

2035 - 2050

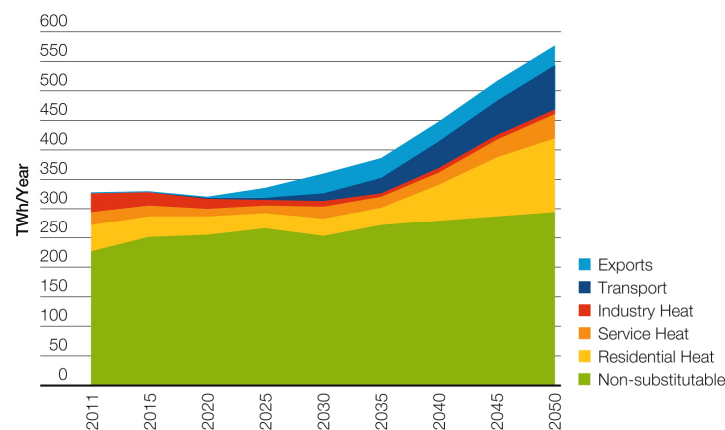
We have taken our Gone Green analysis out to 2050 as it is important to see the level of effort that will be required to meet the 2050 greenhouse gas reduction target

UK Future Energy Scenarios

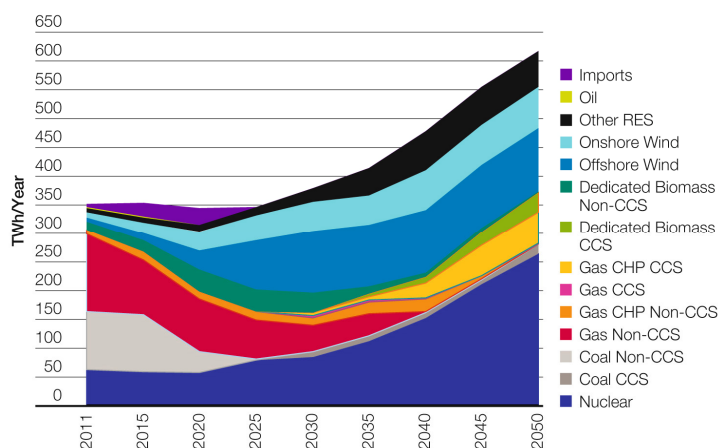
- A significant challenge for National Grid and the UK energy industry is to deliver low carbon energy in an affordable, secure and sustainable way. This is a challenge that will require an estimated £110 billion of investment in electricity generation and transmission up to 2020 to transform the UK's energy infrastructure
- National Grid develops scenarios based on extensive industry and stakeholder feedback which present pathways to decarbonisation. These scenarios are used as a reference point for a range of modelling activities, enabling us to identify strategic network investment requirements for the future
- These scenarios are detailed in our UK Future Energy Scenarios (FES), the latest version of these were published in July 2013.

July 2013

Electricity use to 2050 (see figure 34 in the FES)



Electricity Generation to 2050 (see figure 43 in the FES)



Heat

- The heating market is increasingly dominated by electric heat pumps
- Gas makes up between 10% and 15% of the domestic heat requirement in 2050
- Gas use in industry decreases slightly to 2050

Transport

- Electric vehicles make further inroads into the private car market
- By 2050 there are no conventional fossil fuelled cars left
- There is some fossil fuel left in the car market but this is all used in hybrids
- Pure EV and hybrid vans appear from 2040 onwards and supply over half the van traffic by 2050
- Electric power makes no inroads into the HGV sector

Power Demand

- Demand continues to grow from 2035 to 2050, with significant increases in the domestic heat and transport sectors towards the end of the period

Power Supply

- There is further development of low carbon generation
- The largest growth is in nuclear power but there is continued growth in onshore and offshore wind and other renewables
- There is continued increase in biomass use
- Some gas fired Combined Heat and Power (CHP) is developed in conjunction with heat networks principally supplying the industrial market
- There is very little combustion without Carbon Capture and Storage (CCS)
- Using bio fuels with CCS leads to negative emissions as carbon is taken out of the ecosystem

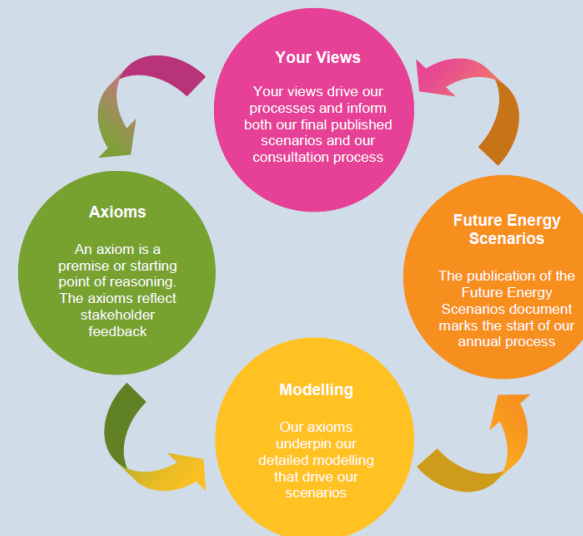
Gas demand

- Demand continues to decline from 2035 to 2050
- Gas use in conventional power generation falls to zero by 2050
- Some gas is retained for heating in the domestic and service sectors and demand declines slowly in the industrial sector

Our Engagement

Over the last year we have undertaken extensive stakeholder engagement. In total we have engaged with over 150 organisations and more than 350 individuals. This has enabled us to take on board the views of our stakeholders when developing our scenarios. The diagram below shows our process of engagement and how stakeholders inform our scenarios.

This robust process of engagement has resulted in continual improvement in the quality of our analysis and a more rigorous challenge and review process. Combined these developments enable the development of our holistic, self-consistent, data rich scenarios.



The release of the 2013 FES marks the start of the next annual cycle in our consultation process in which we will continue to improve our engagement with our stakeholders to develop our 2014 scenarios.

Slow Progression, where developments in renewable and low carbon energy are comparatively slow, and the renewable energy target for 2020 is not met (Slow Progression reaches this level sometime between 2020 and 2025). The carbon reduction target for 2020 is achieved but not the indicative target for 2030.

What's changed since 2012?

- We have retired the Accelerated Growth scenario
- We have instead introduced case studies and sensitivities to ensure we capture potential outcomes versus key uncertainties that push the boundaries of the credible scenario envelope.
- Our axioms have been updated and amended
- Our demand analysis has improved

Principle factors that lead to uncertainty in our scenarios are:

- Political uncertainty, including the effectiveness of policy interventions, particularly those that seek to influence consumer behaviour
- Economic uncertainty and the timing and strength of recovery and the nature of that recovery e.g. the balance of services vs. manufacturing industry
- Social uncertainty and how our choices as consumers will affect the timing and scale of changes in energy demand
- Technology uncertainty in both the supply and demand side and what 'disruptors' may emerge over the next 20 years and beyond.

Our Axioms

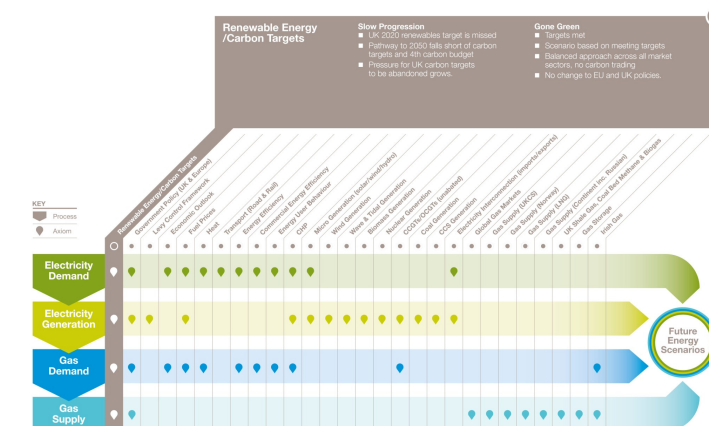
An axiom is a premise or starting point of reasoning assumed to be true. To create our scenarios we have made extensive use of axioms, these have been developed and refined through a series of specifically designed stakeholder workshops and our wider stakeholder engagement.

The axioms map below demonstrates how these axioms flow through our processes to produce the scenarios. An interactive version of this map can be found on the National Grid [website](#).

Our Scenarios

Our scenarios do not predict the future. They explore a range of plausible outcomes and the complete scope of potential drivers that might have an impact on that outcome. We test our scenarios to make sure they are viable. We check credibility of generation load factors and grid operation requirements. This year we have developed two scenarios:

Gone Green has been designed to meet the environmental targets; 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.



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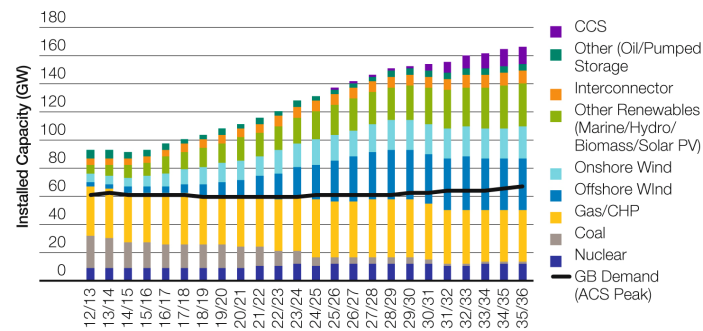
Gone Green 2013

Gone Green represents a balanced approach to meeting renewable energy and CO₂ emission targets in 2020 and 2030

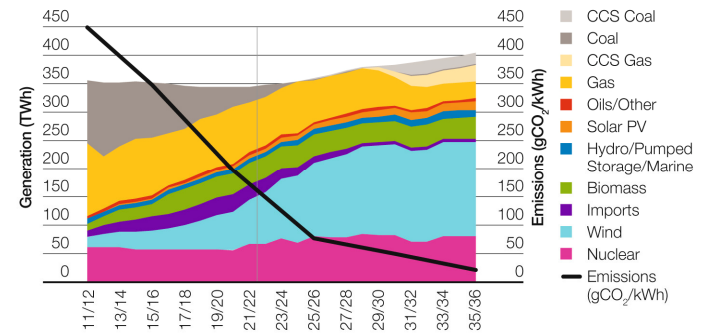
Slow Progression 2013

Slow Progression represents a slower approach to meeting renewable energy and CO₂ emission targets, for example, the UK2020 renewables target is missed and greenhouse gas reductions fall short of the 2050 carbon targets and the 4th carbon budget

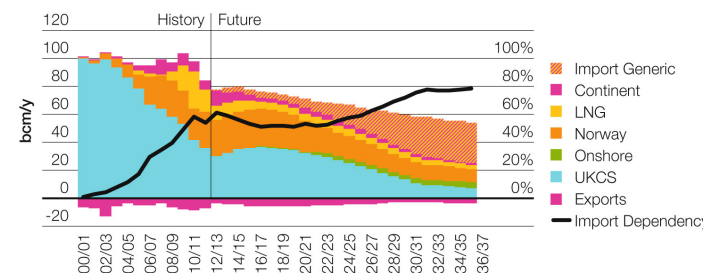
Demand and Generation Background (see figure 36 in the FES)



GB Generation by Fuel Type (see figure 41 in the FES)



Annual Gas Supply (see figure 53 in the FES)



Heat (see section 3.4 of the FES)

- Improved insulation leads to lower electricity demand: **2.6TWh/yr** saved by 2030
- 1.2 million** domestic heat pumps by 2020, **5.7 million** by 2030

Transport (see section 3.6 of the FES)

- 0.56 million** electric vehicles by 2020, **3.2 million** by 2030
- 8TWh** electricity demand in 2030

Consumer (see section 3.5 of the FES)

- Smart meter rollout is completed during 2020, and
- 50%** of consumers are assumed to use time of use tariffs
- By 2030 consumer demand is reduced by **2%** annually and reduced by **4%** at peak (assuming smart appliances)

Power Demand (see section 4.1 of the FES)

- Demand initially rises due to industrial recovery and then falls due to increased energy efficiency measures. Demand increases towards 2030 due to growth in industrial demand, increased population, EVs and heat-pumps.
- These factors offset energy efficiency in the long term

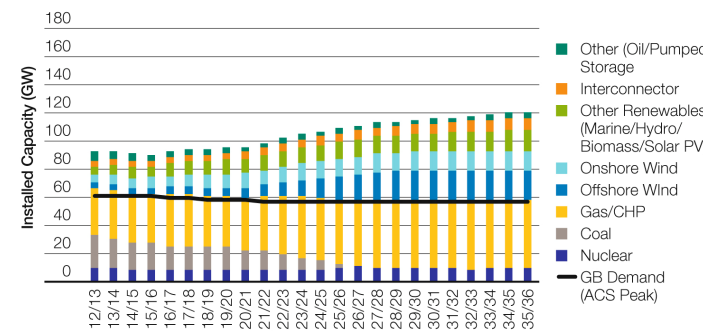
Power Supply (see section 4.2 of the FES)

- 111GW** of GB total installed capacity by 2020 of which **42GW** of this is renewable
- Total wind capacity (including embedded) increases from current levels of around **9GW** to **26GW** in 2020 and **59GW** in 2035 (**21GW** onshore and **38GW** offshore)
- 20GW** of solar PV installed by 2035
- AGR (advanced gas-cooled reactor) nuclear plant receives **7 year** life extension
- First new nuclear plant connects in the early 2020s contributing to an overall increase in nuclear capacity by 2035 of **2GW**
- Most existing unabated plant is closed by the mid 2020s resulting in total unabated coal installed capacity in 2030 of around **2GW**
- 6GW** of coal with CCS (Carbon Capture & Storage) connects by 2035
- Gas-fired capacity increases by a total of **2GW** by 2035
- CCS build from the mid 2020s results in a total installed capacity for gas CCS of around **6GW** by 2035
- GB becomes a net exporter by the mid 2020s predominantly due to large increases in GB renewable generation
- 7GW** of biomass by 2035

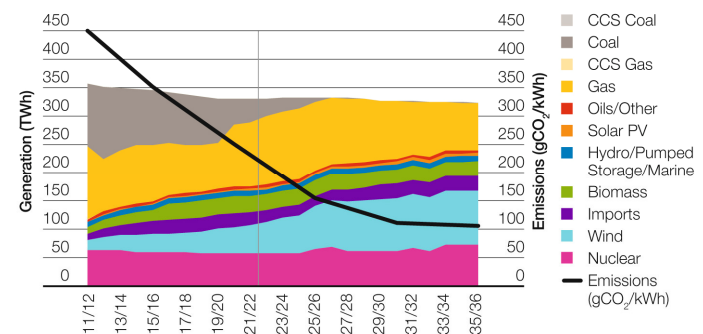
Gas Demand & Supply (see section 4.3 & 4.4 of the FES)

- Gas demand declines in domestic, industrial & commercial and power generation post 2020 leading to a steadily reducing total gas demand
- Limited gas in new homes
- By 2020 the UK is **53%** gas import dependent, increasing to **79%** by 2035
- Global market dynamics lead to considerable uncertainty over the split of Continental/ LNG imports
- Need for flexible supplies/ storage
- Potential for UK biogas developments

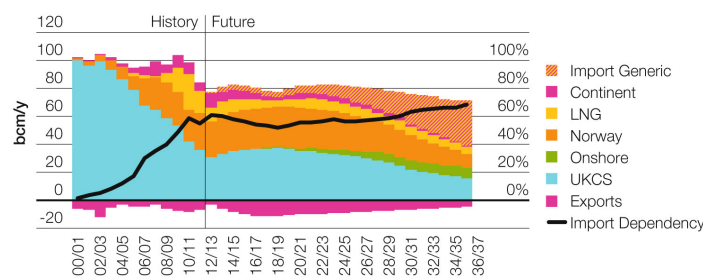
Demand and Generation Background (see figure 35 in the FES)



GB Generation by Fuel Type (see figure 40 in the FES)



Annual Gas Supply (see figure 52 in the FES)



Heat (see section 3.4 of the FES)

- Improved insulation leads to lower electricity demand: **0.6TWh/yr** saved by 2030
- 0.3 million** domestic heat pumps by 2020, **0.6 million** by 2030

Transport (see section 3.6 of the FES)

- 0.16 million** electric vehicles by 2020, **0.9 million** by 2030
- 2TWh** electricity demand in 2030

Consumer (see section 3.5 of the FES)

- Smart meter rollout is completed during 2032, and
- 25%** of consumers are assumed to use time of use tariffs
- By 2030 consumer demand is reduced by **0.2%** annually and reduced by **1%** at peak (no smart appliances)

Power Demand (see section 4.1 of the FES)

- Residential demand climbs post 2020 due to less development in the efficiency of appliances and population growth
- Total demand falls mainly due to declines in the Industrial & Commercial sectors due to less favourable economic conditions

Power Supply (see section 4.2 of the FES)

- 96GW** of GB total installed capacity by 2020 of which **28GW** of this is renewable
- Total wind capacity (including embedded) increases from current levels of around **9GW** to **18GW** in 2020 and **35GW** in 2035 (**14GW** onshore and **21GW** offshore)
- 8GW** of solar PV installed by 2035
- AGR nuclear plant receives **10 year** life extension
- First new nuclear plant connects in the mid 2020s contributing to an overall increase in nuclear capacity by 2035 of **1GW**
- Rapid decrease in the level of coal generation capacity with all plant closing by 2026/27 showing a **23GW** decrease on current levels
- Gas-fired capacity increases by a total of **14GW** by 2035
- No Carbon Capture & Storage
- Net importer of electricity to 2035, by which point net annual imports could rise by over **50%** of current levels
- 5GW** of biomass by 2035

Gas Demand & Supply (see section 4.3 & 4.4 of the FES)

- High proportion of homes, including new builds, continue to be heated by gas boilers leading to higher demand compared to Gone Green
- The UK is very well supplied from UK Continental Shelf (UKCS) and other imports in the years to 2020, with some decline in demand during this period
- By 2020 the UK is **55%** gas import dependent, increasing to **68%** by 2035
- Global market dynamics lead to considerable uncertainty over the split of Continental/ LNG imports
- Need for flexible supplies/ storage
- Potential for UK Shale gas development