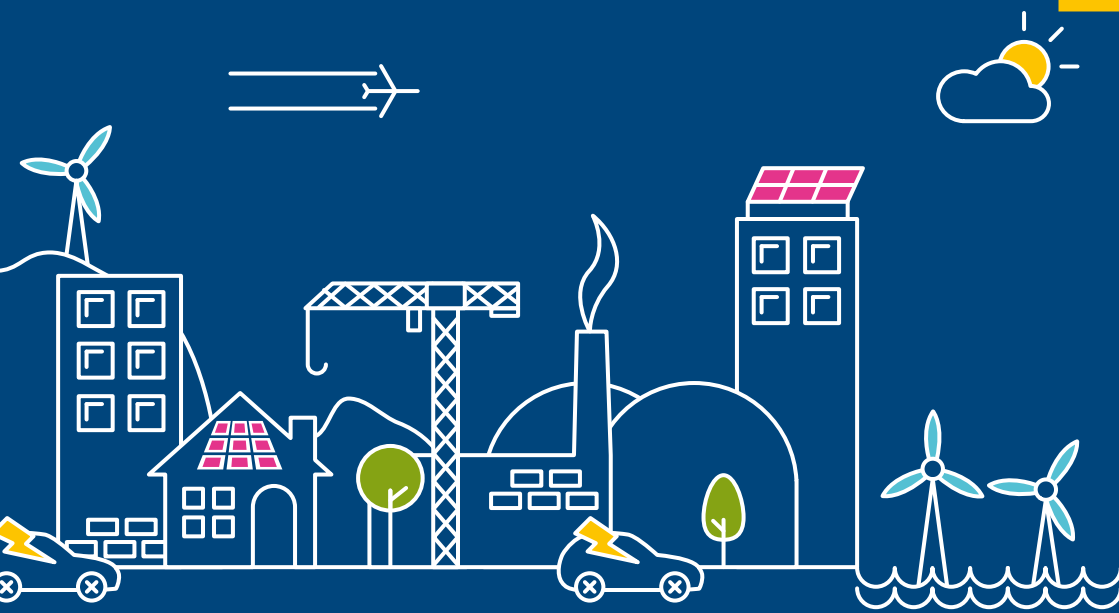
nationalgrid

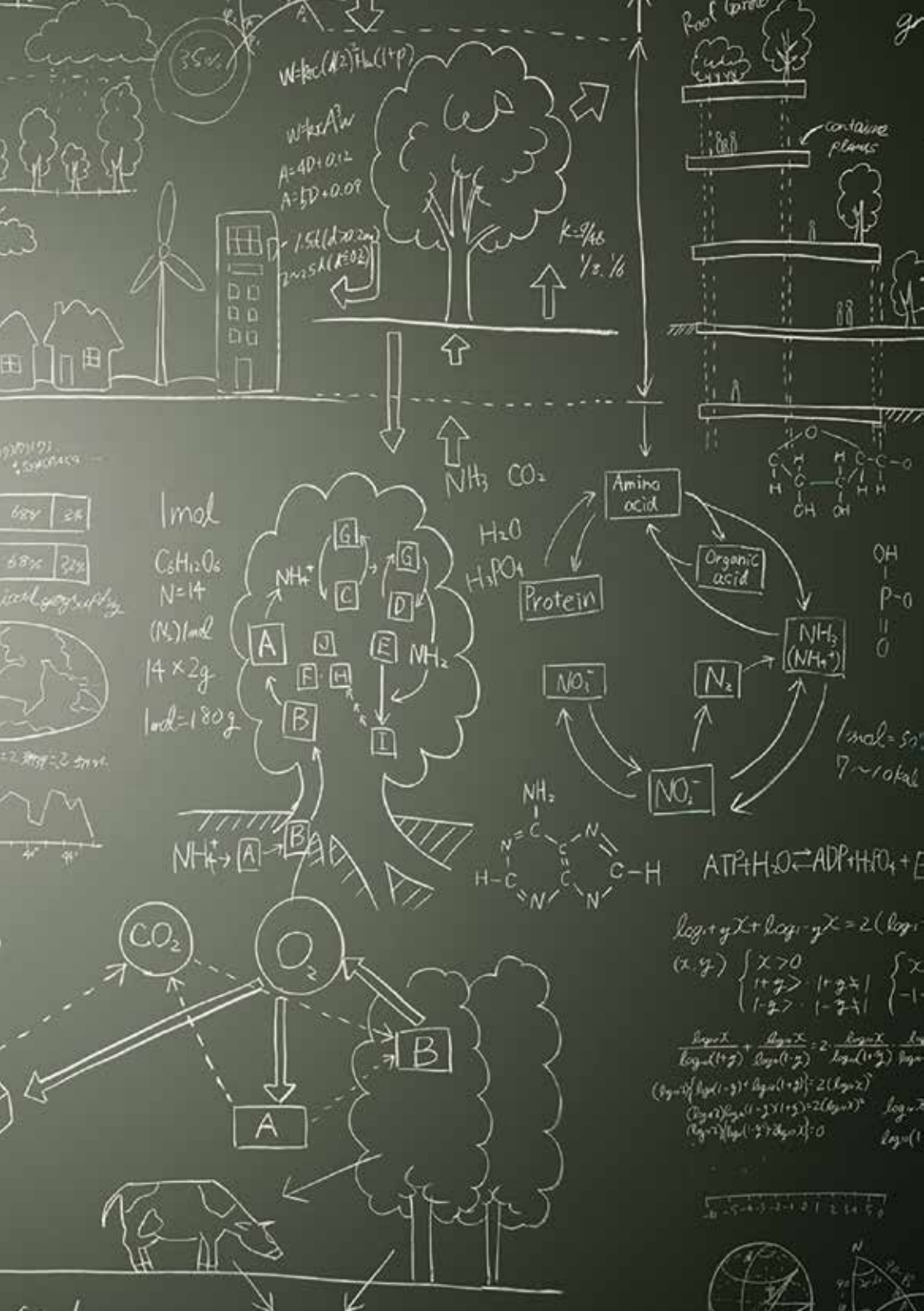
Future Energy Scenarios

UK gas and electricity transmission

Chapter three



JULY 2015


Amino acid
Organic acid
Protein
NH_3 CO_2
H_2O
H_3PO_4
NH_3 (NH_4^+)
NO_3^-
N_2
NO_2^-
1mol
$C_6H_{12}O_6$
N=14
180g
CO_2
O_2
A
B
ATP+H₂O⇌ADP+H₃PO₄
container plants

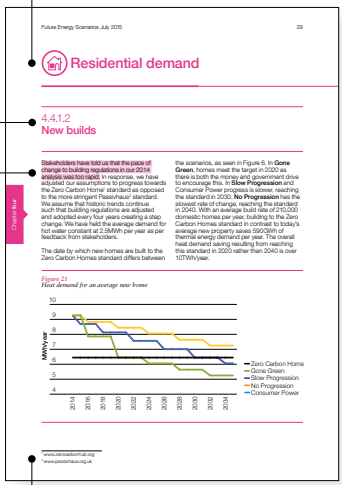
How to use this document

This document has been designed to present information in easily digestible sections, with the subject matter clearly defined in colour-coded chapters.

Heading and icon introduce the main topic on the page.

The main text is divided into sections by subheadings.

We have highlighted specific areas where we have responded to stakeholder feedback.


Future Energy Scenarios July 2015 29

Residential demand

4.4.1.2
New builds

Stakeholders have told us that the pace of change to building regulations in our 2014 analysis was too rapid. In response, we have adjusted our assumptions to progress towards the 'Zero Carbon Home' standard as opposed to the more stringent 'Passivhaus' standard. We have also delayed the timing of change such that building regulations are adjusted and adopted every four years creating a step change. We have held the average demand for hot water constant at 2.9MWh per year as per feedback from stakeholders.

The date by which new homes are built to the Zero Carbon Homes standard differs between the scenarios, as seen in Figure 6. In **Gone Green**, homes meet the target in 2020 as there is both the money and government drive to encourage this. In **Slow Progression** and Consumer Power this process is slower, reaching the standard in 2050. **No Progression** has the slowest rate of change, reaching the standard in 2043. With an average build rate of 210,000 domestic homes per year, building to the Zero Carbon Homes standard in contrast to today's average new property saves 590GWh of thermal energy demand per year. The overall heat demand saving resulting from reaching this standard in 2020 rather than 2040 is over 10TWh/year.

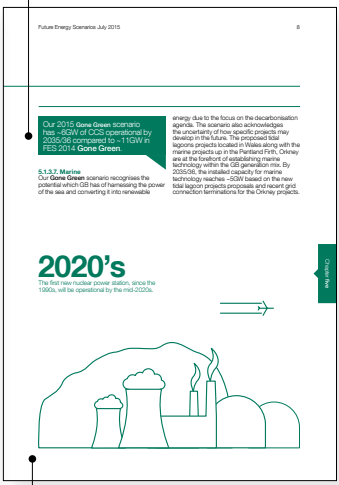
Figure 21
Heat demand for an average new home

www.zerocarbonhub.org
www.passivhaus.org.uk

Chapter Four

Footnotes are used for citations and further commentary.

Key pieces of information are highlighted in boxes.


Future Energy Scenarios July 2015 8

Our 2015 **Gone Green** scenario has ~6GW of CCS operational by 2035/36 compared to ~11GW in FES 2014 **Gone Green**.

5.1.3.7. Marine
Our **Gone Green** scenario recognises the potential which GB has of harnessing the power of the sea and converting it into renewable energy due to the focus on the decarbonisation agenda. The scenario also acknowledges the uncertainty of how specific projects may develop in the future. The proposed tidal lagoons projects located in Wales along with the marine projects up in the Pentland Firth, Orkney are at the forefront of establishing marine technology within the GB generation mix. By 2035/36, the installed capacity for marine technology reaches ~5GW based on the new tidal lagoon projects proposals and recent grid connection terminations for the Orkney projects.

2020's
The first new nuclear power station, since the 1990s, will be operational by the mid-2020s.

Chapter Five

Key data is emphasised with an image.

Chapters are tabbed and colour coded to help you find the section you are looking for.

Chapter three

Landscape

Landscape

3.1 Three rules

For our 2014 Future Energy Scenarios we had 26 axioms that described the fundamental assumptions that underpinned our scenarios. Some of our stakeholders felt that 26 was too many and there was a lack of structure to them. For 2015 we have listened to our stakeholders and replaced the axioms with three rules and five primary assumptions. These drive all of the ranges for inputs to our various models. We believe this increased clarity will aid understanding.

Figure 2
The three rules

Levy control framework	Security of supply (Electricity)	Security of supply (Gas)
Spending capped at £7.6 billion in line with the LCF trajectory out to 2020/21	Abide by security standard as prescribed by secretary of state (currently three hours/ year loss of load expectation)	There will be sufficient capacity to ensure that the N-1 test will continue to be satisfied

3.1.1 Levy control framework (LCF)

The LCF allows Government to control the overall costs of its levy-funded policies associated with the support of renewable generation. The LCF sets annual limits on the levels of support to limit the impact on consumers' energy bills with an overall cap of £7.6bn in 2020/21. This rule has been applied by limiting the deployment of renewable generation to ensure the cap isn't breached in any scenario. This has the most impact in **Gone Green** as the scenario with the largest deployment of renewable generation.

3.1.2 Security of supply (electricity)

The government has set a reliability standard for the GB market at a level which balances the impact of failure to deliver sufficient energy with the cost of capacity required to provide that energy. This standard is based on loss of load expectation (LOLE). LOLE measures the risk across the whole winter of demand exceeding supply under normal operation. It does not mean there will be loss of supply for X hours/year. It gives an indication of the amount of time across the whole winter the System Operator (SO) will need to call on balancing tools such as voltage reduction, maximum generation or emergency assistance from interconnectors.

In most cases, loss of load would be managed without significant impact on end consumers. The standard for GB is set by the government at 3 hours/year LOLE. This rule has been applied when developing the FES generation backgrounds.

It ensures that, post introduction of the Capacity Market in 2018/19, there will be sufficient capacity on the system to meet this standard.

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:295:0001:0022:EN:PDF

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/318466/gas_risk_assessment.pdf

Landscape

3.1.3 Security of supply (gas)

There will be sufficient capacity to ensure that the N-1 test will continue to be satisfied. This rule has been added for 2015 to provide a clear definition of the security of supply standards applied to gas. The N-1 test assesses whether peak demand could still be met if you lost the largest single piece of infrastructure. This rule is used by the European Commission[1] and in the UK the assessment is published by Department of Energy and Climate Change (DECC) in the UK Risk Assessment on Security of Gas Supply[2].

This rule ensures a consistent method is applied for security of supply for gas across all of our scenarios. It also allows comparison with other countries.

If there is not sufficient existing supply capacity to pass the N-1 test then additional capacity will be added to the scenario. To ensure the required level of new capacity can be delivered it will be based on the current view of potential import and storage projects. This is both in terms of the overall level of capacity and the expected start dates. However no single project will be selected to provide this capacity, instead it will be a generic scheme based on a number of projects which could meet this need.

3.2
Primary assumptions

The primary assumptions, in addition to the three rules, drive the modelling in the scenarios and replace the previous set of axioms. Many of our stakeholders found 26 axioms too many with no hierarchy or structure. Adopting five high-level assumptions allows the FES reader to see, more easily, what underpins the scenarios.

Figure 3
The primary assumptions

Landscape

3.2.1 Economic growth

Our economic primary assumption acts vertically across our four scenarios. We use a range of half a percentage point between the higher and lower economic growth forecasts used in our scenarios. This is unchanged from our 2014 modelling assumptions.

Higher economic growth is assumed in **Gone Green** and **Consumer Power**. Here, there is an average gross domestic product (GDP) growth of around 2.4% pa. This figure is based on Experian's central GDP forecast. We assume the economic recovery continues on its current trajectory, leading to higher household disposable income (HHDI) and the option for consumers to invest. This growth cascades down to provide gross value added (GVA) for sectors; this is also used in our econometric demand modelling. Corporations enjoy higher growth influencing their energy technology investment decisions.

Lower economic growth is assumed in **Slow Progression** and **No Progression**. These figures have been calculated from flexing Experian's central forecast down, using Oxford Economics' model, to give an average GDP growth of around 1.9% pa. This lower case represents a slowing of economic development in Great Britain, perhaps influenced by eurozone pressures. HHDI rises here too, but at a slower rate, dampening enthusiasm for investment. The same slower growth rate is experienced by corporations too, leading to lower, more constrained investment for technologies with a longer payback period.

3.2.2 Energy user behaviour

Our primary assumption of energy user behaviour covers a range of factors that feed into our modelling. Broadly speaking, the assumption considers how people and corporations engage with energy. This includes how and when they use it and their ambition to go green. Assumptions covered in energy user behaviour are:

- time of use tariffs (TOUTs) and demand side response (DSR)
- energy efficiency of buildings
- ambient room temperatures
- buying efficient goods
- self-generation of electricity (eg. solar photovoltaic panels (PV))
- investment in technology upgrades and research and development
- electric vehicle (EV) deployment.

These assumptions will help to define the impacts of schemes such as TOUT. More consumer engagement with energy may translate to shifts away from peak demand periods, or the faster deployment rate and required economics for new technologies like electric cars. Premise efficiency refers to insulation of homes and buildings which, along with ambient room temperature, impacts the thermal energy demands of buildings.

With higher energy user behaviour, consumers are engaged in moving their energy demand away from peak periods. They are also buying green technologies like solar panels, energy efficient white goods and electric vehicles. Additionally, corporations are making higher levels of investment in energy efficiency.

On a personal level there is a conscious effort to use less energy and seek cleaner sources. Conversely, lower energy user behaviour is characterised by less importance assigned to energy reduction, as greater priority is given to other factors, such as cost and convenience.

3.2.3 Technology

Our technology primary assumption considers the development and distribution of relevant technologies. This governs our assumptions on the rate of technological innovation. This assumption also considers the impact on affordability, the speed of deployment (including the formation of supply chains that affect availability), replacement rates (the rate at which newer technologies replace older ones) and improvements in energy efficiency of technologies.

Deployment rates and replacement rates are included in both the energy user behaviour and technology assumptions. The energy user behaviour assumption is concerned with the demand side, such as consumer buying behaviour. The technology assumption governs the supply side of the equation. Higher innovation also governs the behaviour of corporations looking for greener solutions or products. Note that the innovation referred to here is realised innovation, rather than ambition.

With higher technological developments more products come to market, which are more price competitive and energy efficient than existing technologies. For example, heat pumps become more competitively priced compared to gas boilers, as do LEDs compared to halogens. Products are also well marketed leading to faster deployment rates. So, if there is a reason to replace a product before the end of its life, perhaps to take advantage of increased functionality or reduced operating costs, then replacement rates will be accelerated.

This assumption also covers technology used in energy production. This includes techniques used to maximise gas production and both large and small scale power generation. For each scenario the comparative level of green ambition and prosperity will impact on whether the technological developments are focused on progressing greener solutions, or towards maximising security of supply.

Landscape

3.2.4 Policy

Our assumptions on policy cover a wide range of areas. These include targets for renewable energy, CO_2 emissions, energy efficiency and oil and gas production. The assumptions cover both policy aims and the support mechanisms to achieve them.

The greater level of green ambition in both **Gone Green** and **Slow Progression** sees new renewable energy targets introduced for 2030, 2040 and 2050. Alongside these there are targets for the level of interconnection. There are also increased energy efficiency standards for manufacturers and retailers of household goods, plus schemes to increase efficiency in the industrial and commercial sectors. Stricter controls are placed on both exploration and production of onshore oil and gas.

The less prosperous **Slow Progression** has a greater focus on delivering lower cost solutions, limiting the effectiveness of some policies. In the more prosperous **Gone Green** scenario greater levels of support are available to ensure policy aims are met.

With a lower level of green ambition in **Consumer Power** and **No Progression**, no new renewable energy targets are introduced and existing targets are relaxed. No new standards are introduced for energy efficiency. There are no changes to the existing regulations concerning onshore oil and gas extraction.

The more prosperous **Consumer Power** scenario sees existing levels of support for energy efficiency schemes maintained with greater incentives available to increase indigenous energy production. By contrast, in **Slow Progression** existing incentives for energy production are maintained but there is less support for energy efficiency schemes.

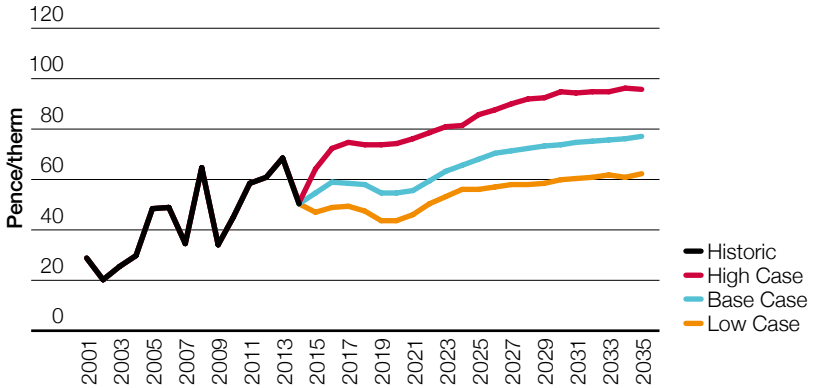
3.2.5 Wholesale fuel prices

Fuel prices can have a significant effect on energy demand. They form an important part of our analysis in determining the energy supplies and demands that feature in our scenarios. All prices have been adjusted for inflation to derive real prices applicable for 2015.

For instance, when modelling power supply, the different sources of available generation, the relative wholesale prices for gas, coal and UK carbon are important in determining what generation fuel will be favoured. The results will have a direct impact upon total gas demand which, in turn, will influence gas supply.

We develop our fuel price projections based on a number of different sources including government agencies, energy consultants, financial institutions and trading houses.

Figure 4
Wholesale gas prices (NBP)



National balancing point (NBP) Gas

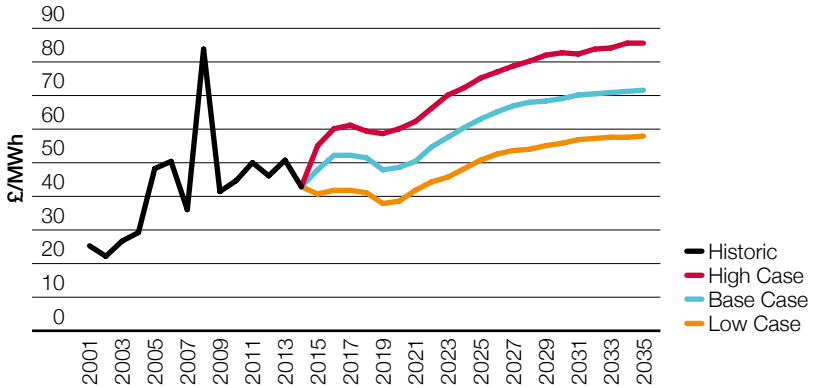
In the short term we expect gas prices to increase or remain flat. As the UK attempts to deliver on its climate and carbon reduction policies, gas usage in the power supply sector will increase. In the longer term, renewables and low carbon power sources increase their contribution in the power supply mix, reducing gas demands.

Towards the end of the decade NBP prices temporarily decline as new liquefied natural gas (LNG) supplies become available from North America (Figure 4). The differences in the gas supply ranges reflect the uncertainties in:

- increasing gas demands in China and India and the impact upon global LNG demands and costs
- the impact on Japanese LNG imports from the restart of nuclear power generation in Japan
- proposed liquefaction export projects from North America and Africa
- UK and European indigenous gas production – including shale gas production
- nuclear power generation in GB.

Landscape

Figure 5
GB base load electricity prices



Baseload electricity

We expect baseload electricity prices to increase or remain flat over the short term. System margins remain low as coal-fired plants close to adhere to the Industrial Emissions Directive (IED), and some gas-fired generation plants are closed or mothballed. Prices decrease towards the end of the decade as lower cost gas generation increasingly factors into the power price.

Figure 5 shows that power prices increase after 2020 as the cost of fuel increases and low carbon or renewable generation increasingly influences generation costs. The differences in the baseload power price ranges reflect the uncertainties in:

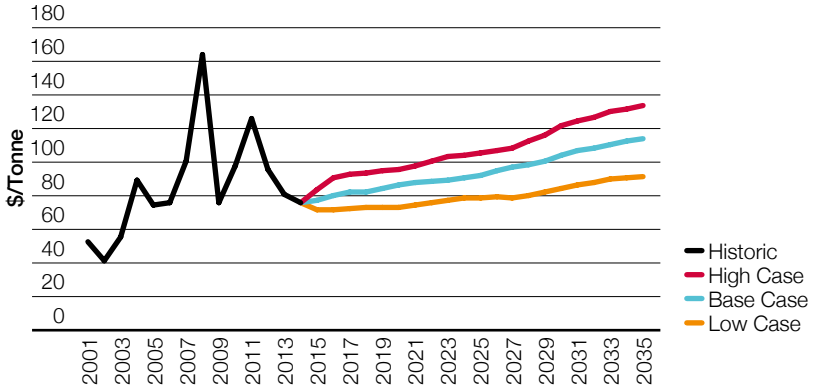
- the cost of generation required (low carbon or thermal) to maintain margins
- the timeliness of new nuclear generation in GB
- wholesale fuel prices for thermal power generation

Coal Prices Amsterdam, Rotterdam and Antwerp (ARA)

Coal prices are expected to steadily increase (Figure 6) as global coal demands remain high. The differences in the coal price ranges reflect the uncertainties in:

- the impact of the Chinese emission and energy policies on coal demands
- the impact of global oversupply if suppliers increase exports in order to maintain revenue
- the impact of climate policies on coal demands in the USA
- the impact of the IED on coal demands for the EU power generation sector
- coal demand increases from India and developing countries
- the impact on Japanese coal imports from the restart of nuclear power generation in Japan.

Figure 6
Wholesale coal prices



Carbon

As part of its commitment to the 1997 Kyoto protocol, the EU Emissions Trading Scheme (ETS) was established in 2005 to incentivise reductions in greenhouse gas emissions from large carbon-intensive industries and electricity generators. The scheme puts a cap on the amount of carbon dioxide (CO_2) that can be emitted and creates a market trading price for carbon allowances that are bought and surrendered in relation to the amount of CO_2 emitted. The costs are determined via a market mechanism which is impacted by the total amount of CO_2 produced and the number of carbon allowances granted by the EU.

A UK carbon price floor (CPF) was introduced on 1 April 2013 to guarantee a minimum price for CO_2 emissions. The CPF was set at £16 per tonne of CO_2 (tCO_2) for 2013 and was expected to rise by £2 per year to £30 tCO_2 by 2020.

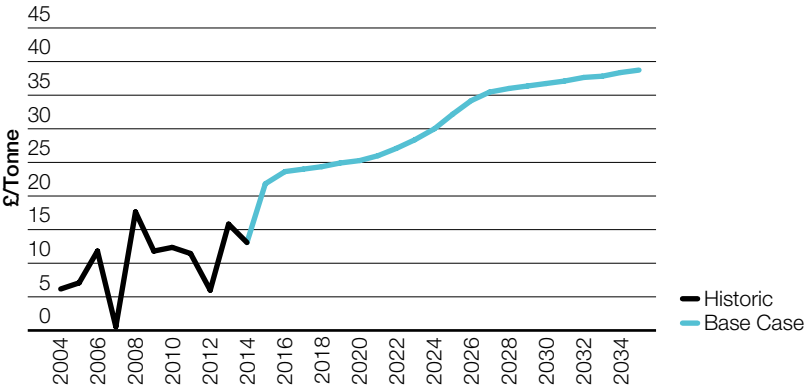
The floor price is achieved by adding a carbon price support (CPS) cost on top of the EU ETS.

To tackle low prices, because of an oversupply of ETS allowances in 2014, the EU started to withhold some 900 million carbon credits from the market. In addition, the UK Government announced a price freeze on the CPS rates in the 2014 budget, in order to ensure the UK remains a competitive location for manufacturing. As a result CPS rates will be capped at a maximum of £18 tCO_2 from 2016/17 until 2019/20, effectively freezing CPS rates at around 2015/16 levels.

The UK carbon price is expected to increase slightly until the end of the decade as the EU ETS prices increase. Longer term the CPS price increases are assumed to be limited or frozen.

Landscape

Figure 7
UK carbon prices



Prices and the FES 15 scenarios

We have used the prices to drive development of FES 2015 scenarios for gas and power demand and power supply.

Figure 8 summarises how the prices have been applied in each of the scenarios.

Figure 8
Fuel price summary

Consumer Power	Price scenario
Baseload electricity	Medium
Gas NBP	Low
Coal ARA	Low
Carbon	Medium

Gone Green	Price scenario
Baseload electricity	Medium
Gas NBP	Medium
Coal ARA	Low
Carbon	Medium

No Progression	Price scenario
Baseload electricity	Low
Gas NBP	Medium
Coal ARA	Low
Carbon	Medium

Slow Progression	Price scenario
Baseload electricity	Medium
Gas NBP	High
Coal ARA	Low
Carbon	Medium

Chapter eight


Government policy


Meet the team


Glossary

Appendix 1 Government policy

CRC Energy Efficiency Scheme (CRC)

The Carbon Reduction Commitment (CRC) Energy Efficiency Scheme[1] is a mandatory scheme aimed at improving energy efficiency and cutting emissions in large public and private sector organisations. The scheme features a range of reputational, behavioural and financial drivers, which aim to encourage organisations to develop energy management strategies that promote a better understanding and more efficient use of energy.

Electricity Market Reform (EMR)

Electricity Market Reform[2] includes the introduction of new long-term contracts: Contracts for Difference (CfDs) for new low carbon generation projects, a Carbon Price Floor[3] (in place since April 2013) and a Capacity Market, to include demand response, interconnectors and generation. EMR also includes an Emissions Performance Standard (EPS), set at 450gCO_2/kWh, to reinforce the requirement that no new coal-fired power stations are built without carbon capture and storage (CCS) and to ensure necessary investment in gas can take place. The Energy Act of 2013 gave the Secretary of State for Energy and Climate Change the power to introduce these elements of EMR (to work alongside the Carbon Price Floor[1]).

National Grid as the National Electricity Transmission System Operator (NETSO) has been appointed as the Delivery Body for EMR. This involves administering the Capacity Market and CfDs on behalf of DECC, as well as providing key analysis to inform decision making.

Our analysis of EMR is ongoing. We have taken account of the main themes in deriving our power supply backgrounds, shown in chapter 5. We assume that the mechanisms will play a part in maintaining adequate plant margins and will ensure that there is sufficient renewable and low carbon generation to meet the renewable and carbon targets in the **Gone Green** scenario.

Feed-In Tariffs scheme (FIT)

The Feed-In Tariffs scheme[4] aims to encourage small scale renewable and low carbon electricity generation by paying users for each unit of electricity generated, as well as a payment for each unit exported to the grid. The scheme is applicable to a number of technologies (solar PV, wind, hydro, and anaerobic digestion) up to a maximum capacity of 5MW of total installed capacity (TIC). Micro combined heat and power (mCHP) plants are also eligible up to 2kW.

Green Deal Energy Company Obligation (ECO)

Green Deal[5] replaces the Carbon Emissions Reduction Target[6] (CERT). It allows individuals and businesses to make energy efficiency improvements to their buildings at no upfront cost through access to the finance needed for the improvements with repayment, in instalments, attached to the electricity bill. Research conducted by GfK NOP showed that in November 2013, 23% of consumers were aware of the Green Deal[7]. It is estimated that 26 million homes could be eligible for Green Deal financing. By the end of March 2015, over 530,000 Green Deal assessments had been carried out, 184 authorised Green Deal providers had been registered and 2,258 organisations were signed up to carry out installations[8].

[1] https://www.gov.uk/crc-energy-efficiency-scheme-qualification-and-registration#overview

[2] https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform

[3] The carbon price floor was legislated for in the 2011 Finance Act

[4] https://www.gov.uk/feed-in-tariffs

[5] https://www.gov.uk/green-deal-energy-saving-measures

[6] http://webarchive.nationalarchives.gov.uk/20121217150421/www.decc.gov.uk/en/content/cms/funding/funding_ops/cert/cert.aspx

[7] https://www.gov.uk/government/publications/green-deal-household-tracker-wave-3

[8] https://www.gov.uk/government/collections/green-deal-and-energy-company-obligation-eco-statistics

Energy Company Obligation (ECO)

The Energy Company Obligation (ECO) commenced in 2013 and will operate until March 2017. It places a legal obligation on energy suppliers to satisfy energy efficiency and fuel saving targets to households. ECO is primarily focused on households unable to achieve significant energy savings from Green Deal without an additional or different measure of support. ECO is directed towards vulnerable and low-income households, community schemes, and those living in harder to treat properties, such as those with solid walls.

Industrial Emissions Directive (IED)

The Industrial Emissions Directive[9] is a European Union directive which commits member states to control and reduce the impact of industrial emissions on the environment post-2015 when the Large Combustion Plant Directive (LCPD) expires.

Under the terms of the IED, affected plant can:

- Opt out and continue running under previous (LCPD) emission limits.
- Opt in under the Transitional National Plan (TNP), which will impose a cap on annual mass nitrogen oxide emissions and a decreasing cap on annual mass sulphur dioxide emissions on all plants operating under a country's TNP until mid-2020. At that point they will have to decide whether to fit appropriate emission-reducing equipment to comply with the directive, be limited to run a maximum of 1,500 hours a year or close.
- Opt in and comply fully from 1 January 2016. This will mean fitting selective catalytic reduction equipment or additional flue-gas de-sulphurisation technology for some plants.

Large Combustion Plant Directive (LCPD)

The Large Combustion Plant Directive[10] is a European Union directive which introduced measures to control the emissions of sulphur dioxide, oxides of nitrogen and dust from large combustion plant. Large power stations (installed capacity greater than 50MW) in the UK must comply with the LCPD. Plants that 'opt out' of meeting the new standards must close by 2015 or after 20,000 hours of operation.

Levy Control Framework (LCF)

The Levy Control Framework[11] caps the annual amount of money that can be levied on bills to support UK low carbon generation at £2.35bn in 2012/13, rising to £7.6bn in 2020/21. This covers Feed-in Tariffs (FITs), Renewables Obligation (RO) and Contracts for Difference.

Renewable Heat Incentive (RHI)

The Renewable Heat Incentive[12] scheme provides payments for heat generated from renewable technologies including biomass boilers, solar thermal and heat pumps. There are three distinct phases of financial support:

- RHI Phase 1 – for commercial, industrial, public, not-for-profit and community generators of renewable heat
- RHI Phase 2 – a renewable heat premium payment (RHPP) to householders who have no access to the gas network and who generate renewable heat. Under RHPP householders receive a single payment for the installation of renewable heat technology
- RHI Phase 3 – for householders generating renewable heat. Householders will receive regular annual or quarterly payments for heat generated.

[9] http://www.official-documents.gov.uk/document/hc1012/hc16/1604/1604.pdf (page 12)

[10] https://www.gov.uk/government/publications/environmental-permitting-guidance-the-large-combustion-plants-directive

[11] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48244/3290-control-fwork-decc-levyfunded-spending.pdf

[12] https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/renewable-heat-incentive-rhi

Appendix 1 Government policy

Renewables Obligation (RO)
The Renewables Obligation[13] (RO) is the main support mechanism for renewable electricity projects in the UK. Smaller scale generation is mainly supported through the Feed-in Tariff scheme (FITs).

The RO came into effect in 2002 in England and Wales, and Scotland, followed by Northern Ireland in 2005. It places an obligation on UK electricity suppliers to source an increasing proportion of the electricity they supply from renewable sources.

Renewables Obligation Certificates (ROCs) are green certificates issued to operators of accredited renewable generating stations for the eligible renewable electricity they generate. Operators can trade ROCs with other parties. ROCs are ultimately used by suppliers to demonstrate that they have met their obligation.

Where suppliers do not present a sufficient number of ROCs to meet their obligation, they must pay an equivalent amount into a buy-out fund. The administration cost of the scheme is recovered from the fund and the rest is distributed back to suppliers in proportion to the number of ROCs they produced in respect of their individual obligation.

Energy Saving Opportunities Scheme (ESOS)
The government established ESOS[14] to implement Article 8 (4-6) of the EU Energy Efficiency Directive (2012/27/EU). The ESOS Regulations 2014 give effect to the scheme.

ESOS is a mandatory energy assessment scheme for organisations in the UK that meet the qualification criteria. The Environment Agency is the UK scheme administrator.

Organisations that qualify for ESOS must carry out ESOS assessments every 4 years. These assessments are audits of the energy used by their buildings, industrial processes and transport to identify cost-effective energy saving measures.

Organisations must notify the Environment Agency by a set deadline that they have complied with their ESOS obligations, the first of which is 5 December 2014.

[13] https://www.ofgem.gov.uk/environmental-programmes/renewables-obligation-ro

[14] https://www.gov.uk/energy-savings-opportunity-scheme-esos

Appendix 2 – Meet the Energy, Strategy & Policy team

Balancing and Markets
We explore the future electricity balancing challenges and opportunities relating to changing generation and demand. We consider the role that technologies such as interconnectors, electricity storage, demand side response and other innovative solutions may play in the future balancing toolkit. Engagement with stakeholders is vital to the development of ourinterconnector scenarios and through industry groups and bilateral meetings we ensure all perspectives are taken into consideration. We welcome your views on balancing the electricity system over coming decades.

Emma Carr
Balancing and Markets Manager

Dave Wagstaff
EMR Network Cost Analyst

Iain Ashworth
Balancing Analyst

Matthew Speedy
Balancing Analyst

Rhiannon Grey
Balancing Analyst

EMR Modelling
Our team was set up to fulfil part of National Grid's obligations as Electricity Market Reform (EMR) Delivery Body. Our responsibilities include analysis used to recommend the capacity to procure in the Capacity Market that is published annually in our Electricity Capacity Reports and modelling to inform the setting of strike prices for Contracts for Difference (CfDs) as illustrated by our report for the EMR Delivery Plan. We also carry out related modelling work outside of our EMR responsibilities, for example to inform the volume of the new balancing services (SBR and DSBR) required in the mid-decade years.

Duncan Rimmer
EMR Modelling Manager

Ajay Pandey
EMR Senior Data Officer

Gareth Lloyd
EMR Analytical Manager

Simon Geen
EMR Analytical Manager

Gas Demand
As the gas demand team we project the usage of gas for both the Industrial and Commercial markets and the residential sector. We utilise various modelling tools and techniques to support our analysis alongside taking part in several industry discussion groups to balance our statistical analysis with innovative thinking on the future of gas. Heat forms a significant part of our analysis as this is currently dependent on gas in addition to transport which has the potential to become more reliant on gas. Amongst our stakeholders, we engage with gas providers and distribution networks to ensure we're using the most up to date information. If you can share any views on gas demand, please get in touch.

Iain Shepherd
Energy Demand Analyst

Phil Clough
Gas Demand Analyst

Rob Nickerson
Senior Gas Demand Analyst

Appendix 2 – Meet the Energy, Strategy & Policy team

Gas Supply
We take gas demand projections from our colleagues in the Gas Demand team and work out how much gas will have to come from different sources to meet the demand. Our work depends very much on detailed industry knowledge rather than complicated mathematical modelling, and is helped by the 70 years of industry experience that we have between us. During the year we talk to major industry players, producers, terminal operators, other network operators and potential developers. We also attend industry discussions, all to make sure that we are working with the best possible information when we come to make our supply to demand match. If you have anything that you think we should know about possible gas supplies we'd be very interested to hear from you.

Simon Durk
Gas Supply Manager

Nigel Bradbury
Primary Energy Analyst

Chris Thompson
Senior Gas Supply Analyst

Christian Parsons
Gas Supply Analyst

Market Outlook
We bring together expert thinking, market data, industry experts, stakeholder feedback and indepth analysis to create a rounded view of the future of energy. Our publications cover the short, medium and longer-term including the Winter and Summer Outlook Reports, the Winter Consultation, the Safety Monitors Report and, of course, the Future Energy Scenarios (FES). Our role is to extract the key messages from the inputs and analysis to give a clear direction to National Grid and the industry on energy trends, landscapes and the future energy challenges. We also produce the Stakeholder Feedback document that summarises views from interested parties on the FES document and provides a commentary of how these responses have been used to develop and progress the scenarios. We welcome your views on the content of all these documents.

Catherine Lange
Market Outlook Manager

Andy Dobbie
Energy Security Analyst

Caroline Kluyver
Content Officer

Chris Thackeray
Content Officer

Duncan Sluce
Energy Security Analyst

Faye Relton
Strategy Analyst

Power Demand
We spend much of our time striving to understand electricity usage once it's been generated. Our models are concerned with what people do with electricity in their day-to-day lives, from the home to the office and beyond, from an annual basis right down to an understanding of within day usage profiles. This considers the future landscape for transport, heating and lighting. To understand potential electricity usage, we engage with members of Britain's society, including homeowners, business people, academics and journalists. We also regularly attend a wide range of industry events and conferences along with reading a wide range of publications and annual reports. Please let us know your thoughts and opinions on power demand and how this may change into the future.

Russell Fowler
Power Demand Manager

Huw Thomas
Power Demand Analyst

Kein-Arn Ong
Senior Power Demand Analyst

Orlando Elmhirst
Senior Power Demand Analyst

Power Supply
We consider the sources of generation that will be used to meet power demand now and in the future. We consider all sources of generation (both established and emerging technologies) irrespective of where and how they are connected. We consider how the political ambition, environmental legislation, the economic climate, technological advancements and social engagement influence electricity generation. We look forward to discussing with you our power supply scenarios and will be delighted to hear from you if you have any information on power supply which could be included in our analysis.

Lilian MacLeod
Power Supply Manager

Dr Giuliano Bordignon
Senior Power Economics Analyst

Greg Hunt
Senior Power Supply Analyst

Janet Coley
Senior Power Supply Analyst

Luke Cutler
Power Supply Analyst

Mark Perry
Senior Power Supply Analyst

Secondments

Liana Cipcigan
Seconded from Cardiff University

Leadership team

Roisin Quinn
Head of Energy, Strategy and Policy

Janet Mather
Demand and Supply Manager

Kirsty Martin
PA to Head of Energy, Strategy and Policy

Marcus Stewart
Energy Supply Manager

Nigel Fox
Strategy Development Manager

Appendix 3 Glossary

Acronym	Word	Description
ACT	Advanced conversion technology	Gasification, pyrolysis or anaerobic digestion, or any combination of those.
ASHP	Air source heat pump	Air source heat pumps absorb heat from the outside air. This heat can then be used to produce hot water or space heating.
ARA	Amsterdam Rotterdam and Antwerp (Coal Price)	The cost of coal in the major NW Europe coal importing ports of Amsterdam/ Rotterdam/Antwerp (ARA). http://www.worldcoal.org/resources/coal-statistics/shipping-terms-glossary/
AD	Anaerobic digestion	Bacterial fermentation of organic material in the absence of free oxygen.
	Ancillary services	Services procured by a system operator to balance demand and supply and to ensure the security and quality of electricity supply across the transmission system. These services include reserve, frequency control and voltage control. In GB these are known as balancing services and each service has different parameters that a provider must meet.
	Annual power demand	The electrical power demand in any one fiscal year. Different definitions of annual demand are used for different purposes.
ACS	Average cold spell	Average cold spell: defined as a particular combination of weather elements which gives rise to a level of winter peak demand which has a 50% chance of being exceeded as a result of weather variation alone. There are different definitions of ACS peak demand for different purposes.
BBL	Balgzand Bacton Line	A gas pipeline between Balgzand in the Netherlands and Bacton in the UK. http://www.bblcompany.com
	Baseload electricity price	The cost of wholesale electricity paid for baseload power.
bcm	billion cubic metres	Unit or measurement of volume, used in the gas industry. 1 bcm = 1,000,000,000 cubic metres
	Biogas	Biogas is a naturally occurring gas that is produced from organic material and has similar characteristics to natural gas.
	Biomethane	We use the term biomethane specifically for biogas that is of a suitable quality to be injected into distribution or transmission networks. http://www.biomethane.org.uk/
	Boil-off	A small amount of gas which continually boils off from LNG storage tanks. This helps to keep the tanks cold.
CM	Capacity Market	The Capacity Market is designed to ensure security of electricity supply. This is achieved by providing a payment for reliable sources of capacity, alongside their electricity revenues, ensuring they deliver energy when needed.
CCS	Carbon capture and storage	Carbon (CO_2) Capture and Storage (CCS) is a process by which the CO_2 produced in the combustion of fossil fuels is captured, transported to a storage location and isolated from the atmosphere. Capture of CO_2 can be applied to large emission sources like power plants used for electricity generation and industrial processes. The CO_2 is then compressed and transported for long-term storage in geological formations or for use in industrial processes.
CO_2	Carbon dioxide	Carbon dioxide (CO_2) is the main greenhouse gas and the vast majority of CO_2 emissions come from the burning of fossil fuels (coal, natural gas and oil).
CPF	Carbon price floor	A price paid by UK generators and large carbon intensive industries for CO_2 emissions.
CPS	Carbon price support	A price paid by UK generators and large carbon intensive industries in addition to the EU ETS to guarantee a minimum floor price for CO_2 emissions.
CRC	Carbon Reduction Commitment	See appendix on government policy. The Carbon Reduction Commitment is a mandatory scheme aimed at improving energy efficiency and cutting emissions in large public sector and large private sector organisations.
	Cash out	Prices that are used to settle the difference between contracted generation or consumption and the amount that was actually generated or consumed in each half hour trading period

Acronym	Word	Description
	Climate change targets	Targets for share of energy use sourced from renewable sources. The 2020 UK targets are defined in the Directive 2009/28/EC of the European Parliament and of the Council of the European Union, see http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009L0028&from=EN#ntc1-L_2009140EN.01004601-E0001
CBM	Coal bed methane	Coal bed methane is methane that is extracted from un-mined coal seams by drilling wells directly into the seams to release the gas. http://www.worldcoal.org/coal/coal-seam-methane/coal-bed-methane/
COP	Coefficient of performance	The ratio of heating (or cooling) provided per electrical energy consumed.
CCGT	Combined cycle gas turbine	Gas turbine that uses the combustion of natural gas or diesel to drive a gas turbine generator to generate electricity. The residual heat from this process is used to produce steam in a heat recovery boiler which in turn, drives a steam turbine generator to generate more electricity.
CHP	Combined heat and power	A system whereby both heat and electricity are generated simultaneously as part of one process. Covers a range of technologies that achieve this.
CFL	Compact fluorescent light	A lighting technology introduced to replace traditional incandescent bulbs. Commonly referred to as energy saving bulbs.
CWV	Composite weather variable	A measure of weather incorporating the effects of both temperature and wind speed. We have adopted the new industry wide CWV equations that take effect on 1 October 2015.
CNG	Compressed natural gas	Compressed natural gas is made by compressing natural gas to less than 1 percent of the volume it occupies at standard atmospheric pressure.
CfD	Contract for Difference	See appendix on government policy. Contract between the Low Carbon Contracts Company (LCCC) and a low carbon electricity generator designed to reduce its exposure to volatile wholesale prices.
DBSR	Demand side balancing reserve	Demand side balancing reserve (DSBR) is a balancing service that has been developed to support National Grid in balancing the system during the mid-decade period when capacity margins are expected to be tight. DSBR is targeted at large energy users who volunteer to reduce their demand during winter week-day evenings between 4 and 8pm in return for a payment. Along with supplemental balancing reserve (SBR), this service will act as a safety net to protect consumers, only to be deployed in the event of there being insufficient capacity available in the market to meet demand.
DSR	Demand side response	A deliberate change to an industrial and commercial user's natural pattern of metered electricity or gas consumption, brought about by a signal from another party.
DECC	Department of Energy and Climate Change	A UK government department: The Department of Energy & Climate Change (DECC) works to make sure the UK has secure, clean, affordable energy supplies and promote international action to mitigate climate change.
	Deterministic	A modelling approach that produces a single view or outcome. This approach has no random elements as all outcomes and inputs are completely determined.
DUKES	Digest of UK Energy Statistics	A DECC publication which contains historic information on energy in the UK.
	Dispatch (aka economic dispatch)	The operation of generation facilities to produce energy at the lowest cost to reliably serve consumers, recognizing any operational limits of generation and transmission facilities.
	Distributed generation	Generation connected to the distributed networks which is equal or greater than 1 MW in size, up to onshore transmission areas' mandatory connection thresholds. The thresholds are 100 MW in NGET transmission area, 30 MW in Scottish Power (SP) transmission area and 10 MW in Scottish Hydro-Electric Transmission (SHET) transmission area.
	Distribution losses	Power losses that are caused by the electrical resistance of the distribution system.
DNO	Distribution network operator	Distribution network operators own and operate gas or electricity distribution networks.

Appendix 3 Glossary

Acronym	Word	Description
EV	Electric vehicle	An electric vehicle has an electric motor to drive the vehicle. It can either be driven solely off a battery, as part of a hybrid system or have a generator that can recharge the battery but does not drive the wheels. We only consider EVs that can be plugged in to charge in this report.
EMR	Electricity Market Reform	See appendix on government policy. A government policy to incentivise investment in secure, low-carbon electricity, improve the security of Great Britain's electricity supply, and improve affordability for consumers.
ELSI	Electricity scenario illustrator	ELSI is a National Grid tool used to model network constraint costs and interconnector flows.
	Electricity storage technologies	Mechanical (for example, pumped hydro and compressed air), thermal (for example, molten salt), electrical (for example, supercapacitors), electrochemical (various battery types), chemical (for example, hydrogen). Each technology has different characteristics, such as speed and duration of response, scale and maturity status.
ETYS	Electricity Ten Year Statement	The ETYS illustrates the potential future development of the National Electricity Transmission System (NETS) over a ten year (minimum) period and is published on an annual basis.
ETL	Electricity Transmission Licence	A permit which allows transmission companies to own and operate electricity transmission assets. Conditions within the licence place rules on how holders can operate within their licence.
	Embedded generation	Power generating stations/units that don't have a contractual agreement with the National Electricity Transmission System Operator (NETSO). They reduce electricity demand on the National Electricity Transmission System.
ECO	Energy Company Obligation	See appendix on government policy. The scheme places a legal obligation on energy suppliers to help households meet energy efficiency and fuel savings targets.
ECUK	Energy Consumption in the UK	A UK government publication which reviews historic energy consumption and changes in efficiency, intensity and output since the 1970s.
ENA	Energy Networks Association	The Energy Networks Association is an industry association funded by gas or transmission and distribution licence holders.
ESOS	Energy Savings Opportunity Scheme	See appendix on government policy. The Energy Savings Opportunity Scheme is a mandatory energy assessment scheme for qualifying organisations in the UK.
	Error correcting model	A model with the characteristics that the deviation of the current state from its long-run relationship will be fed into its short-run dynamics.
EU ETS	EU Emissions Trading Scheme (EU ETS)	A European Union trading scheme that allows participants to buy and sell carbon emissions allowances. https://www.gov.uk/eu-ets-carbon-markets
ENTSO-E	European Network of Transmission System Operators – Electricity	ENTSO-E is an association of European electricity TSOs. ENTSO-E was established and given legal mandates by the EU's Third Legislative Package for the Internal Energy Market in 2009, which aims at further liberalising electricity markets in the EU.
EU	European Union	A political and economic union of 28 member states that are located primarily in Europe.
FiT	Feed-in Tariffs	See appendix on government policy. Government programme designed to promote the uptake of a range of small-scale renewable and low-carbon electricity generation technologies
FIDER	Final Investment Decision Enabling for Renewables	Scheme to help developers of low carbon electricity projects make final investment decisions ahead of the Contract for Difference regime.
FFR	Firm Frequency Response	Firm Frequency Response (FFR) is the firm provision of Dynamic or Non-Dynamic Response to changes in Frequency. http://www2.nationalgrid.com/uk/services/balancing-services/frequency-response/firm-frequency-response/
	Foot room	The ability for a generation plant to allow output to decrease without going below its minimum output level and disconnecting from the system.

Acronym	Word	Description
	Frequency controlled demand management	Frequency control demand management (FCDM) provides frequency response through interruption of demand customers. The electricity demand is automatically interrupted when the system frequency transgresses the low frequency relay setting on site. http://www2.nationalgrid.com/uk/services/balancing-services/frequency-response/frequency-control-by-demand-management/
	Frequency response	An ancillary service procured by National Grid as system operator to help ensure system frequency is kept as close to 50Hz as possible. Also known as frequency control or frequency regulation.
FES	Future Energy Scenarios	The FES is a range of credible futures which has been developed in conjunction with the energy industry. They are a set of scenarios covering the period from now to 2050, and are used to frame discussions and perform stress tests. They form the starting point for all transmission network and investment planning, and are used to identify future operability challenges and potential solutions.
GTYS	Gas Ten Year Statement	The GTYS illustrates the potential future development of the (gas) National Transmission System (NTS) over a ten year period and is published on an annual basis.
GW	Gigawatt	1,000,000,000 watts, a measure of power
GWh	Gigawatt hour	1,000,000,000 watt hours, a unit of energy
gCO_2/kWh	Gram of carbon dioxide per kilowatt hour	Measurement of CO_2 equivalent emissions per kWh of energy used or produced
GB	Great Britain	A geographical, social and economic grouping of countries that contains England, Scotland and Wales.
	Green Deal	See appendix on government policy. A scheme that allows individuals and businesses to make energy efficiency improvements to their buildings.
GDHIF	Green Deal Home Improvement Fund	See appendix on government policy. A scheme that allows individuals to get financial support for qualifying energy efficiency improvements to homes.
GHG	Green house gases	A gas in the atmosphere that absorbs and emits radiation within the thermal infrared range.
GDP	Gross Domestic Product	An aggregate measure of production equal to the sum of the gross values added of all resident, institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs).
GVA	Gross Value Added	The value of goods and services produced in a sector of the economy
GSHP	Ground source heat pump	Ground source heat pumps absorb heat from the ground. This heat can then be used to produce hot water or space heating.
	Head Room	The operation of generation plant below its minimum output levels to allow output to increase at times of need.
	Heat pump	A heat pump is a device that provides heat energy from a source of heat to a destination called a “heat sink”.
HGV	Heavy goods vehicle	A truck weighing over 3,500 kg.
HHDI	Household disposable income	Household income minus tax.
IED	Industrial Emissions Directive	See appendix on government policy. The Industrial Emissions Directive is a European Union directive which commits member states to control and reduce the impact of industrial emissions on the environment post-2015 when the Large Combustion Plant Directive (LCPD) expires.
ITPR	Integrated Transmission Planning and Regulation	Ofgem’s Integrated Transmission Planning and Regulation (ITPR) project examined the arrangements for planning and delivering the onshore, offshore and cross-border electricity transmission networks. Ofgem published the final conclusions in March 2015.
IUK	Interconnector (UK)	A bi-directional gas pipeline between Bacton in the UK and Zeebrugge Belgium. http://www.interconnector.com

Appendix 3 Glossary

Acronym	Word	Description
	interconnector, gas	Gas interconnectors connect gas transmission systems from other countries to the National Transmission System (NTS) in England, Scotland and Wales. There are currently three gas interconnectors which connect to the NTS. These are: – IUK interconnector to Belgium – BBL to the Netherlands – Moffat to the Republic of Ireland, Northern Ireland and the Isle of Man.
	interconnector, power	Electricity interconnectors are transmission assets that connect the GB market to Europe and allow suppliers to trade electricity between markets.
IRR	Internal Rate of Return	The annualised rate of return, independent of inflation, for the net present value of an investment of zero in a given time frame.
IEA	International Energy Agency	The International Energy Agency is an intergovernmental organisation that acts as an energy policy advisor to member states.
LCPD	Large Combustion Plant Directive	See appendix on government policy. The Large Combustion Plant Directive is a European Union Directive which introduced measures to control the emissions of sulphur dioxide, oxides of nitrogen and dust from large combustion plant.
LCF	Levy Control Framework	See appendix on government policy. The Levy Control Framework caps the annual amount of money that can be levied on bills to support UK low carbon generation at £2.35bn in 2012/13, rising to £7.6bn in 2020/21. This covers Feed-in Tariffs (FITs), Renewables Obligation (RO) and Contracts for Difference.
LED	Light emitting diode	An energy efficient electronic lighting technology which is increasingly being adopted in UK homes and businesses.
LNG	Liquefied natural gas	LNG is formed by chilling gas to -161˚C so that it occupies 600 times less space than in its gaseous form. www2.nationalgrid.com/uk/Services/Grain-lng/what-is-lng/
	Load Factor	the average power output divided by the peak power output over a period of time.
LDZ	Local Distribution Zone	A gas distribution zone connecting end users to the (gas) National Transmission System.
LOLE	Loss of load expectation	LOLE is used to describe electricity security of supply. It is an approach based on probability and is measured in hours/year. It measures the risk, across the whole winter, of demand exceeding supply under normal operation. This does not mean there will be loss of supply for X hours/year. It gives an indication of the amount of time, across the whole winter, which the system operator (SO) will need to call on balancing tools such as voltage reduction, maximum generation or emergency assistance from interconnectors. In most cases, loss of load would be managed without significant impact on end consumers.
LCCC	Low Carbon Contracts Company	Private company owned by the Department of Energy and Climate Change (DECC) that manages the Contracts for Difference (CFD) scheme introduced by government as part of the EMR programme.
LCHT	Low carbon heating technology	A heating technology that has a lower carbon intensity for heating homes than an A rated condensing gas boiler
LCNF	Low Carbon Network Fund	A fund established by Ofgem to support projects sponsored by the distribution network operators (DNOs) to try out new technology, operating and commercial arrangements.
	Marine technologies	Tidal streams, tidal lagoons and energy from wave technologies (see http://www.emec.org.uk/)
	Medium range storage	These commercially operated sites have shorter injection/withdrawal times so can react more quickly to demand, injecting when demand or prices are lower and withdrawing when higher. http://www2.nationalgrid.com/UK/Our-company/Gas/Gas-Storage/
MWe	Megawatt (electrical)	1,000,000 Watts, a measure of power.
MWh	Megawatt hour	1,000,000 Watt hours, a measure of power usage or consumption in 1 hour.
	Merit Order	An ordered list of generators, sorted by the marginal cost of generation.
mCHP	Micro-Combined Heat and Power	A subset of CHP, designed for domestic use.

Acronym	Word	Description
	Micro generation	Defined within this document as generation units with an installed capacity of less than 1 MW.
mcm	Million cubic meters	Unit or measurement of volume, used in the gas industry. 1 mcm = 1,000,000 cubic metres.
Mte CO_2	Million tonnes of CO_2 equivalent	Carbon dioxide equivalency is a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same global warming potential (GWP), when measured over a specified timescale (generally, 100 years).
	N-1	Refers to the European Commission security of supply test, where total supply minus the largest single loss is assessed against total peak demand. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:295:0001:0022:EN:PDF
NBP	National balancing point	The wholesale gas market in Britain has one price for gas irrespective of where the gas comes from. This is called the national balancing point (NBP) price of gas and is usually quoted in pence per therm of gas.
	National balancing point (NBP) gas price	Britain's wholesale NBP Gas price is derived from the buying and selling of natural gas in Britain after it has arrived from offshore production facilities. https://www.ofgem.gov.uk/gas/wholesale-market/gb-gas-wholesale-market
NETS	National Electricity Transmission System	It transmits high-voltage electricity from where it is produced to where it is needed throughout the country. The system is made up of high voltage electricity wires that extend across Britain and nearby offshore waters. It is owned and maintained by regional transmission companies, while the system as a whole is operated by a single system operator (SO).
NTS	National Transmission System	A high-pressure gas transportation system consisting of compressor stations, pipelines, multijunction sites and offtakes. NTS pipelines transport gas from terminals to NTS offtakes and are designed to operate up to pressures of 94 barg.
NGV	Natural gas vehicle	A vehicle which uses compressed or liquefied natural gas as an alternative to petrol of diesel.
NOx	Nitrous oxide	A group of chemical compounds, some of which are contributors to pollution, acid rain or are classified as green house gases.
OFGEM	Office of Gas and Electricity Markets	The UK's independent National Regulatory Authority, a non-ministerial government department. Their principal objective is to protect the interests of existing and future electricity and gas consumers.
	Oil & Gas UK	Oil & Gas UK is a representative body for the UK offshore oil and gas industry. It is a not-for-profit organisation, established in April 2007. http://www.oilandgasuk.co.uk
OCGT	Open Cycle Gas Turbine	Gas turbines in which air is first compressed in the compressor element before fuel is injected and burned in the combustor.
	Passivhaus	A Passivhaus is a building, for which thermal comfort can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions – without the need for additional recirculation of air.
	Peak demand, electricity	The maximum power demand in any one fiscal year: Peak demand typically occurs at around 5:30pm on a week-day between December and February. Different definitions of peak demand are used for different purposes.
	Peak demand, gas	The 1-in-20 peak day demand is the level of demand that, in a long series of winters, with connected load held at levels appropriate to the winter in question, would be exceeded in one out of 20 winters, with each winter counted only once.
pa	Per annum	per year.
PV	Photovoltaic	A method of converting solar energy into direct current electricity using semi-conducting materials.
PHEV	Plug-in hybrid electric vehicle	Has a battery which can be charged by plugging it in as well as a regular engine.
	Power supply background (aka Generation background)	The sources of generation across Great Britain to meet the power demand.

Appendix 3 Glossary

Acronym	Word	Description
	Pumping demand	The power required by hydro-electric units to pump water into the reservoirs.
PEV	Pure electric vehicle	Has only a battery for energy storage.
RHI	Renewable Heat Incentive	See appendix on government policy. A payment incentive owned by Ofgem which pays owners of certain, renewable heating technologies per unit of heat produced. There is a domestic and a non-domestic version.
ROC	Renewable Obligation Certificate	See appendix on government policy. Green certificates issued to operators of accredited renewable generating stations for the eligible renewable electricity they generate. ROCs are ultimately used by suppliers to demonstrate that they have met their obligation.
RO	Renewables Obligation	See appendix on government policy. Main support mechanism for renewable electricity projects in the UK. It places an obligation on UK electricity suppliers to source an increasing proportion of the electricity they supply from renewable sources.
R&D	Research and development	A general term for activities which involve improvements to goods or processes, or research into new goods or processes.
	Seasonal storage or long-range storage	There is one long-range storage site on the national transmission system: Rough, situated off the Yorkshire coast. Rough is owned by Centrica and mainly puts gas into storage (called 'injection') in the summer and takes gas out of storage in the winter. http://www2.nationalgrid.com/UK/Our-company/Gas/Gas-Storage/
	Self-consumption	Where an end user consumes the electricity they generate, commonly from solar generation. This reduces the need to import electricity from grid but does not necessarily mean an end user is self-sufficient.
	Shale gas	Shale gas is natural gas that is found in shale rock. It is extracted by injecting water, sand and chemicals into the shale rock to create cracks or fractures so that the shale gas can be extracted. https://www.gov.uk/government/publications/about-shale-gas-and-hydraulic-fracturing-fracking
SRMC	Short run marginal cost	The instantaneous variable cost for a power plant to provide an additional unit of electricity. The short run marginal cost (SRMC) is derived from the cost of fuel, the cost of CO_2 emissions, the share of operating and maintenance (O&M) costs that varies with the plant electricity output and any income from incentives and the provision of heat associated to the plant electricity output.
STOR	Short term operating reserve	Short term operating reserve (STOR) is a service for the provision of additional active power from generation and/or demand reduction.
	Smart appliances	Residential power consuming goods which are able to reduce their power demand at defined times of the day either by reacting to a signal or by being programmed.
	Smart meter	New generation gas and electricity meters which have the ability to broadcast secure usage information to customers and energy suppliers, potentially facilitating energy efficiency savings and more accurate bills.
	Station demand	The onsite power station requirement, for example for systems or start up.
	Summer minimum	The minimum power demand off the transmission network in any one fiscal year: Minimum demand typically occurs at around 06:00am on a Sunday between May and September.
SBR	Supplemental balancing reserve	Supplemental balancing reserve (SBR) is a balancing service that has been developed to support National Grid in balancing the system during the mid-decade period when capacity margins are expected to be tight. SBR is targeted at keeping power stations in reserve that would otherwise be closed or mothballed. Along with demand side balancing reserve (DSBR), this service will act as a safety net to protect consumers, only to be deployed in the event of there being insufficient capacity available in the market to meet demand.
	System inertia	The property of the system that resists changes. This is provided largely by the rotating synchronous generator inertia that is a function of the rotor mass, diameter and speed of rotation. Low system inertia increases the risk of rapid system changes.
	System operability	The ability to maintain system stability and all of the asset ratings and operational parameters within pre-defined limits safely, economically and sustainably.

Acronym	Word	Description
SO	System operator	An entity entrusted with transporting energy in the form of natural gas or power on a regional or national level, using fixed infrastructure. Unlike a TSO, the SO may not necessarily own the assets concerned. For example, National Grid operates the electricity transmission system in Scotland, which is owned by Scottish Hydro Electricity Transmission and Scottish Power.
TWh	Terawatt hour	1,000,000,000,000 watt hours, a unit of energy
TOUT	Time Of Use Tariff	A charging system that is established in order to incentivise residential consumers to alter their consumption behaviour – usually away from high power demand times.
tCO^2	Tonne of carbon dioxide	A fixed unit of measurement commonly used when discussing carbon dioxide emissions.
TEC	Transmission entry capacity	The maximum amount of active power deliverable by a power station at its grid entry point (which can be either onshore or offshore). This will be the maximum power deliverable by all of the generating units within the power station, minus any auxiliary loads.
	Transmission losses	Power losses that are caused by the electrical resistance of the transmission system.
TSO	Transmission system operators	An entity entrusted with transporting energy in the form of natural gas or power on a regional or national level, using fixed infrastructure.
	Triad	Triad demand is measured as the average demand on the system over three half hours between November and February (inclusive) in a financial year. These three half hours comprise the half hour of system demand peak and the two other half hours of highest system demand which are separated from system demand peak and each other by at least ten days.
UKCS	UK Continental Shelf	The UK Continental Shelf (UKCS) comprises those areas of the sea bed and subsoil beyond the territorial sea over which the UK exercises sovereign rights of exploration and exploitation of natural resources.
UK	United Kingdom of Great Britain and Northern Ireland	A geographical, social and economic grouping of countries that contains England, Scotland, Wales and Northern Ireland.
UCL	University College London	A UK university based in London.
	Weather corrected	The actual demand figure that has been adjusted to take account of the difference between the actual weather and the seasonal normal weather.

Annual data in FES

Where a single year is referred to in FES, e.g. 2020, we are referring to that calendar year.

Where data is across split years, e.g. 2020/21, we are referring to power years. These run from 1 April to 31 March. For example, 2020/21 refers to 1 April 2020 to 31 March 2021.

Disclaimer

For the purpose of this statement, National Grid Gas plc and National Grid Electricity Transmission plc will together be referred to as National Grid. The information contained within the UK Future Energy Scenarios document ("the Document") is disclosed voluntarily and without charge to you in order to facilitate and encourage discussion of the scenarios used by National Grid in its electricity and gas planning processes.

The Document does not replace the Gas Ten Year Statement (GTYS) or the Electricity Ten Year Statement (ETYS) (or any other document published by National Grid containing substantially the same information as those documents) published in accordance with the relevant licence conditions. While National Grid have not sought to mislead any party as to the content of the Document and, whilst the content represents National Grid's best views as of 1 June 2015, readers should not place any reliance on the content of the Document. The Document (including, without limitation, information as regards capacity planning, future investment and the resulting capacity) must be considered as illustrative only and no warranty can be or is made as to the accuracy and completeness of such Document, nor shall anything within the Document constitute an offer capable of acceptance or form the basis of any contract. Other than in the event of fraudulent misstatement or fraudulent misrepresentation, National Grid does not accept any responsibility for any use which is made of the information contained within this Document.

Continuing the conversation

Get involved in the debate on the future of energy on Twitter at #FES2015 and join our LinkedIn group 'Future of Energy by National Grid.'

Email us with your views on FES or any of our future of energy documents at: transmission.ukfes@nationalgrid.com **and one of our experts will get in touch.**

Access our current and past FES documents, data and multimedia at: http://fes.nationalgrid.com

Keep up to date on key issues relating to National Grid via our Connecting website: www.nationalgridconnecting.com/

You can write to us at:
Energy Strategy and Policy
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

nationalgrid

National Grid plc
National Grid House,
Warwick Technology Park,
Gallows Hill, Warwick.
CV34 6DA United Kingdom
Registered in England and Wales
No. 4031152

www.nationalgrid.com