions/edr/edr.aspx>

Annex A – Methodology for considering energy security

Assessing UK energy security – current and future

Competitive markets are and will remain central to the UK's delivery of energy, and energy security. However the Government recognises that the way the market values risk is not necessarily consistent with the way risk is valued by the Government and the public, and that consequently the level of security provided by the market may not be socially or politically optimal. In these cases we may need to consider changing the market framework or making a policy intervention.

When considering energy security the UK Government uses three complementary approaches: horizon scanning for risk; assessing the characteristics of the energy system; and stress testing.

I – Horizon scanning for risks

The Government monitors the global and domestic context of our energy market, identifying possible futures and assessing their implications for our energy security. This process identifies and builds the Government's understanding of issues which threaten the security of our energy systems, and allows it to consider how best to mitigate key risks and where necessary initiate specific new actions to address new challenges. A synopsis of the most significant cross-cutting risks is given in Chapter 3.

II – Assessing the characteristics of the energy system

In addition to looking broadly across the energy system, the UK Government undertakes detailed sector-by-sector assessments of the security of UK energy markets. These assessments consider our energy system now, how it will change in the future, and the implications of such changes for our energy security, using a framework of the four key characteristics of security:

Adequate Capacity – The difference between the expected/likely volume that can be supplied within the UK, against the likely maximum demand. Ensuring adequate capacity for the UK energy system allows the system to absorb sudden fluctuation in demand and to buffer supply outages and reduce the likelihood of price spikes.

Diversity – Diversity covers the mix of fuel types, their place of origin, the amount and nature of our energy supply infrastructure, and the number of companies involved and their market shares. Diversity reduces the system’s exposure to any one particular risk, and so reduces the impact on the system if any one risk is realised.

Reliability – The certainty with which an aspect of the supply chain will fulfil its function, taking account of the reliability of sources, infrastructure and delivery networks. Reliability indicates the risk that an aspect of the system will fail to deliver. An important aspect of reliability is how flexible components of supply are.

Demand side responsiveness – The degree to which demand can adjust to accommodate any changes in supply. The availability of demand side response indicates the ability of the system to absorb any supply shortages.

Analysis of these sectors is set out in Chapters 4 to 6 of this document. Indicators, data on specific aspects of the energy system, are used throughout these chapters, picked out in blue boxes, to illustrate the historical context and likely future trend for the particular aspect of energy security. These indicators can be used to illustrate our current situation regarding energy security. They are not targets but give an indication of the current position and a spur to debate.

III – Stress testing our energy system

To complement the work set out above the Government also regularly models threats to our energy system, to ensure that our existing systems are able to cope with these threats. This modelling work complements the two approaches set out above and is referenced throughout the document. Recent studies include:

Fuel	Study
Oil	Fuel Price Shocks and a Low Carbon Economy: Oxford Economics (2011)
	UK downstream oil infrastructure: Wood Mackenzie (2009)
Gas	Gas Security of Supply: A policy statement: DECC (2010)
	Risk assessment for the purpose of EU regulation 994/2012: DECC (2011)
	Winter Outlook: National Grid (2012)
Electricity	Electricity Capacity Assessment: Ofgem (2012)
	System Balancing: DECC (2012)

These approaches are considered in the short term (within the next five years), medium term (until the mid 2030s), and long term (the run up to 2050).

International comparisons

In preparing our methodology we drew on relevant examples from other countries. For example:

- The International Energy Agency have prepared a model of short-term energy security (MOSES) to help evaluate and compare the energy security of IEA countries. MOSES is aimed at policy makers to help identify energy policy priorities, and groups countries with similar combinations of risk and resilience factors based on quantitative indicators, reflecting risks and the ability to cope with energy supply and energy system resilience.
- The Australian Government Department of Resources, Energy and Tourism published a National Energy Security Assessment (NESA) in 2011. The NESA considers liquid fuels (primarily oil), natural gas and electricity; assesses adequacy, reliability (which includes diversity) and competitiveness; and, considers energy security in the short, medium and long term, up until 2035.
- The US Chambers of Commerce produces an international index of energy security, from 1980 to 2010, for 25 developed and emerging economies. Scores for the index are calculated using 28 weighted metrics covering international energy supplies, fossil fuel imports, energy expenditures, energy use, transportation, power generation, and energy-related carbon dioxide emissions. According to this index since the 1980s, the United Kingdom has scored consistently in the top three most energy secure countries in the group of large energy users, and currently ranks second after Mexico. In general this index suggests that countries with large energy resource bases and efficient economies enjoy the greatest comparative energy security advantage.



Published by TSO (The Stationery Office) and available from:

Online

www.tsoshop.co.uk

Mail, telephone, fax and email

TSO

PO Box 29, Norwich NR3 1GN

Telephone orders/general enquiries: 0870 600 5522

Order through the Parliamentary Hotline Lo-Call 0845 7 023474

Fax orders: 0870 600 5533

Email: customer.services@tso.co.uk

Textphone: 0870 240 3701

The Houses of Parliament Shop

12 Bridge Street, Parliament

Square, London SW1A 2JX

Telephone orders/general enquiries: 020 7219 3890

Fax orders: 020 7219 3866

Email: shop@parliament.uk

Internet: <http://www.shop.parliament.uk>

TSO@Blackwell and other accredited agents

ISBN 978-0-10-184662-2



9 780101 846622