

# UK Future Energy Scenarios

## Stakeholder Feedback

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# Introduction

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Welcome to our 2014 UK Future Energy Scenarios Stakeholder Feedback document. Following the release of our 2013 UK Future Energy Scenarios (UK FES) in July last year, we launched a consultation process to seek the views of our stakeholders, in order to ensure our scenarios are as plausible and credible as possible.

This autumn we continued to develop our engagement, making it both broader, welcoming new stakeholders into the process, and richer, through holding more detailed discussions. This document provides a summary of the feedback we received during our consultation process and outlines how your views will shape our scenarios for 2014.

One of the most consistent themes that emerged from our consultation was the vast level of uncertainty regarding the future of energy in the UK; many of you believed National Grid's 2013 scenarios did not provide a sufficiently broad range of outcomes to capture and reflect this uncertainty. You also expressed a desire for a clearer narrative to support the quantitative data in the UK FES document, and suggested the scenarios should reflect the so called energy 'trilemma' of sustainability, affordability and security of supply.

We have listened to your views and subsequently we are developing four scenarios for 2014, with a varying emphasis on sustainability and affordability. These scenarios will provide a broader envelope of potential energy futures. We will enhance the narrative surrounding the scenarios, in order to be as inclusive, transparent and accessible as possible for our broad range of stakeholders.

I hope you find this document useful and informative, and I look forward to sharing our 2014 UK Future Energy Scenarios with you.



**Richard Smith**  
Head of Energy  
Strategy and Policy

# Summary

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## Stakeholder Consultation

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- In July National Grid published its 2013 UK Future Energy Scenarios document.
- Throughout the autumn we sought your views on our scenarios.
- We conducted bilateral meetings with a broad range of our stakeholders and held industry workshops in Glasgow and London.
- Over 75 organisations engaged with our consultation process.
- We will continue to listen to your feedback and develop our engagement process to ensure our consultation is as wide-ranging, open and inclusive as possible and tailored to our stakeholders' needs.



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## You said...

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- We have received a variety of thoughts, opinions and views on our UK Future Energy Scenarios and underlying axioms.
- There are a number of common themes that have come out of this process.
- These will be explored in further detail later in this document, where we have highlighted how these will influence our 2014 process.

**For example, as our stakeholders have repeatedly expressed a desire for a broader range of future energy outcomes, we have made the decision to produce 4 scenarios for 2014.**



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## Next Steps

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- We will launch our 2014 UK Future Energy Scenarios document at our annual one day conference in London on Thursday 10 July 2014.
- We will continue to improve our engagement by tailoring our approach to suit each of our stakeholders.
- We will investigate alternative methods of engagement, including social media and online resources, to improve both your understanding of our scenarios and the value of our scenarios to you.
- Our scenarios provide a basis for network analysis to enable the development of our network investment plans. The timeline illustrates the key stages in our UK FES process.



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## Appendix

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### **Workshop Questions -**

- Here we provide charts displaying the aggregated results from responses to the questions asked at our workshops.

### **Axioms Abacus -**

- At this year's workshops we introduced our axioms abacus. The charts show the spread of views on each of our axioms.
- We have used these results to benchmark our 2013 scenarios, highlighting areas of consensus and differing views, with the results helping to shape the development of our 2014 scenarios.

### **2014 Axioms**

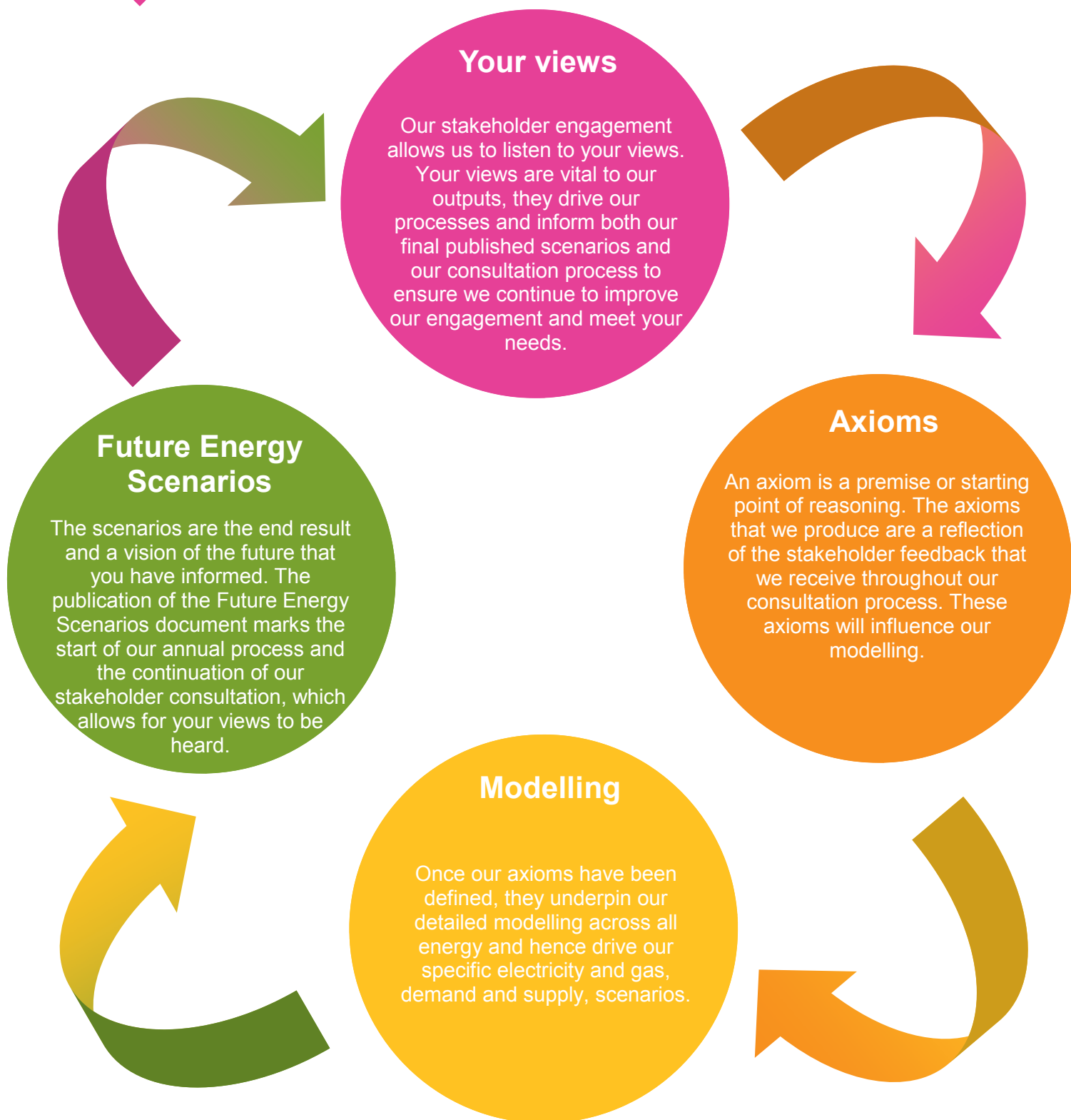
- These axioms will underpin our 2014 scenarios.

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For further details on the content of our UK Future Energy Scenarios please visit our [website](http://www2.nationalgrid.com/uk/industry-information/future-of-energy/future-energy-scenarios/)<sup>1</sup>

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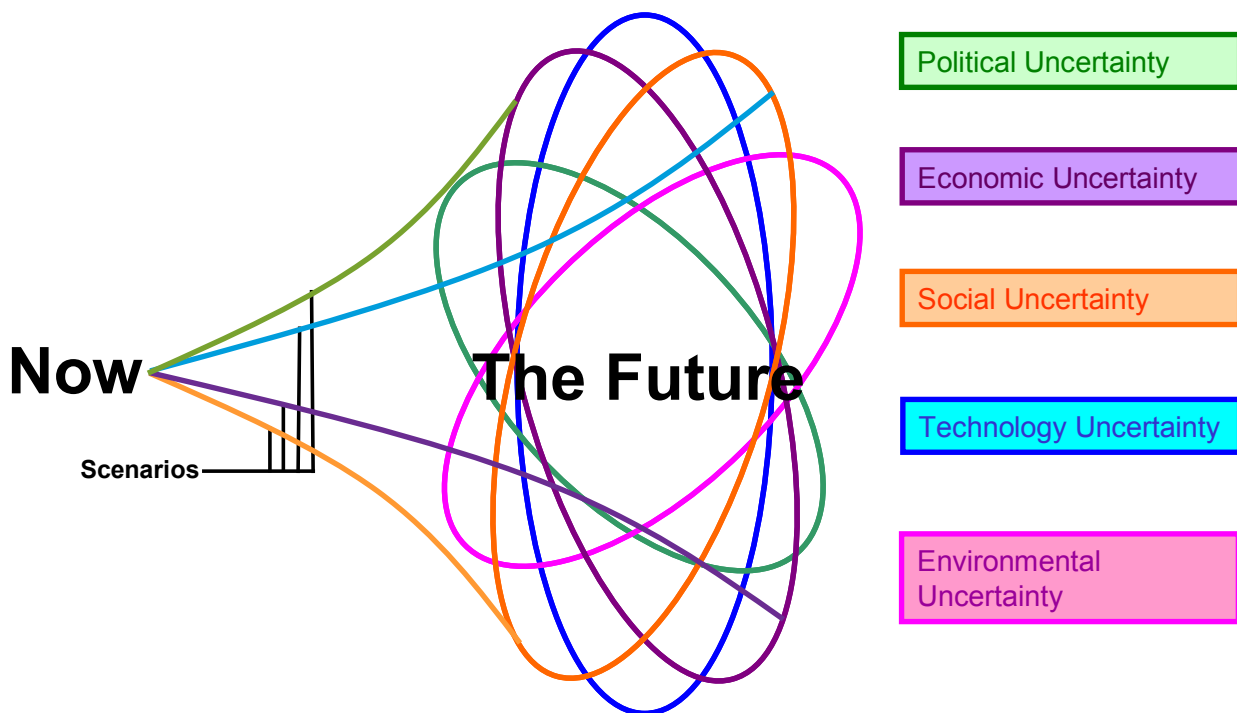
# Your role in the scenarios...



# Why Scenarios?

## Why scenarios?

The UK energy sector has the challenge of providing safe, reliable and secure energy as part of a sustainable, decarbonised and affordable future. However, across our industry, there is a great deal of both short and long term uncertainty when talking about the future.



With this in mind, a single forecast of energy demand and supply does not give a sufficiently rich picture of possible future developments. Hence National Grid develops energy scenarios that are sufficiently diverse to encompass a broad range of possible energy futures. Developing four scenarios for 2014 allow us to widen the envelope to address this uncertainty in a way that remains credible and plausible.

Our scenarios are not to be confused with forecasts. Scenarios planning does not predict the future; rather it considers the complete scope of potential drivers that might have an impact. Each scenario is purposefully different; we do not assign probabilities to our scenarios and we do not assume that one scenario is any more likely than another.

# 1 Stakeholder Consultation



## Our Stakeholder Engagement

We are strongly committed to stakeholder engagement. Throughout 2013 we have listened to and acted on your feedback, and we will continue to engage on UK energy matters, proactively communicating our scenarios.

This document outlines some of the action we have taken and some of the actions we are committed to taking, in direct response to the feedback you have given us.

## Our Stakeholder Engagement Principles

**Inclusiveness:** we will seek to ensure that the views of all interested parties are sought.

**Transparency:** to raise awareness of the opportunities to engage.

**Accessibility:** to facilitate discussions at meetings/workshops.

**Targeted:** to suit the interest, knowledge and awareness of different groups of stakeholders.

**Responsiveness:** adopting a flexible process and acting on stakeholder feedback.

**Accountability:** we listen to what our stakeholders tell us and act on their feedback.

**Taking views seriously:** we will ensure that all the views expressed are appropriately considered.

**Evaluation:** we will evaluate our approach to engagement to enable continuous improvement.

**Innovative:** we will implement new ways of engagement to maximise benefit both to National Grid and our stakeholders.



*“The process used by National Grid in constructing the scenarios is impressive and involves wide scale consultation and engagement via a number of workshops held across the country. I think most would agree that National Grid has gone out of its way to be inclusive in the development of its scenarios.”*

Robert Sansom, Doctoral Researcher

Source: <http://ukerc.wordpress.com/2013/12/05/minister-read-my-lips-by-robert-sansom-imperial-college/>



## Our Consultation Process

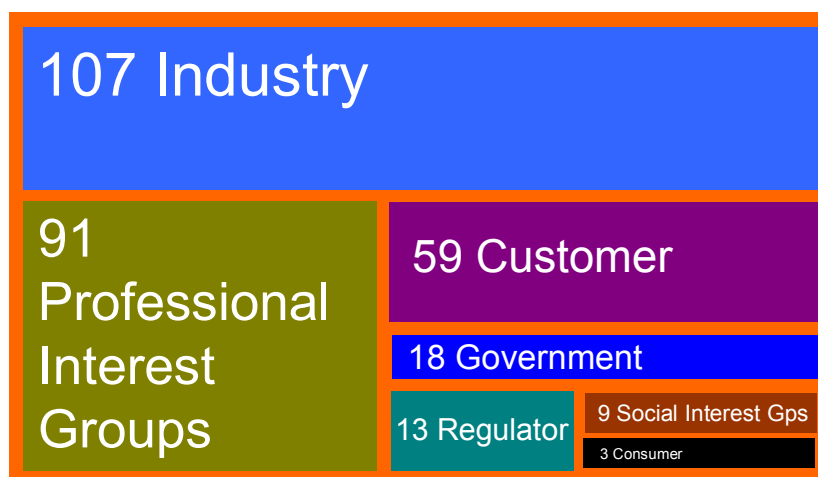
Following the launch of our 2013 UK Future Energy Scenarios document at our annual conference in July, we held a series of engagement events in order to consult on the scenarios and capture a wide array of responses, thoughts and opinions from stakeholders. Our consultation process included:

- Bilateral (one to one) meetings
- Workshops that enabled a broad spectrum of our stakeholders to debate our scenarios in detail and provide qualitative and quantitative feedback on them.
- Questionnaires covering a wide range of stakeholders (Producers, Importers, Shippers, Storage Operators and Terminal Operators).

## 2013 UK FES stakeholder engagement statistics

The following statistics summarise our stakeholder engagement on the 2013 UK Future Energy scenarios, excluding bilateral meetings. The 7 stakeholder groups allow us to understand where our stakeholders' interests lie and ensure we are providing relevant information. More information on our 7 stakeholder groups can be found on page 34.

# 300 delegates



(187 organisations at conference & workshops)

**Our other engagement:**

- Bilateral meetings
- Videos
- Questionnaires
- Online surveys
- Feedback forms
- Connecting website
- Twitter

## Continuing the Process

We sought feedback not only on our scenarios, but on our engagement process itself. We will continue to develop our stakeholder engagement process to ensure it is inclusive, transparent, accessible and tailored to our stakeholders' requirements.

### National Grid Scenarios

..."National Grid needs to **tell an engaging story**". "What do the scenarios mean for National Grid and individuals, where are the decision points and what trade offs will have to be made?" Many stakeholders expressed a wish to see a richer storyline for each of our scenarios.

...we should provide more detail behind the **assumptions and outcomes of the scenarios**.

...we should introduce **more Future Energy Scenarios**. According to the voting sessions held at recent stakeholder workshops, our scenarios do not provide a sufficiently broad range of future energy outcomes. Table discussions indicated that there was a preference towards four scenarios.

...National Grid's scenarios need to **capture the wide bandwidth of uncertainty** in the energy industry. Technology uncertainty is very big and government policies could change very rapidly; National Grid need to have enough scenarios to be flexible with this.

...we should explore **scenarios based around the energy 'trilemma'**, of sustainability, affordability and security of supply. This approach was suggested at our London workshops, with the general consensus that it would be appropriate for 2014.

...A slower Slow Progression is necessary. "Slow Progression is still quite green; there's scope for something else." "We've lost one scenario [Accelerated Growth]. People are more pessimistic, so what if we go the other way and have a very slow Slow Progression?"

...National Grid could take a more probabilistic approach with **multiple options and pathways**; it would be useful to rank levels of realism.

...Cost ranking of scenarios would be useful, considering the cost implications for consumer bills and National Grid's network infrastructure.

...More input is needed from academia and a range of stakeholders.

## Our thoughts and actions for 2013

From the beginning of our scenario development process for 2014, we have put more emphasis on the narrative surrounding the scenarios. This will enable us to build a solid and engaging qualitative story that will support and enhance our quantitative data and deliver value to our stakeholders.

We are introducing two new scenarios for 2014, in addition to our Slow Progression and Gone Green Scenarios. Based on stakeholder feedback, the energy 'trilemma' will form the foundations of our 2014 UK FES. These scenarios are explored in more detail on the following page.

This new approach to the scenarios provides a wider envelope for possible energy outcomes in order to reflect the current level of uncertainty in the energy industry. As our scenarios are not forecasts, we do not assign a probability to each possible outcome or assume that one scenario is more likely than another.

By flexing affordability, the four scenarios for 2014 will explore with differing levels of financial constraints at both government and consumer level. We will also continue to include capital costs of new generation, and will investigate the potential of costing other elements of our scenarios where reliable underlying costing data is available.

We will continue to analyse our stakeholder engagement and seek feedback from a wide range of stakeholders from the energy industry and beyond, in order to ensure our consultation is as inclusive as possible and our scenarios continue to provide a credible and holistic range of future energy outcomes.

# Our 2014 UK Future Energy Scenarios

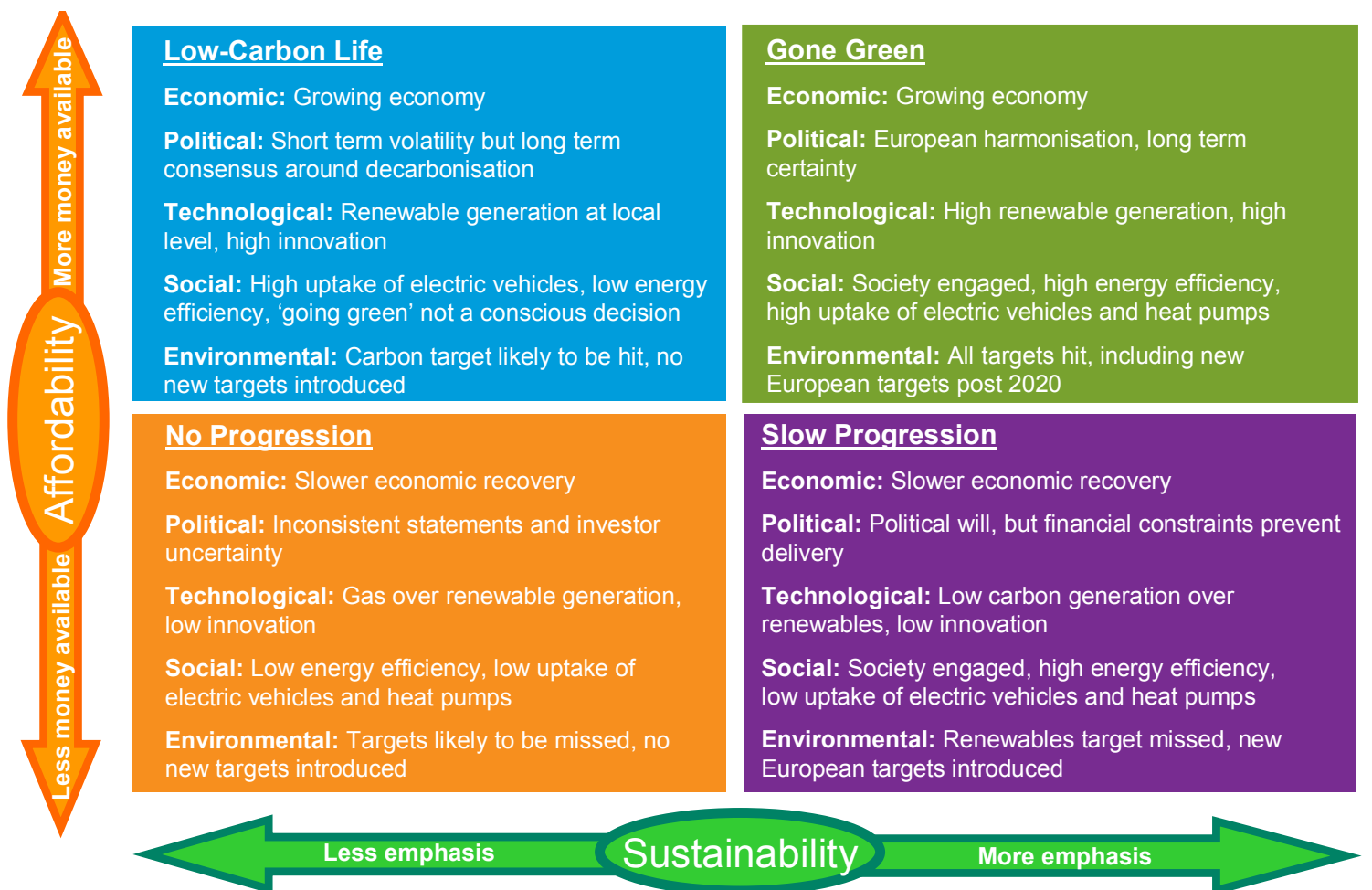
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Our 2014 UK Future Energy Scenarios are based on the concept of the so called energy 'trilemma'; balancing the competing needs for sustainability, affordability and security of supply.

Sustainability and affordability will be flexed across the scenarios, with each scenario having a different emphasis on the two variables. Security of supply will remain fixed across all scenarios in line with one of the key objectives of Electricity Market Reform.

The two variables of sustainability and affordability form a 2x2 matrix, on which the scenarios range from the extremes of 'more money available and more emphasis on sustainability' to 'less money available and less emphasis on sustainability'.

The generation mix, the role of gas, and energy demand will vary between scenarios, influenced by factors such as economic recovery and the extent of financial constraints, the introduction of new renewable targets and the effectiveness of consumer engagement.



## You also said...

### System operation and balancing

...It is important for National Grid to consider and share information on what the scenarios mean for operating the system.

...We should incorporate storage into the scenarios to a greater extent, giving particular consideration to new types of storage.

### Power Supply

...There should be greater focus on **decentralised power generation**.

...Greater breakdown of power supply data would be useful.

... Further consideration of the **economic factors** influencing generation would enhance the assumptions which underpin the Power Supply scenarios.

### Electric vehicles

...National Grid's electric vehicle and heat pump forecasts are generally in line with the views of our stakeholders.

...There is a wide range of views on what proportion of electric vehicle owners will move their charging to offpeak periods. During the voting sessions at our recent stakeholder workshops there was some agreement with our position for Gone Green and Slow Progression. However, there was also a spread of views either side of the two scenarios.

### Power demand definitions

...It is unclear how definitions and figures for power demand vary between National Grid publications.

### District heating

...Stakeholders asked for more detail of our assumptions surrounding the development of district heating within the UK and how this influences demand for gas and electricity.

## Our thoughts and actions for 2013

Chapter 5 of our Electricity Ten Year Statement\* discusses the impact the scenarios have on system operation. The 2013 ETYS is available at the link in the footnote, and the 2014 ETYS will be published in November 2014.

We will include an evidence based storage case study in our 2014 UK FES document where we will consider how and when storage plays a role in our scenarios.

The move to four UK Future Energy Scenarios for 2014 will allow us to explore a scenario with a higher proportion of decentralised power generation; this will be captured by our Low-Carbon Life scenario, which sees greater investment in renewable generation at a local level.

For 2014, we will provide greater granularity of power supply data, particularly for increases and decreases in capacity for each year we study. We are also considering other factors that can be incorporated within our Power Supply scenario development in order to make the scenarios more valuable to our stakeholders.

During our 2012 consultation process, our stakeholders told us our electric vehicle forecasts were too ambitious. We addressed this feedback in 2013 by seeking independent scrutiny of our electric vehicle analysis from external consultants at TRL (Transport Research Laboratory), and following our recent consultation, stakeholders are now in agreement with our latest figures.

We are developing our 2014 scenarios such that different electric vehicle charging profiles can be used for different user groups and we will continue to develop our scenarios further when more data becomes available from electric vehicle trials in the future.

This year we will provide greater clarity around the definitions used in relation to our power demand scenarios. Where possible, we will use consistent definitions within our UK Future Energy Scenarios document and across other National Grid publications, and where this is not possible, we will explain why.

We are giving further consideration to the role of district heating within our scenarios. At present, 2% of UK heat demand is served by district heating, with the majority targeted towards larger consumers making use of gas-fired combined heat and power, however we will explore where there is further potential.

\* <http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Electricity-ten-year-statement/Current-statement/>

## What will we do with the feedback?

Feedback from our UK Future Energy Scenarios consultation has been gathered from a wide range of stakeholders and is currently being used to inform the development of our 2014 scenarios. Whilst it is not possible to incorporate the views of everyone on every issue, we believe our 2014 scenarios will reflect a greater proportion of our stakeholders' views, will be more balanced and provide a greater range of potential future energy outcomes.

## What are the scenarios used for?

Our 2014 scenarios will be used as a reference point for a range of modelling activities including detailed network analysis which enables National Grid to identify potential gas and electricity network investment requirements in the future. The scenarios also underpin a wide range of other supply and demand analyses, and will feed into our business plans. Through this consultation on our future energy scenarios we will be able to ensure that any future plans reflect your views.



# How the scenarios are used

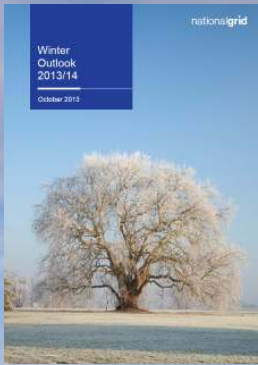
Electricity Market Reform



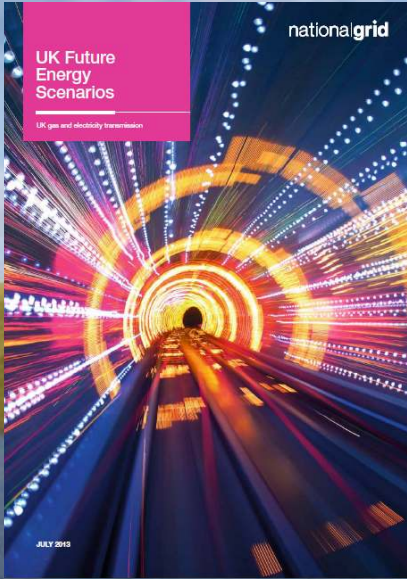
National Grid's Gas and Electricity Ten Year Statement



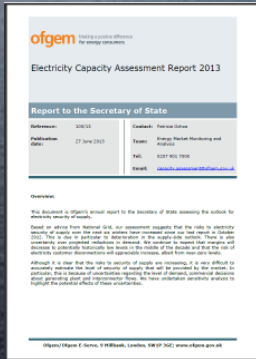
Winter Outlook Report



Security of Supply Report



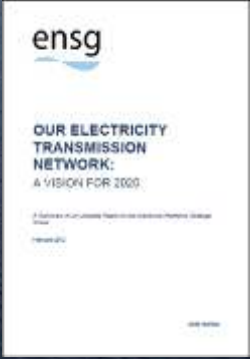
National Grid Business Plan  
Finance Plan  
Capital Plan



Capacity Adequacy Report



ENTSOG and ENTSOE Ten Year Network Development Plan



Electricity Networks Strategy Group

## Next Steps...

### Future stakeholder engagement

We will continue to engage with you to ensure your views are included in our work going forward. We will continue to discuss, listen and act on what our stakeholders tell us and focus on improving our engagement. We would like our consultation to be as wide-ranging, open and inclusive as possible and would welcome your views and opinions on our engagement process.

Whilst our formal consultation on the 2013 UK Future Energy Scenarios has come to a close, our engagement with you is a continual process throughout the year. We are open to dialogue with you on an ongoing basis and welcome your continued feedback.

### Contact us

#### We welcome your comments on:

- Our stakeholder consultation process
- How useful you found this document

Please email any thoughts or questions to us via [transmission.ukfes@nationalgrid.com](mailto:transmission.ukfes@nationalgrid.com)

### Future of Energy website

Visit National Grid's Future of Energy website for further details of our UK Future Energy Scenarios, and explore the future of energy in the UK and the impact on National Grid's transmission networks: <http://www2.nationalgrid.com/uk/industry-information/future-of-energy/future-energy-scenarios/>

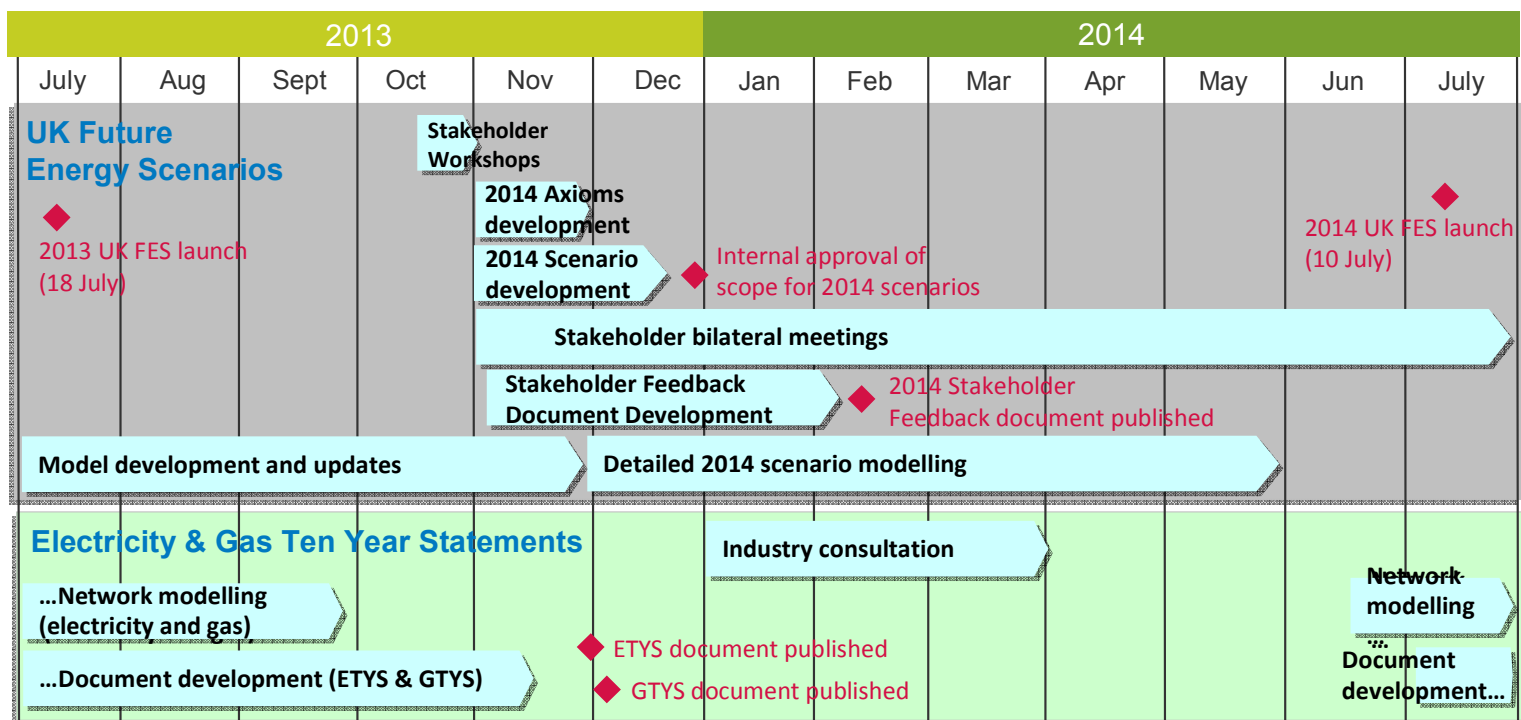
### National Grid Connecting

You can also find articles, bulletins and debates relating to the future of energy on National Grid's [Connecting website](#). Recent publications include 'Searching for a solar solution' and debates on changing consumer behaviour, the future of UK energy demand and the UK's energy mix.

## Key milestones going forward

We will be holding our annual one day conference on 10 July 2014 at One Great George Street, Westminster, London, where we will present our new 2014 scenarios and publish the 2014 UK Future Energy Scenario document. An invitation to register will be sent to our UK FES distribution list closer to the event. To be added to the distribution list, please email [transmission.ukfes@nationalgrid.com](mailto:transmission.ukfes@nationalgrid.com). Material from the conference and the 2014 UK FES document will be published on our website.

The timeline below highlights the key stages in our UK FES process, and illustrates how our stakeholder engagement and development of scenarios interlink with network modelling activities within National Grid.



# 4 Appendix 1: Workshop Questions

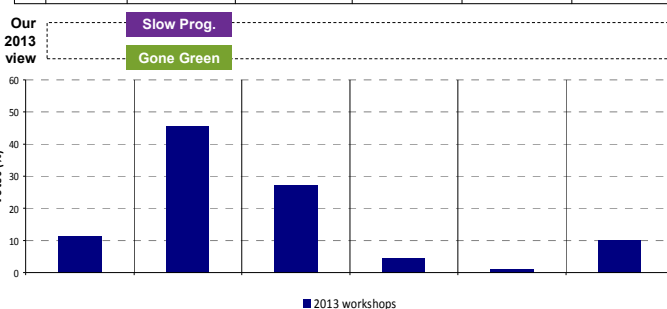
The following charts show the responses to questions asked at our three stakeholder workshops. They show the aggregated results for the responses from all of the workshops. The charts also show where our 2013 Gone Green and Slow Progression scenarios sit within the various options for each question, and where applicable (Questions 25 and 26) show where views were the previous year in relation to this year.

We have used these results to benchmark our 2013 scenarios, highlighting areas of agreement and disagreement, with the results also helping to shape the development of our 2014 scenarios. Feedback on this method of engagement has been overwhelmingly positive, and we intend to continue to develop this approach, improving the format and structure of the questions to ensure we and our stakeholders gain maximum value from the process.

## Question 1

### Power Demand

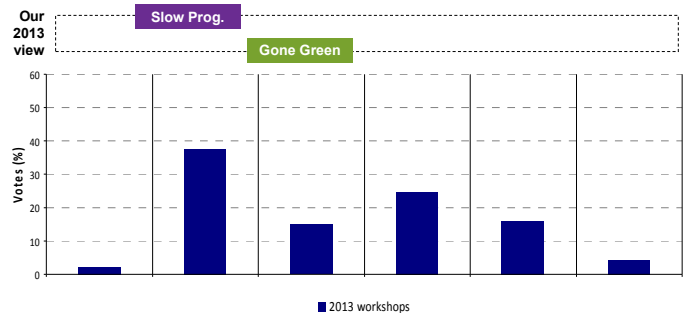
1	By 2030 how much will the average domestic appliance efficiency improve?					
	1: <10%	2: 10 - 30%	3: >30 - 50%	4: >50 - 70%	5: >70%	6: No View



## Question 2

### Power Demand

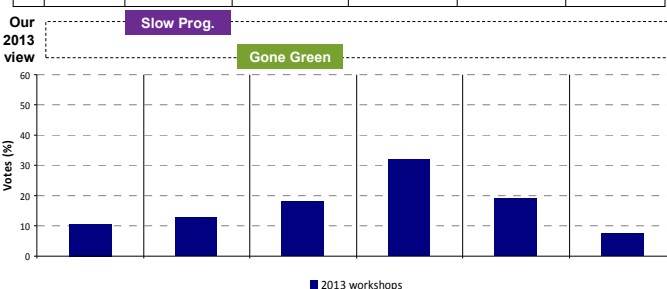
2	By 2030 what proportion of cars on the road will be electric?					
	1: <1%	2: 1 - 5%	3: >5 - 10%	4: >10 - 20%	5: >20%	6: No View



## Question 3

### Power Demand

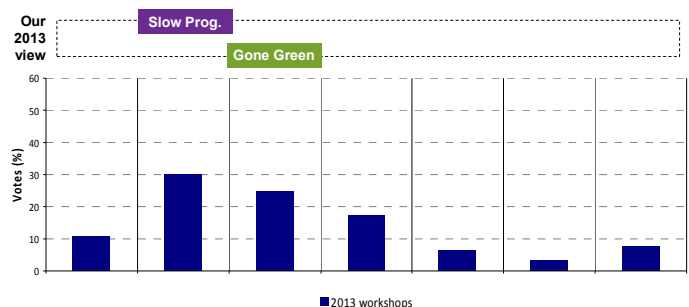
3	By 2030 what proportion of electric car owners will move their charging to offpeak periods?					
	1: <10%	2: >10 - 40%	3: >40 - 60%	4: >60 - 90%	5: >90%	6: No View



## Question 4

### Power Demand

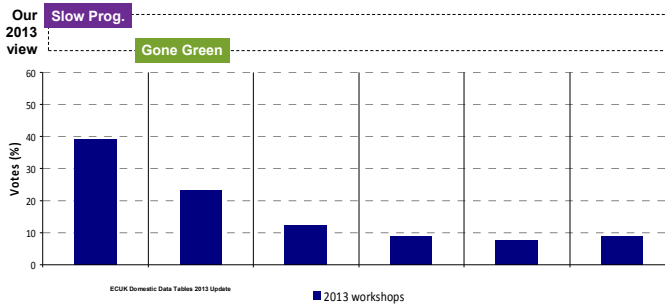
4	What capacity of microgeneration do you think will be installed by 2030 under the Government's FIT scheme (GWs)?						
	1: <5	2: 5 - 11	3: >11 - 17	4: >17 - 23	5: >23 - 30	6: >30	7: No View



### Question 5

#### Power Demand

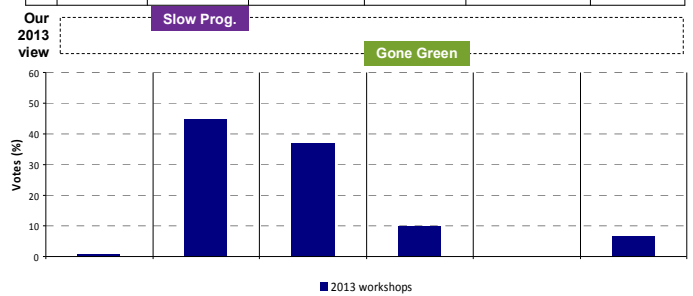
5	What percentage of new homes <u>without gas connections</u> will have heat pumps (as opposed to biomass, oil etc.) by 2020?					
	1: <20%	2: >20 - 40%	3: >40 - 60%	4: >60 - 80%	5: >80%	6: No View



### Question 6

#### Economy

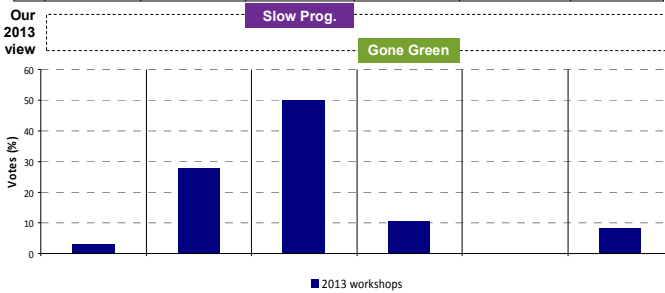
6	In the short term UK GDP is expected to recover to pre-recession growth, by 2015 do you believe GDP will grow by:					
	1: <0%	2: 0-1% per annum	3: >1-2% per annum	4: >2-3% per annum	5: >3% per annum	6: No View



### Question 7

#### Economy

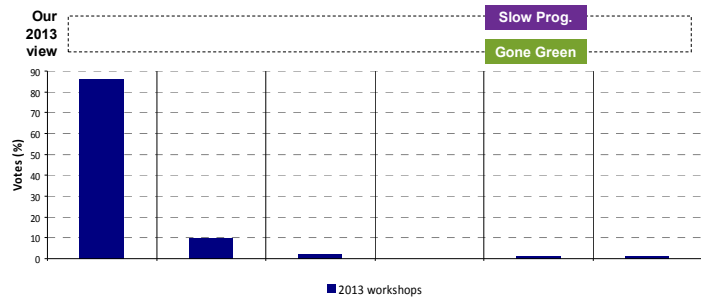
7	In the longer term (out to 2030) UK GDP is expected to reach a stable growth level, do you believe GDP will grow year on year by:					
	1: <0%	2: 0-1% per annum	3: >1-2% per annum	4: >2-3% per annum	5: >3% per annum	6: No View



### Question 8

#### Gas Demand

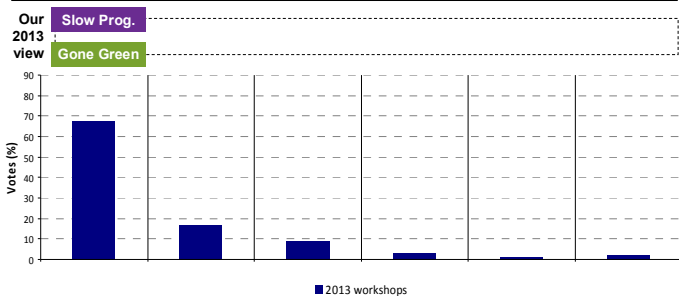
8	Will retail energy prices in 2020 be higher or lower than today?					
	1: Higher Electricity / Higher Gas	2: Higher Electricity / Lower Gas	3: Lower Electricity / Higher Gas	4: Lower Electricity / Lower Gas	5: About the same	6: No View



### Question 9

#### Gas Demand

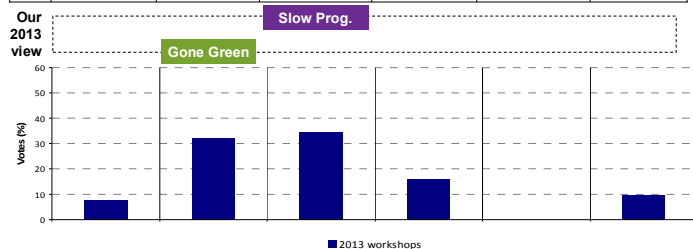
9	Will retail energy prices in 2030 be higher or lower than today?					
	1: Higher Electricity / Higher Gas	2: Higher Electricity / Lower Gas	3: Lower Electricity / Higher Gas	4: Lower Electricity / Lower Gas	5: About the same	6: No View



### Question 10

#### Gas Demand

10	If energy becomes more affordable, how will household internal temperatures change over the next decade?					
	1: They will continue to decrease	2: They will not change	3: They will increase but not as much as 2 degrees (2005 levels)	4: They will increase up to 2 degrees	5: They will increase above historic highest levels more than 2 degrees	6: No view



# Appendix 1 continued...

## Question 11

### Gas Demand

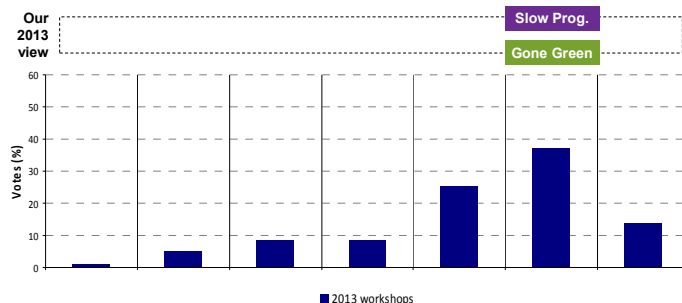
11	How much solid wall insulation will materialise in existing homes in total, compared to the charts shown?						
	1: 75% less than IA	2: about 50% less than IA	3: about 25% less than IA	4: About the same	5: Up to 25% more than IA	6: 50% more than IA or greater	7: No View



## Question 12

### Gas Demand

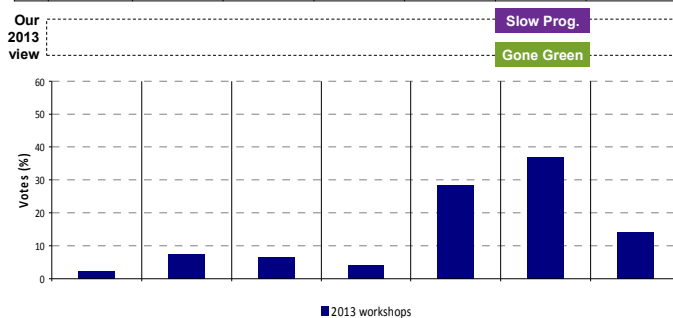
12	What year do you think gas will be banned from <u>new</u> domestic properties? (year closest to)						
	1: 2016	2: 2020	3: 2025	4: 2030	5: >2030	6: Never	7: No View



## Question 13

### Gas Demand

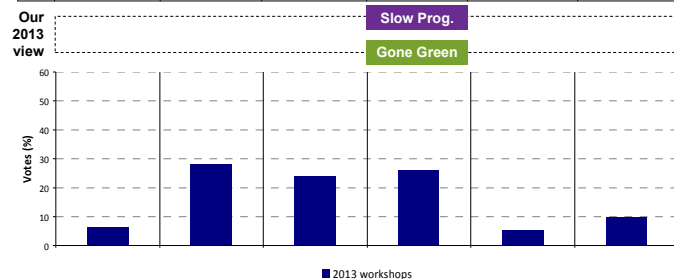
13	What year do you think gas will be banned from <u>new</u> commercial properties?						
	1: 2020	2: 2025	3: 2030	4: 2035	5: >2035	6: Never	7: No View



## Question 14

### Gas Demand

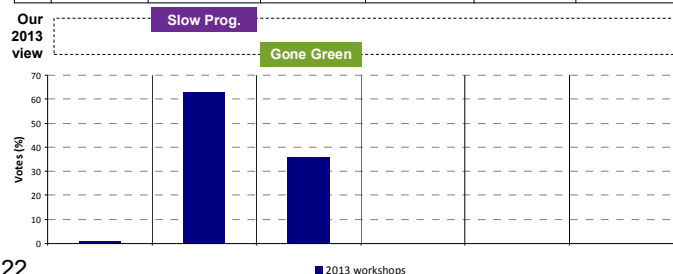
14	Will the gas demand related to industrial, process and manufacturing continue to decline? If so, by how much will demand fall by 2030?					
	1: No it will recover	2: Yes, 0 - 10%	3: Yes, >10 - 20%	4: Yes, >20 - 40%	5: Yes, beyond 40%	6: No view



## Question 15

### Power Supply

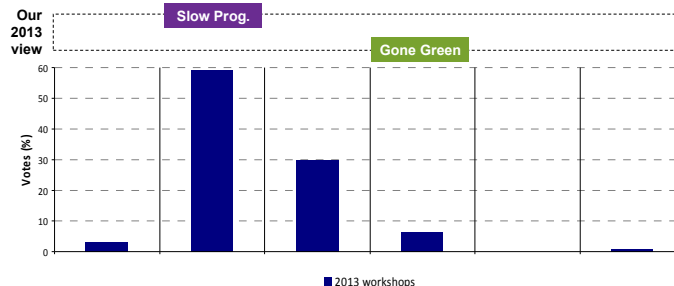
15	By 2030 which do you see as having the highest installed capacity in terms of the UK power supply mix?					
	1: Nuclear	2: Gas (CCGT, OCGT & CHP)	3: Wind	4: CCS	5: Some other technology	6: No view



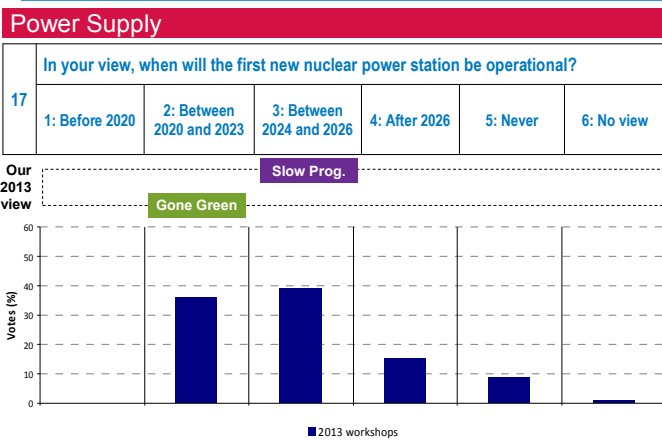
## Question 16

### Power Supply

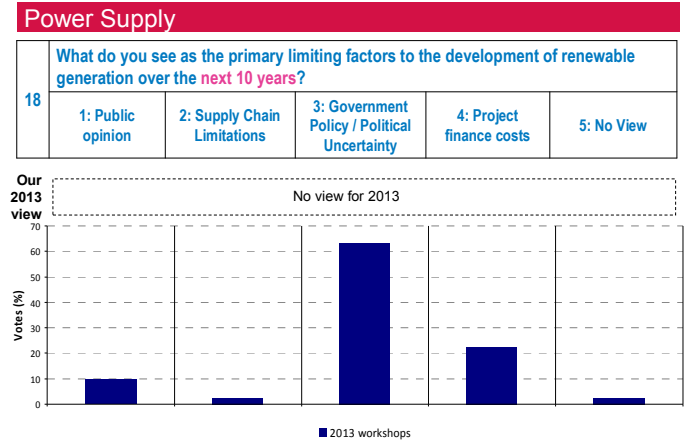
16	In your view how much total renewable energy capacity will be connected to the electricity system by 2020?					
	1: Less than 20GW	2: >20 - 30GW	3: >30 - 40G	4: >40 - 50GW	5: More than 50GW	6: No view



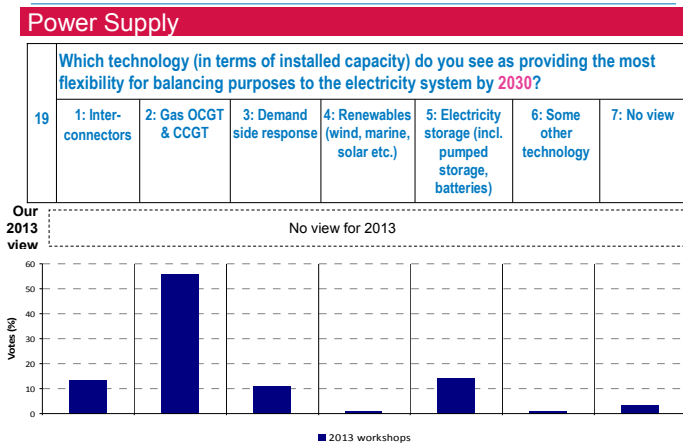
## Question 17



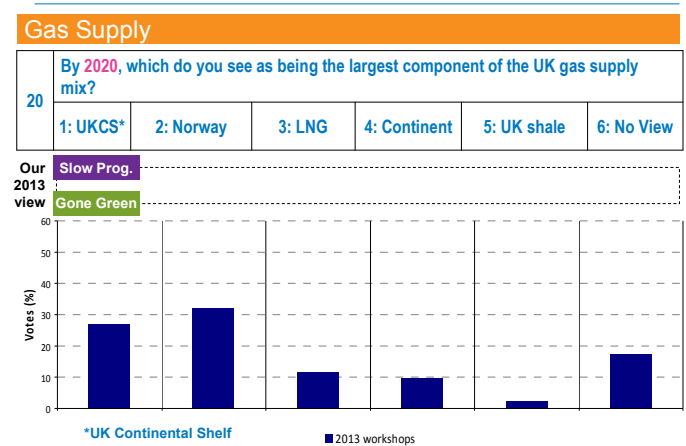
## Question 18



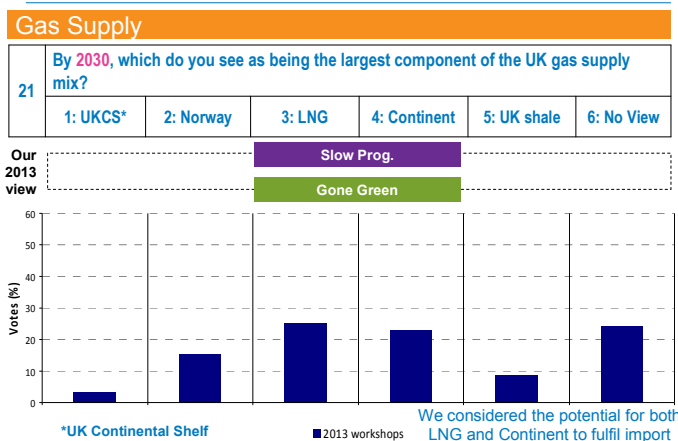
## Question 19



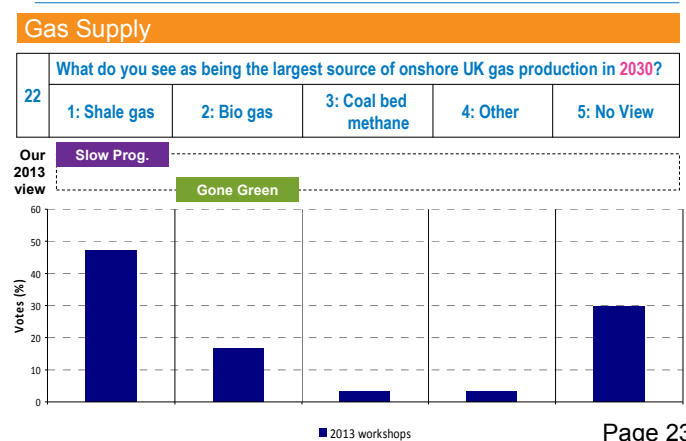
## Question 20



## Question 21



## Question 22

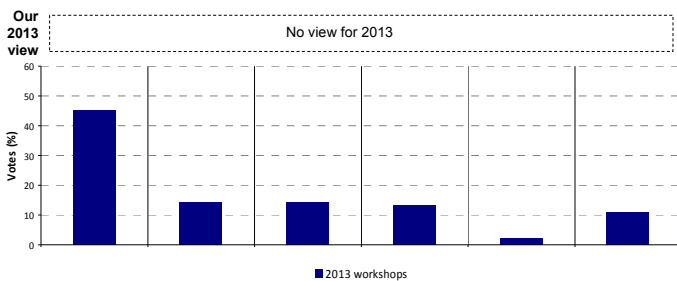


# Appendix 1 continued...

## Question 23

### Gas Supply

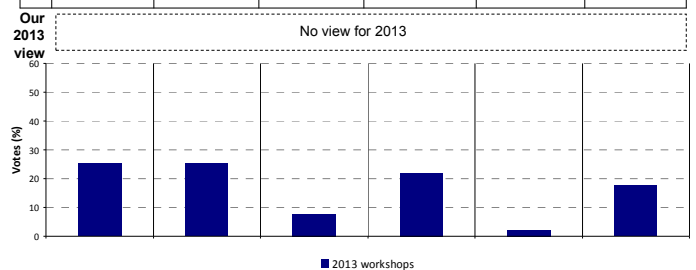
23	What do you see as being the best option to increase flexibility for UK gas supply over the next 10 years?					
	1: UK storage	2: LNG facilities	3: Inter-connection	4: Demand side response	5: Other	6: No View



## Question 24

### Gas Supply

24	What market influences do you see having the greatest affect on UK security over the next 10 years?					
	1: Outages to key supply routes	2: Global LNG prices / demand	3: Continental market operation	4: Availability of UK storage	5: Low demand side response	6: No view



## Question 25

### Future Energy Scenarios

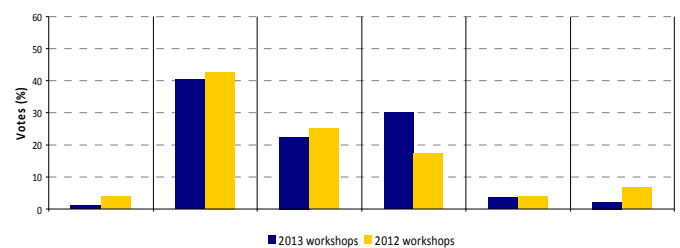
25	When will the UK achieve 15% of its energy requirements from renewable sources?				
	1: Before 2020	2: 2020	3: 2021 – 2025	4: After 2025	5: No View



## Question 26

### Future Energy Scenarios

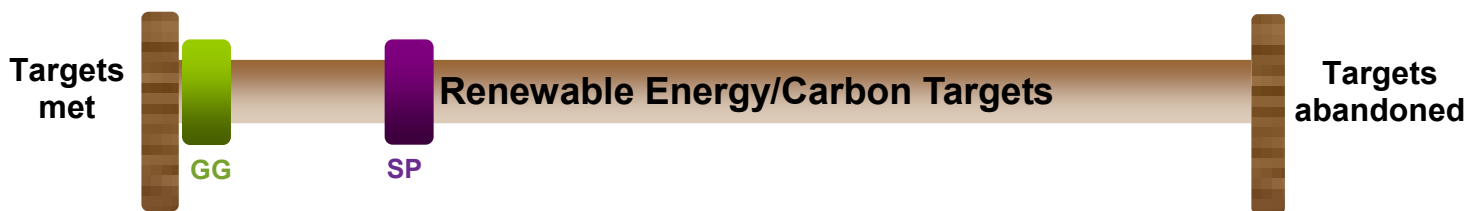
26	National Grid's Future Energy Scenarios provide a sufficiently broad range of future energy outcomes:					
	1: Strongly Agree	2: Agree	3: Neutral	4: Disagree	5: Strongly Disagree	6: No View





# Appendix 2: Axioms Abacus

During our workshops in October 2013 we introduced our axioms abacus; 28 sliding scales that represent each of our underlying assumptions, or axioms, based on the concept of an abacus. On each of the axiom scales, a bead was used to identify the position of our 2013 **Gone Green** and **Slow Progression** scenarios.

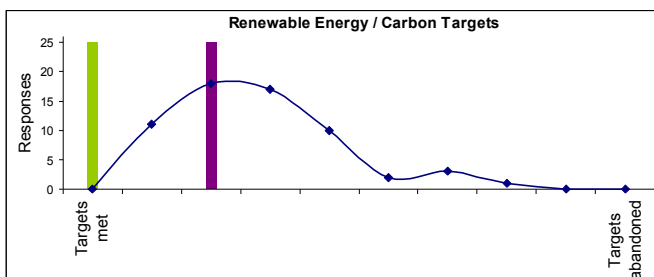


During the workshops we asked each of our stakeholders to place a marker on each of the 28 scales to represent what they saw as the most credible position for each axiom, using Gone Green and Slow Progression for context. From this, we created charts that displayed the boundaries and clustering of opinions for each of the axioms.

These charts have been used to inform our axioms for 2014, which will in turn form the foundations of our 2014 UK Future Energy Scenarios, and are shown below. The blue line represents the distribution of stakeholders' responses, with the two coloured bars indicating the position of our 2013 scenarios.

## 2013 Axioms Abacus

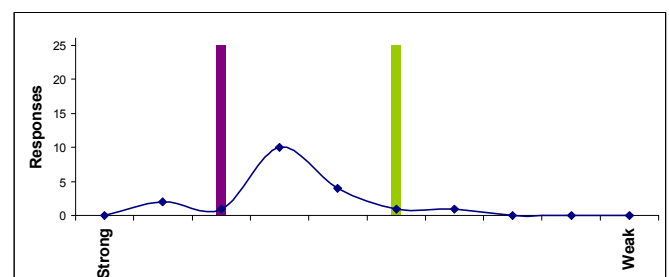
### Renewable Energy/Carbon Targets



Axiom updated to broaden the range for 2014

## 2013 Axioms Abacus

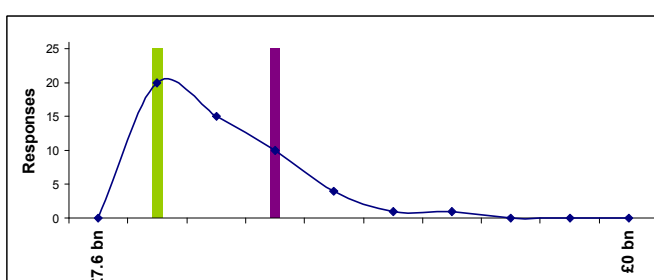
### Government Policy



Axiom range broadly inline with stakeholder views

## 2013 Axioms Abacus

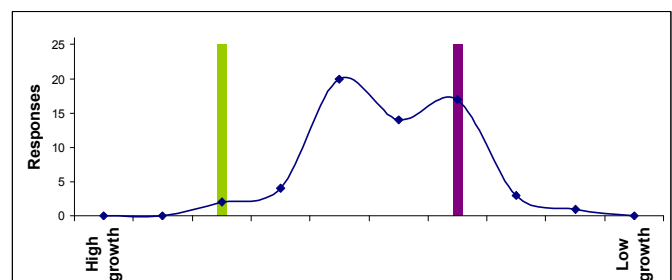
### Levy Control Framework



Axiom removed for 2014 as captured under Government Policy

## 2013 Axioms Abacus

### Economic Outlook

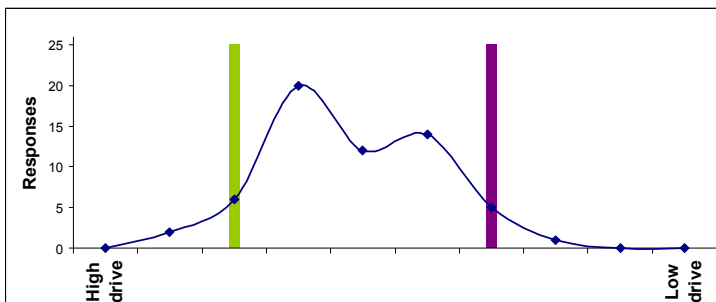


No change to axiom range. Position of high and low case adjusted for 2014 inline with stakeholder views and expert advice.

# Appendix 2 continued...

## 2013 Axioms Abacus

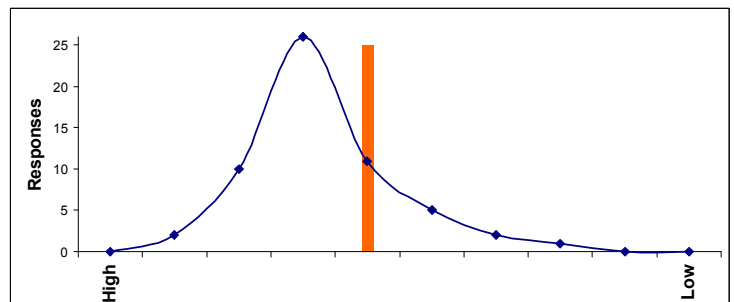
### Energy Efficiency



Minimal change to axiom range; the timing of when certain energy efficiency levels are reached has changed due to introduction of four scenarios for 2014.

## 2013 Axioms Abacus

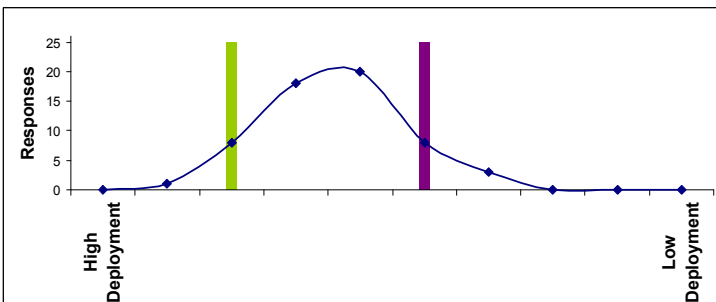
### Fuel Prices



In 2013 there was a single view for Fuel Prices for Slow Prog. and Gone Green. We are introducing a range for 2014 for gas and power prices.

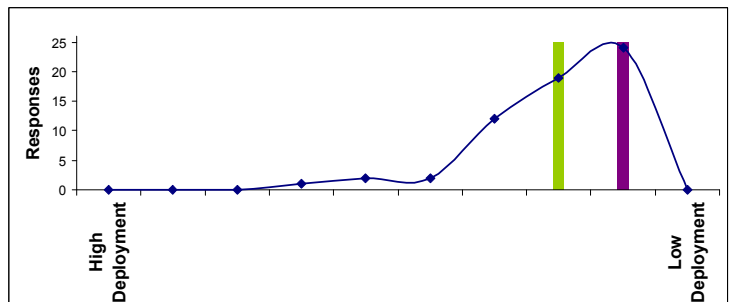
## 2013 Axioms Abacus

### \* Wind Generation



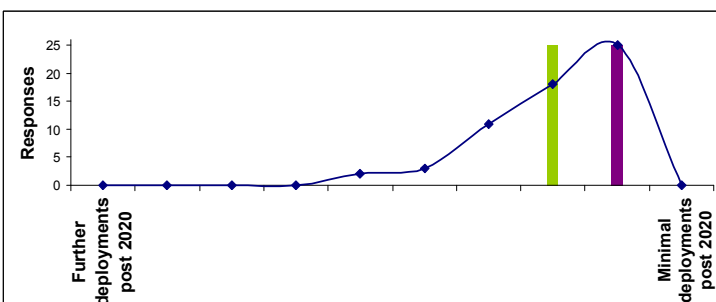
## 2013 Axioms Abacus

### \* Wave and Tidal Generation



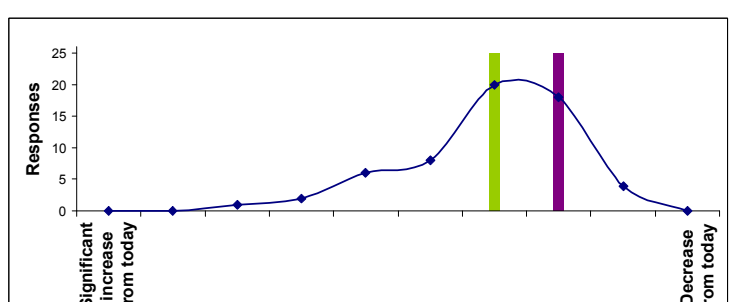
## 2013 Axioms Abacus

### \* Biomass Generation



## 2013 Axioms Abacus

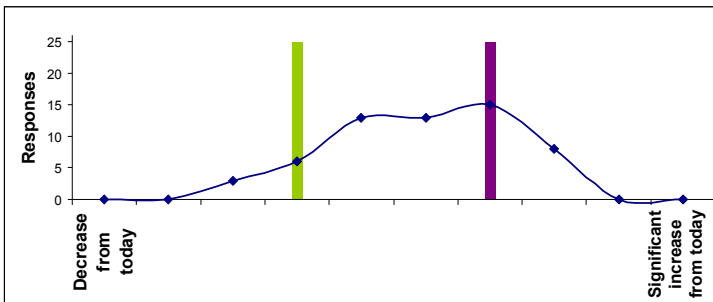
### \* Nuclear Generation



\* For our power supply scenarios there will be a wider range for 2014, due to the development of four scenarios. These scenarios are not yet finalised, however we will incorporate the views of stakeholders and widen the scope of the axioms where applicable.

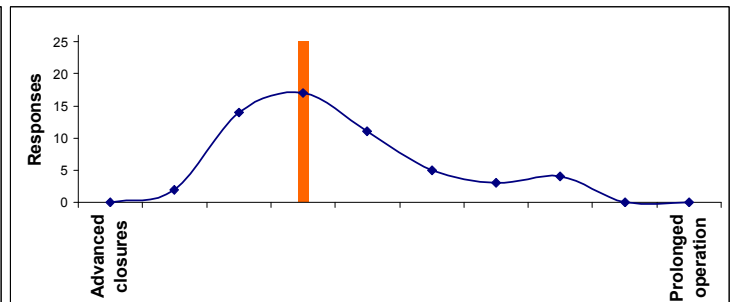
2013 Axioms Abacus

\* CCGT/OCGT Generation



2013 Axioms Abacus

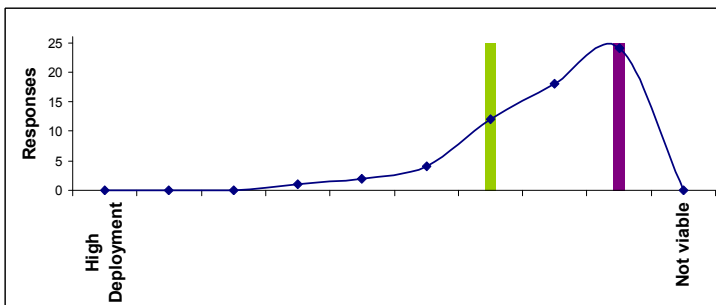
\* Coal Generation



In 2013 there was a single view for Coal Generation for Slow Prog. and Gone Green.

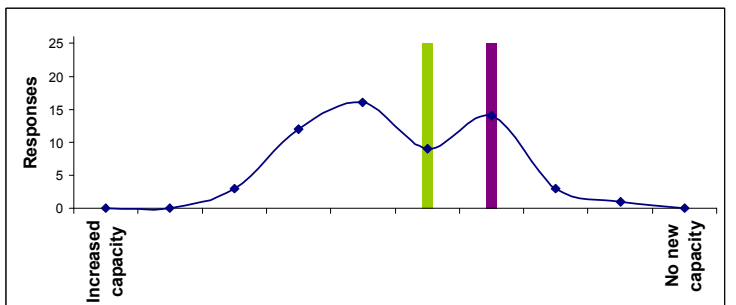
2013 Axioms Abacus

\* CCS Generation



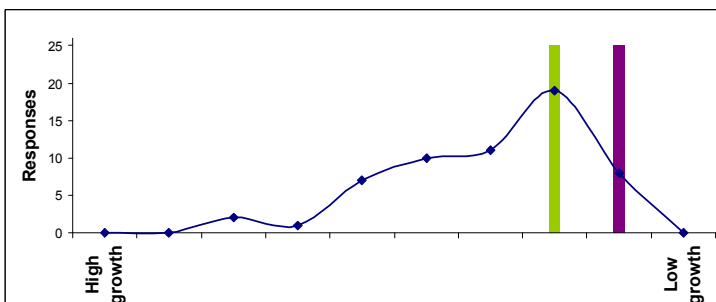
2013 Axioms Abacus

\* Electricity Interconnection



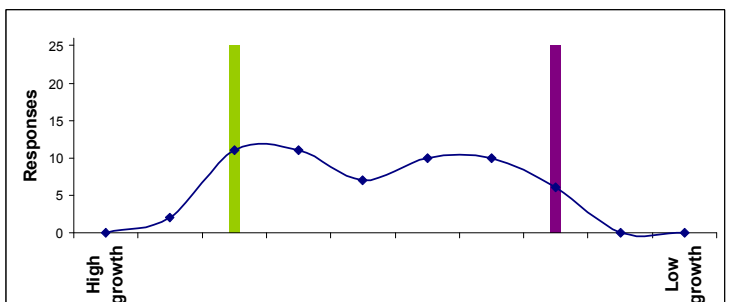
2013 Axioms Abacus

CHP



2013 Axioms Abacus

Microgeneration



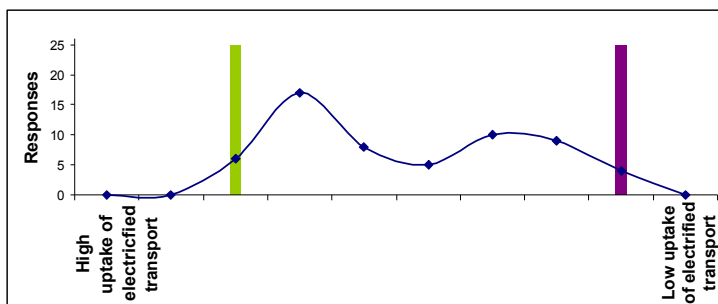
Improved data sources for 2014 resulting in a widening of the range.

No change to axiom for 2014.

# Appendix 2 continued...

## 2013 Axioms Abacus

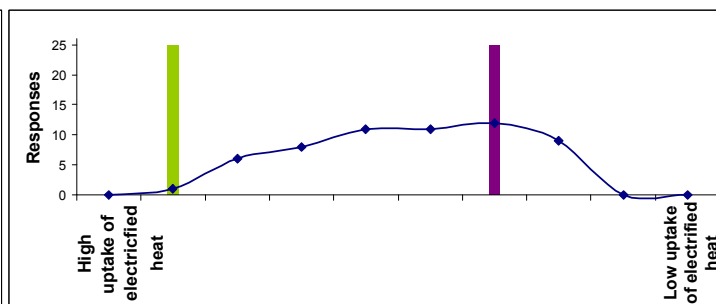
### Transport



No change to rail or electric vehicles for 2014.

## 2013 Axioms Abacus

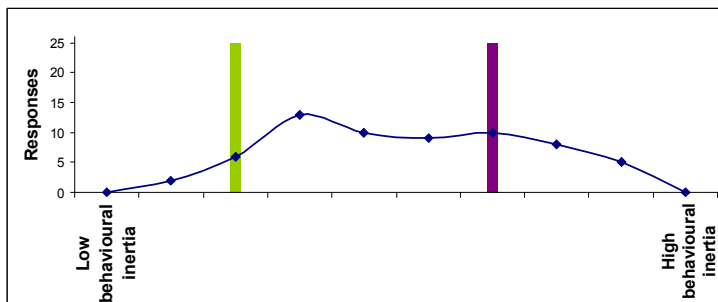
### Heat



Axiom range broadly inline with stakeholder views. No change to the number of heat pumps and resistive electric heating.

## 2013 Axioms Abacus

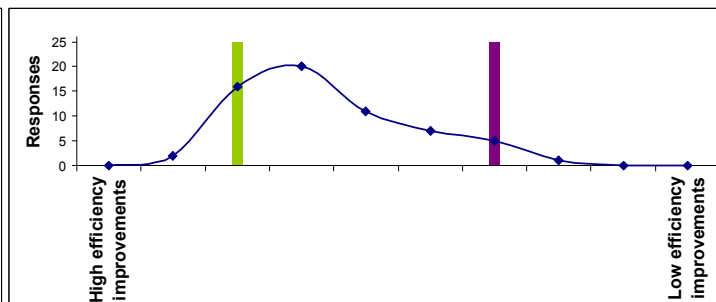
### Energy User Behaviour



Range and maximum amount of peak charging has increased for EVs. No change to appliance numbers. The range for internal temperatures will be capped at a 2°C increase from 2012.

## 2013 Axioms Abacus

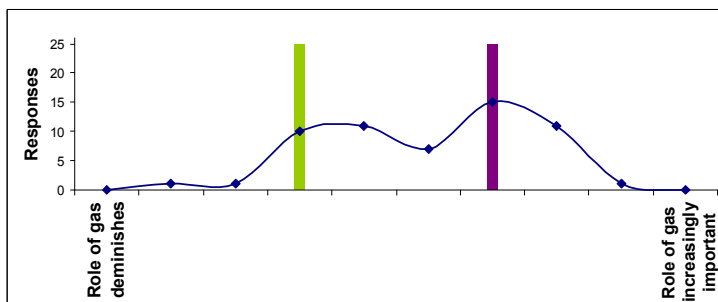
### Commercial energy efficiency



Axiom range remains the same for 2014.

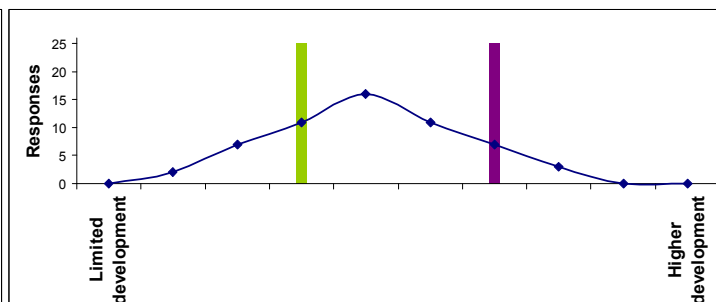
## 2013 Axioms Abacus

### \*\* Global Gas Markets



## 2013 Axioms Abacus

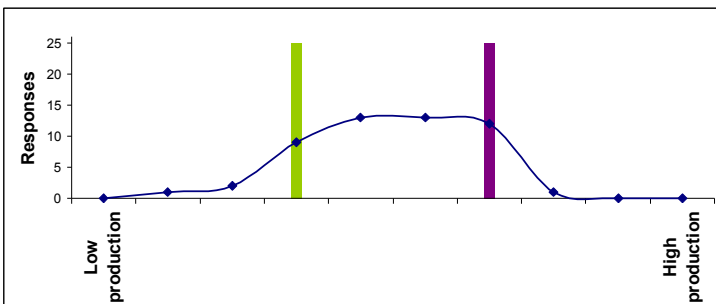
### \*\* Gas Supply (UKCS)



\*\* The Axioms Abacus exercise indicates that the range of axioms for gas supply is broadly inline with stakeholder views. However, we will continue to seek feedback from stakeholders and monitor both UK and International developments in the arena of gas supply.

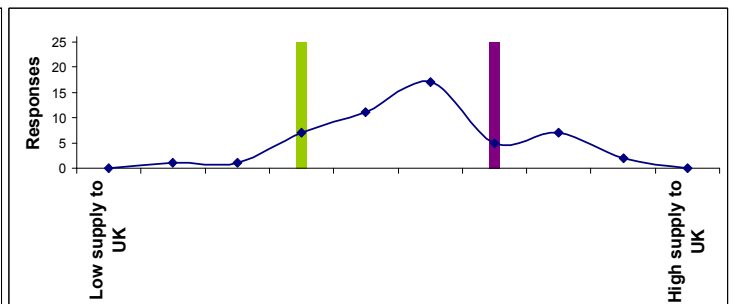
2013 Axioms Abacus

\*\* Gas Supply (Norway)



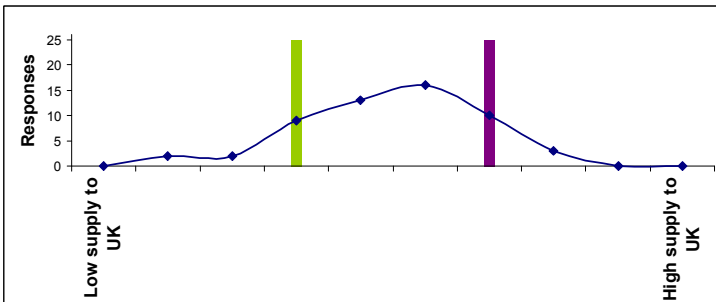
2013 Axioms Abacus

\*\* Gas Supply (LNG)



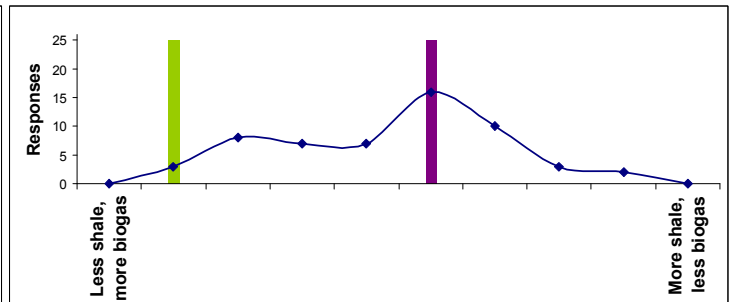
2013 Axioms Abacus

\*\* Gas Supply (Continent)



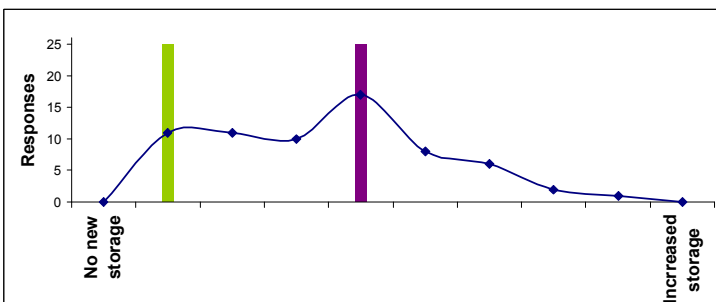
2013 Axioms Abacus

\*\* UK Shale, CBM, Biogas



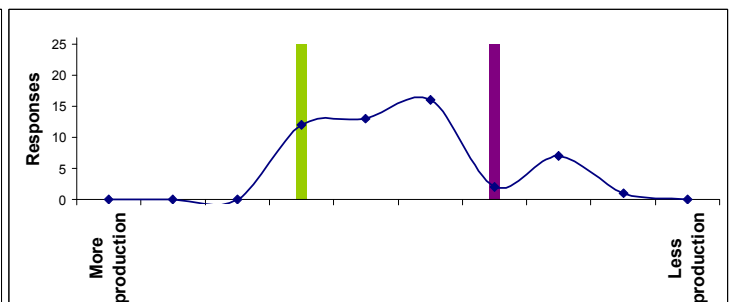
2013 Axioms Abacus

\*\* Gas Storage



2013 Axioms Abacus

\*\* Irish Gas



## Appendix 3: 2014 Axioms

The axioms listed below will underpin our 2014 UK Future Energy Scenarios. An axiom is a premise or starting point of reasoning. It is a logical statement assumed to be true. Our 2014 axioms have been developed through stakeholder workshop and bilateral meetings, specifically influenced by the voting results and axioms abacus, which can be seen in Appendix 1 and Appendix 2.

### Rules

Levy Control Framework	Spend capped at £7.6 billion as agreed within LCF Trajectory out to 2021
Security of Supply	Abide by security standard as prescribed by Secretary of State (currently three hours loss of load expectation)

### Axioms

Number	Title	Low Extreme	High Extreme
1	Renewable Energy/ Carbon Targets	UK 2020 renewables target is missed. Pathway to 2050 falls short of carbon targets and 4th carbon budget. Pressure for UK carbon targets to be abandoned grows.	15% of all energy from Renewable sources by 2020, greenhouse gas emissions meeting the carbon budgets out to 2027, and an 80% reduction in greenhouse gas emissions by 2050.
2	Government Policy (UK & Europe)	EMR mechanisms delivered late and are ineffective. Policy will hinder investment decisions. Policy fails and is weak and ineffective.	EMR mechanisms in place. Policy will drive investment decisions. No mass government intervention in markets. Policy is strong and effective.
3	Economic Outlook	Low economic growth.  Benchmarked against external forecasts.	Moderate economic growth.  Benchmarked against external forecasts.
4	Energy Efficiency incl. commercial	Lower drive for energy efficiency.	Higher drive for energy efficiency.
5		Low fuel prices. Benchmarked against external forecasts.	High fuel prices. Benchmarked against external forecasts.
6	Carbon Price	Low carbon price	High carbon price
7	Wind Generation	Limited deployment.	High deployment in line with targets for 2020. Primary renewable source for meeting the renewable targets.

Number	Title	Low Extreme	High Extreme
8	Solar Generation	Low solar PV growth as incentives (hence returns) reduce.	Continued growth in solar PV driven by falling Installation costs.
9	Hydro Generation	Hydro deployment broadly static.	Hydro deployment minimal growth.
10	Wave & Tidal Generation	Minimal deployment by 2030 (demonstration projects only).	Demonstration projects pre-2020. Limited build-up of capacity post-2020 as costs start to fall.
11	Bio-energy Generation	Limited new build due to financing/fuel source restrictions. Existing/announced projects are completed with some delays. No new dedicated biomass plants. Co-firing is phased out.	Pre-2020 there is stronger development; conversions are favoured over cofiring and dedicated plants. Post-2020, there is modest build of new dedicated plants. Modest deployment of embedded biomass.
12	Nuclear Generation	Further additional Advanced Gas-cooled Reactor (AGR) life extensions. First new nuclear plant delayed to late 2020s with limited deployment thereafter.	Limited additional AGR life extensions. First new nuclear plant slightly delayed to early 2020s. New nuclear deployment increases from late 2020s, as part of a mixed low carbon and renewable generation fleet.
13	CCGTs/OCGTs (unabated)	Existing fleet closes early. Limited new build for gas plant in the near term.	Limited new build in near term. Existing fleet remains on longer than currently anticipated. More aggressive build programme for new fleet.
14	Coal Generation	Advanced closures based on Industrial Emissions Directive (IED) decisions. No new build.	Prolonged operation based on IED decisions. No new build.

## Appendix 3 continued

Number	Title	Low Extreme	High Extreme
15	Carbon Capture & Storage (CCS) generation	CCS is not commercially viable for coal or gas.	Commercial deployment of coal/gas CCS occurs during the 2020s as part of a mixed low carbon and renewable generation fleet, with some deployment of biomass with CCS in the later years.
16	Electricity Interconnection (imports/ exports)	Low interconnection capacity driven by market forces.	High interconnection capacity driven by market forces and government policy.
17	CHP	Limited to existing industrial sites. No domestic district heating schemes.	Continued moderate growth in on-site industrial/ commercial CHP deployment. Some district heating projects pre-2020, moderate growth post-2020.
18	Transport (Road & Rail)	<p>Conventional road transport efficiency improvements continue.</p> <p>Low EV/ plug-in hybrid car uptake rates.</p> <p>Negligible change in HGV/bus fuel sources.</p> <p>Electrification of rail reflecting Network Rail historic trends.</p>	<p>Conventional road transport efficiency improvements continue. Modest EV/ plug-in hybrid car uptake rates pre-2020 driven by incentives. Uptake rate increases through to 2030 as costs become comparative to conventional vehicles.</p> <p>Incremental growth in transition of HGV/bus fleet to CNG/LNG by 2030.</p> <p>Electrification of Rail reflecting Network Rail aspirations and extending to all passenger miles by 2050.</p>
19	Heat	Some conversion of on gas grid properties. Incremental off gas grid deployment of technology at current rates.	Incentives promote wider uptake of low carbon heating technologies in both on gas and off gas grid properties



Number	Title	Low Extreme	High Extreme
20	Energy User Behaviour	The lack of capability or economic incentive at point of use results in high behavioural inertia and little change to energy usage patterns.	Over time, the increasing capability and economic incentives reduce behavioural inertia and drive demand reduction/shifting.
21	Global Gas Markets	Gas increasingly marginalised in global markets, leading to a weak investment climate for global gas supply projects.	Gas increasingly important in global markets, leading to a strong investment climate for global gas supply projects.
22	Gas Supply (UKCS)	Discoveries are less than initially expected. Technical challenges are high increasing the costs of bringing fields to market. Negative investment climate that limits exploration.	Reserves find is greater than expected. Less technical challenges in recovering reserves. Positive climate for investment driving increased exploration activity.
23	Gas Supply (Norway)	Low Norwegian volumes to the UK due to a combination of lower Norwegian production and/or higher flows to the Continent.	High Norwegian volumes to the UK due to a combination of higher Norwegian production and/or lower flows to the Continent
24	Gas Supply (LNG)	Low LNG imports to the UK due to a combination of low global LNG production and/or high demand in global markets.	High LNG imports to the UK due to a combination of high global LNG production and/or low demand in global Markets.
25	Gas Supply (Continent incl. Russian Gas)	Low Continental imports to the UK due to limited access to continental markets and/or limited investment in European Supply projects.	High Continental imports to the UK due to increased access to continental markets and/or significant investment in European Supply projects.
26	UK Shale Gas, Coal Bed Methane (CBM) & Biogas	Limited development of UK onshore resources as investment is targeted elsewhere.	High development of UK onshore resources due to a positive investment climate.

# Engagement in 2013

The list below details many of the organisations that engaged with the 2013 UK Future Energy Scenarios process, participating in events such as the 2013 UK FES launch conference or the stakeholder workshops.

We group our stakeholders to help us to understand where their interest lies and ensure we are providing relevant information. Our 7 stakeholder groups are as follows:

**Industry** e.g. Transmission Owners, Interconnectors, Energy Networks Association, ENTSO-E

**Professional Interest Groups** e.g. Consultants, Universities, Professional Bodies, Investors

**Customers** e.g. Generators, Distribution Network Operators, Balancing Service providers

**Government** e.g. MPs/MEPs, DECC, DEFRA,

**Regulators** e.g. Ofgem, ACER

**Social Interest Groups** e.g. RSPB, National Trust

**Consumer Groups** e.g. Which?, community groups

2OC	Drain Centre	Gas Matters
44 Communications	Drax Power	Gasunie transport services
ABB	E.ON	Gazprom Marketing & Trading
Adjacent Power	E.ON Gas Storage	GDF Suez
Alstom Grid	Eclipse Energy	GE Power & Water
AMEC	Ecofys	Gemserv
Axpo	EDF Energy	GEN Nederland
Baringa	EFET	GL Garrad Hassan
BENTEK ENERGY	EIC	GL Noble Denton
BG Group	Electricity Alliance North	Goldman Sachs
Bord Gáis Networks	Electricity North West	GPS PE Pipe Systems
BP Gas Marketing	Electricity Supply Board	Grant Thornton
Brodies LLP	Elxon	Green Alliance
BTM Group	EMEA Smart Grid Practice	GTC
Bundesnetzagentur	ENA	Harper Energy
Business Juice	Energi Danmark	Haven Power
Centrica	Energised Environments	Heating and Hotwater Industry Council
Centrica Storage	Energy and Utilities Alliance	Highview Power
CG Power Solutions UK	Energy Link	Hogan Lovells
Chemical Industries Association	Energy Savings Trust	Holmwood Consulting
Chevron Gas and Midstream	Energy Technologies Institute	Horizon Nuclear Power
Citi Research	Energy UK	Ian Welch Power Consulting
Citigroup Global Markets	Eni UK	Iberdrola
CNG Services	Enstra Consulting	ICIS
Combined Heat & Power Association	ENTSOG	Interconnector
Committee on Climate Change	ESB	J.P. Morgan
Consumer Futures	European Federation of Energy Traders	John Muir Trust
Cornwall Energy	ExxonMobil	JX Nippon Exploration and Production
Crane Building Services & Utilities	Ferranti Computer Systems	Landsvirkjun
CREDIT SUISSE	first.utility	Laser Energy
DECC	Fluxys	Le Fevre Consulting
DNV GL	Forewind	London Energy Consulting
DONG Energy	Fred. Olsen Renewables	Loughborough University
		Macquarie

Major Energy Users Council	Shell
Manx Electricity Authority	Siemens
Marathon Oil	SITA UK
McGraw-Hill	Skanska
MITIE	SLR Consulting
MLB Consultancy	Smart Grid Consultancy
Murphy Group	Societe Generale
MWH	South Hook Gas
National Grid Grain LNG	SSE
New Power	SSE Renewbles
Northern Gas Networks	Stag Energy
npower	Statkraft UK
Ofgem	Statoil
Oil & Gas UK	Storengy UK
Oxford Institute for Energy Studies	Sustainability First
PETRONAS Energy Trading	T4 Sustainability
Pinsent Masons	Teesside Gas Processing Plant
Platts	Tethra Energy
Portland Advisers	The Crown Estate
Power Efficiency	The ENDS Report
Pöyry	The National Trust for Scotland
Renewable Energy Association	Thomson Reuters
Renewable Energy Systems Group	Total Gas & Power
Renewable UK	Tradelink Solutions
Royal Haskoning	TRL
RSPB	UCL
RWE Generation SE	UK Power Networks
RWE nPower	UK Power Reserve
RWE npower Renewables	University of Birmingham
Scotia Gas Networks	University of Durham
Scottish Council for Development and Industry	University of Manchester
Scottish Development International	Utilita
Scottish Enterprise	Utility Week
Scottish Government	Utiyx
Scottish Hydrogen and Fuel Cell Association	Wales & West Utilities
Scottish Parliament	Waters Wye Associates
Scottish Power	Western Power
Scottish Environment Protection Agency	Which?
	Wood Mackenzie
	WWF UK
	Zechstein Energy Storage

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