Ofgem, 'Project Discovery' (2009)

1. Purpose of the activity

Project Discovery was launched with the objective of examining the prospects for secure and sustainable energy supplies over the next 10-15 years. The work sought to put the debate regarding UK energy in the wider global and environmental context.

Four scenarios were developed for the next decade and beyond; these were - Green Transition, Green Stimulus, Dash for Energy and Slow Growth. The scenarios were subject to a series of `stress tests' in terms of their impact on - level of investment required, gas import dependancy and carbon dioxide emissions. The stress tests described in the Project Discovery report include Re-directon of LNG supplies, Russi-Ukraine dispute, Bacton Outage, No wind output and Electrcity interconnectors fully exporting (though others were undertaken these were not detailed in the report).

The scenario described in detail below is `Green Transition'.

2. Model / scenario description

a) timespan and region	2025, UK
b) scenario type	Forecasting; Quantitaive; Normative; Expert; Whole Energy System.
c) what the approach has been designed to achieve	The intention was not to construct a central case or best estimate of the shape of the future of the energy market but to reflect what Ofgem viewed as reasonable outcomes subject to given global conditions. The scenarios were also not developed with extremes in mind. Scenarios based on 2 key drivers – the speed of the global economic recovery (ER) and the extent of the globally co-ordinated environmental action (EA). The combination of these drivers yielded the four scenarios of: Green Transition (Rapid EA & ER), Green Stimulus (Rapid EA & Slow ER), Dash for Energy (Slow ER and Rapid ER) and Slow Growth (Slow EA & Slow ER). From the scenarios the prospects for secure and sustainable supplies for the next 10-15 years were assessed within a global and environmental context. The analysis demonstrates the scale of the response required to meet demand, including the levels of investment to deliver the envisaged scenario outcomes.
d) description of modelling method	The scenarios assume that market participants respond immediately to market signals within a purely economic rational. Where energy supply is scarce and a response on demand side is required, the model allocates energy to customers that most value it, and in the form (i.e. electricty or gas) that they most value.
e) references, links	Report and other material available from http://www.ofgem.gov.uk/markets/whlmkts/discovery/Pages/ProjectDiscovery.aspx

3. Key Assumptions

a) carbon& energy prices	Commodity prices are a reflection of differing levels of demand and investment under the four scenarios; they are not intended to capture the full extent of price volatility but rather a starting point from which to understand the impact of a plausible range of commodity price outcomes. The Green Transition invisages a wold of lower and less volatile oil prices ($60bbl (2010) to $90 (2025)) which are dampend in the longer term by a global shift towards alternative energy sources. In all scenarios gas prices rise in line with oil due to contractual linkage of gas prices in Europe ($45/t (2010) to $72 (2025)). Coal is made competive with gas on a short-run basis in the generation sector, taking into account the cost of carbon ($80/t for 2010 and 2025). The carbon prices are assumed to rise to €50/t by 2025 (from €17/t in 2010) as a result of the tightening of the EU ETS and achieving a global agreement on climate change at Copenhagen. Data was obtained form publicly available UK Government derived sources, published reports and engagement with external parties and advisors. Variable data for carbon price, technology development and system constraints according to scenario.
b) final energy demand	Total energy demand is lower towards the end of the next decade. UK gas demand falls but electricity demand grows on the back of wider deployment of heat pumps and electric vehicles. Energy efficiency results in 0.75% reduction in gas demand annually. Electricity efficiency assumptions results in 1.5% reduction in demand annually.
c) economic conditions	There is a rapid economic recovery and significant new investment globally.
d) social conditions	Not specified.
e) learning rates	Not specified.
f) technology costs	To measure impact on prices Ofgem projects total investment required under each scenario and estimate the impact of the scenarios on whole sale electricity prices. Costs were converted into typical domestic consumer bills for electricity and gas, taking into account expected reductions in consumption over time through energy efficiency measures.
g) policies	- A global agreement on tackling climate change is reached leading to 30% reduction carbon dioxide emissions from 1990 by 2020. - Energy efficiency measures are effective. - New nuclear and CCS demonstration projects come on-line before 2020, supported by high carbon prices and/or additional subsidy.

4. Outputs

<table>
<tr><td>(a) final energy demand overall;</td><td>Demand for electricity stands at 372 TWh in 2025 (357 TWh in 2020). There was no break down for heat, transport and heat.</td></tr>
<tr><td>(b) how demands were met by fuel</td><td>In 2025 electricity demand is met by the following generation capacity and corresponding generation output:
<table>
<tr><th></th><th>Generation capacity (GW)</th><th>Generation output (TWh)</th></tr>
<tr><td>CCGT</td><td>27.028</td><td>71.9</td></tr>
<tr><td>Oil</td><td>0</td><td>0</td></tr>
<tr><td>CHP</td><td>4.85</td><td>19.4</td></tr>
<tr><td>Coal</td><td>18.367</td><td>44.5</td></tr>
<tr><td>Nuclear</td><td>7.590</td><td>57.8</td></tr>
<tr><td>Wind</td><td>32.836</td><td>95.5</td></tr>
<tr><td>Other renewables</td><td>7.604</td><td>28.7</td></tr>
<tr><td>Pumped Storage</td><td>2.690</td><td></td></tr>
<tr><td>Interconnectors</td><td>3.500</td><td>Imports of 2.0</td></tr>
<tr><td colspan="3">Additional generation capacity included 50 TWh from CCS and 1.1 TWh from others.</td></tr>
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<tr><td>(c) power generation by technology</td><td>In 2025 power generation for electricity from technology would be:
- 2 x 400MW CCS plants; 2 x 1.6 GW fully retrofitted and 2 x 1.6GW of fully CCS plant;
- 4 x 1.6 GW nuclear.
- Proportion from Renewable electricity in 2025 35%;
- Proportion from Renewable Heat in 2025 18%.</td></tr>
<tr><td>(d) role for bioenergy</td><td>Role of bio-energy - not explicitly disclosed though likely to be a part of the 4.85 GW of CHP.</td></tr>
<tr><td>(e) role of enabling technologies</td><td>Pumped storage at 2.690 GW.
The role of smart grids is not explicitly cited other than having an impact on electricity demand but investment in smart technologies is cited as increasing from £0 in 2010 to £10 Bn in 2020 in the Green Transition Scenario.</td></tr>
<tr><td>(f) extent of decentralised energy production and role of CHP</td><td>4.85 GW of CHP in the Green Transition scenario.</td></tr>
<tr><td>(g) costs of achieving goals</td><td>For the Green Transition the following cumulative investments are made across energy system (Nuclear, Renewables, CCS, CCGT, T&D, Interconnectors, Energy Efficiency, Renewable Heat, LNG Terminals, Gas Storage, SCR, Smart Meters) within the modelled timeframe:
<table>
<tr><td>2010</td><td>£ 14.1 Bn</td></tr>
<tr><td>2015</td><td>£ 77.7 Bn</td></tr>
<tr><td>2020</td><td>£ 199.0 Bn</td></tr>
<tr><td>2025</td><td>£ 240.4 Bn</td></tr>
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5. Key messages

The key messages from the report are:

- Each scenario shows that energy supplies can be maintained, but the analysis exposes real risks to supplies, potential price rises and varying carbon impacts.

- Retirements of older nuclear plant and closures of coal and oil plant by the end of 2015 under European environmental legislation could pose a threat to security of supply. Increasing gas import dependency could be exacerbated by growth in gas-fired power generation. Significant changes in the way in which the UK generates and consumes power may be needed to manage the variability associated with increasing reliance on wind power.
- High levels of investment are likely to be needed to secure energy supplies and meet carbon targets – up to £200 billion may be required over the next 10-15 years. This would more than double the recent rate of investment.
- Consumer bills rise in all scenarios due to the levels of new investment required and increasing costs of carbon, and especially so if oil and gas spot prices spike sharply or continue their underlying rise since 2003.
- Existing regulatory and market arrangements may well be seriously tested.

Under the Green Transition scenario, the EU renewables target and the Government's carbon budgets are met, but at a cost to consumers in the near term who would be required to fund the investment. This scenario is generally favourable to security of supply due to a combination of falling demand through energy efficiency measures and the stimulated investment in new renewables and CCS capacity. With new nuclear as well, the generation mix is well diversified in this scenario relative to the Slow Growth and Dash for Energy scenarios. The greatest risk to security of supply would be from intermittency of renewables generation, although with a more responsive demand side enabled by new technologies such as smart meters, the market's ability to manage potential shortfalls should be enhanced.

Electricity Generation:

- Gas imports increase until 2016 and then stabilise.
- Diverse generation mix.
- Risk from generation intermittency towards the end of the period due to high levels of wind generation;
- 2020 renewable targets met: 30% electricity;
- Carbon dioxide emissions from the electricity and gas sectors: down 33% from 2005 levels;
- Domestic consumer bills: increase by 23% by 2020.
- Total investment costs 2009-2020: £200 Bn

Transport:

- Demand side increase due to heat pumps and electric vehicles in 2025 (61.6 TWh).

Energy Efficiency and Heat:

- 2020 renewable targets met: 12% heat and energy efficiency measures are effective, and carbon dioxide emissions reduce rapidly.

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