# Foresight, 'Sustainable Energy and the Built Environment' (2009)

## 1. Purpose of the activity

The work is framed as follows `The UK is entering a period of energy transition. The main forces driving change are a growing consensus about the scale and importance of climate change, and the need to ensure secure energy supplies for the UK in the face of rising global demand. There is an urgent imperative to re-shape policy in order to decarbonise the energy we use and to secure sustainable supplies for the long term. Achieving these goals will require attention to the relationships between energy systems, the built environment, and the human activities within it, since half of all UK carbon emissions come from energy used in buildings'.

The work targeted cross-cutting issues and used a co-evolutionary framework to examine the interdependencies between social, political, economic and technological aspects of energy use, energy generation and the built environment. It defined the drivers as climate change and the need to decarbonise, energy security and fuel poverty. To assist the understanding of possibilities, and the opportunities and risks of the interventions of dealing with these issues might bring, the project developed a set of long term scenarios. The scenarios are based on a 2x2 axes of projections based on the degree of international co-operation (political and economic dimension) and degree of use of disruptive technologies (innovation investment). The scenarios are:

- Resourceful Regions - optimising of existing systems preferred / bounded and independent co-operation;
- Carbon Creativity - optimising of existing systems preferred / open and interdependent co-operation;
- Sunshine State - development of new systems preferred / bounded and independent co-operation; and
- Green Growth - development of new systems preferred / open and interdependent co-operation.

These informed narratives highlight the different mixes of energy supply and different approaches to developing the built environment. The scenario described in detail below is `Green Growth'.

## 2. Model / scenario description

| | |
|---|---|
| a) timespan and region | 2050, UK |
| b) scenario type: | Qualitative, descriptive forecasting scenarios[1] based on a review of the evidence base. Scenario development was participatory with technology roadmap workshops being used to derive a qualitative exploration of future uncertainties and opportunities in order to undertake an assessment of the analysis of and implications for policy makers. Sector-specific, focusing on built environment. |
| c) what the approach has been designed to achieve. | To provide a tool to allow stakeholders from government and other organisations to explore and discuss the development of their policies and strategies. The project itself was concerned with the opportunities and challenges for the UK built environment, over the next five decades, to respond to, and shape, changing energy systems. With the focus being on determining how change in the built environment can contribute to decarbonisation and other energy policy goals. |

[1] As defined for this analysis, the Foresight report is a 'forecasting' exercise, but as quoted on p11 of the report *"Foresight scenarios are neither predictions nor forecasts, nor comprehensive critiques. They are informed narratives, developed to support a systematic exploration of possible futures with the aim of helping to make current policies robust and resilient to future change."*

| | |
|---|---|
| d) description of modelling method | - Descriptive method which involved the combining of robust scientific and other evidence with well informed futures thinking, to inform and influence policy development in government.<br>- For the project eight workshops brought together experts, stakeholders, policy makers and professionals to develop an understanding of the key drivers of future change, possible technology trajectories, and to shape and test the scenarios.<br>- Specifically targeted at cross-cutting issues and conducted in a framework of co-evolution to highlight interdependencies between social, political, economic and technological aspects of energy use, energy generation and built environment.<br>- Highly descriptive. No system modelling or testing the viability of the fuel mix or supply portfolio. Cost of options is not considered. Some of the proposed energy / generation sources may not be viable. Focuses predominantly on the built environment.<br>- Simple use of narratives and extrapolation of present policy issues with the state of the energy system and built environment across 4 different scenarios allows the extent of policy change needed to attain emissions reductions to be highlighted. |
| e) references, links | Main report and supporting papers available from http://www.bis.gov.uk/foresight/our-work/projects/current-projects/sustainable-energy-management-and-the-built-environment/reports-and-publications. |

## 3. Key Assumptions

| | |
|---|---|
| a) carbon & energy prices | - A substantial carbon tax to drive change.<br>- No stated energy prices though the Green Growth Scenario is stated as coming about by increasing energy costs driven by rising demand and shrinking supplies of fossil based fuel.<br>- Projections of the mix of fuels to supply energy, and to generate electricity were estimated, relative to 2007 DUKES data, for each scenario for 2050. Scenario figures are based on the Foresight project team's assumptions of energy demand reflected in the narratives of each scenario. |
| b) final energy demand | A reduction in energy demand is achieved by regulation such as banning air conditioning and heat dumping and the development of technologies that obviate need to travel . |
| c) economic conditions | Emphasis on decoupling economic growth from carbon emissions. |
| d) social conditions | Social values emphasise universalism and benevolence. People take responsibility for their energy use supported by energy avatars and have become much more active and engaged consumers. |
| e) learning rates | Fossil fuel depletion and climate change are serious concerns; novel technologies and systems are regarded as the way to deal with them. |
| f) technology costs | Not considered. Though for Green Growth the use of technology to reduce energy losses and emissions from buildings and travel is considered vital; technology is also used by energy avatars. |

| | |
|---|---|
| g) policies | - Regulation has resulted in closed loop production systems and whole-system approach has become the norm.<br>- Regulations to require full-service approach to both construction and management of new buildings. In housing, `generation skipping' is introduced which results in whole scale demolition programmes of old inefficient housing to be replaced by zero-carbon housing. There is less of an emphasis on retro-fitting existing housing.<br>- Banning of air conditioning systems.<br>- Strategic Planning Framework gives the government the power to improve large scale development on local areas.<br>- The role of financial incentives is stated as having a significant role. |

## 4. Outputs

| | |
|---|---|
| (a) final energy demand overall; | Not stated explicitly. In Green Growth there is a significant reduction in the total share of fossil fuels which are replaced by renewable and electricity imports. |
| (b) how demands were met by fuel | - New generation of zero emission housing and off-site construction techniques plus demolition of obsolete stock. Regulation of construction and development activity for energy service management.<br>- Variable road pricing and Pay as you go car clubs reduce transport energy needs. Development of lower emissions and electric vehicles and reduced personal car use also contribute.<br><br>Primary energy demand in 2050 generated by:<br>Coal 6 %<br>Oil 14 %<br>Gas 9 %<br>Nuclear 3 %<br>Renewables 47 %<br>Net Electricity Imports 21 % |
| (c) power generation by technology | Includes Severn tidal barrage; electricity from hydro-electric power in the Pyrenees and Saharan solar arrays.<br><br>Nuclear is pushed out of the mix, except as a transitional technology, due to the amount of investment a nuclear programme requires would squeeze out investment in large scale renewable. Nuclear fusion technology R&D is maintained. |
| (d) role for bioenergy | No discussion on bio-energy. Though by 2058 bio-tech is stated as having possibly created a fuel which can power vehicles effectively. |
| (e) role of enabling technologies | Smart centralised power systems allow demand side management to the extent that grid operators can switch off appliances and prevent certain devices being switched on at times of peak load. |
| (f) extent of decentralised energy production and role of CHP | The Green Growth scenario displays considerably more decentralised energy system than current system. These, however, fail to compete on price with large scale renewables but are used to manage power outages which result from the immature state of grid management from the high proportion of renewables. |
| (g) costs | Not explicitly stated. |

## 5. Key messages

The analysis concludes that the key strategic challenges (within energy systems, the built environment and human activities within it) are:

- overcoming the lock-in to current centralised systems;
- enabling greater activity at a wider range of scales;
- exploiting an improved understanding of social and psychological components of energy behaviours to encourage engagement with decarbonisation; and
- assessing security and resilience matters in an appropriately integrated way.

It also draws attention to significant implementation challenges:

- upgrading buildings, places, and spaces;
- encouraging innovative development and construction industries;
- building the evidence base and fostering effective policies; and
- leading by example across government and the public sector.

***Mark Workman, ERP Analysis Team***
***October 2010***