Cabinet Office Performance and Innovation Unit

Renewable Electricity Entry Scenarios

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1. Introduction

This note presents the results of modelling of policy criteria in relation to the market support of renewable electricity generation.

The modelling presented in this note is based on a modified version of the OXERA Renewable Energy Model. The modifications are:

- removal of the Renewables Obligation Certificate (ROC) system and its replacement with a fixed uplift on the electricity price of between 10 and 30 £/MWh; and
- the use of generally non-binding build rate limits of 2 GW/year for onshore wind, 2 GW/year for offshore wind, 500 MW/year for energy crops, for 300 MW/year for marine technologies. In the first four or five years from 2001 these lower build rates have been used. Nevertheless, these build rates would be widely thought to be infeasible, especially in the early years of the period, if not throughout it. The purpose of setting a very high cap on rates is to observe the price effect of changing the level of price uplift without the interference of imposed quantity restrictions. This approach to the modelling is appropriate for assessing the costs of achieving different targets.

There are the following important caveats attached to the results presented in this note.

- The renewables entry cost estimates and technology trends are those selected by the Cabinet Office. Where possible OXERA has checked the current entry costs against published sources.

- The scenarios of accessible resources have been agreed in discussion with the Cabinet Office. They do not represent OXERA's view. However, OXERA has

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compared the assumptions with other sources in order to confirm that they are not unreasonable. Planning restrictions and other determinants of capacity built are incorporated into these resource assumptions.

- It is very difficult to forecast entry costs in the future, and even costs today are not well characterised, although they may be well known between the contracting parties developing renewables projects. For these reasons alone, there is considerable uncertainty surrounding the results presented in this paper. The use of scenarios and selections of assumptions give some indication of the ranges in plausible results, however, no confidence limits have been placed around the results, so they should be used with caution.

- Where the results indicate large volumes of new build, then there may be impacts on the wholesale prices obtained, the prices of other fuels, and network costs, none of which have been considered in this note.

- In presenting these results, OXERA is not presenting a forecast. In particular, it is not suggesting that private industry will decide to build new renewables capacity or that planning authorities will allow capacity to be built at the rates necessary to achieve these results. Therefore, these results should not be taken to suggest that, for example, the UK's 10% renewables target for 2010 will or will not be achieved.

In the low scenario, renewable electricity generated figures are quoted as a percentage of 341 TWh—the electricity supplied in 2020 in the PIU's 'global sustainability' scenario.

In the high scenario, renewable electricity generated figures are quoted as a percentage of 459 TWh—the electricity supplied in 2020 in the PIU's 'world markets' scenario.

Each scenario is modelled for three sets of assumptions: a benchmark, fast technical change, and low wind resource availability—these relate to assumptions laid out in the tables in section 5. The high scenario is also modelled for assumptions of the benchmark with an extra 1 GW of energy from waste capacity. An introduction to the assumptions is given in the paper dated July 11th 2001.

The main points arising from the modelling are as follows.

- The cost of achieving 10% in 2010 is £480m–650m, or about 2% of the household bill, for the low and high scenarios, respectively. This is lower than the DTI's published estimate, because it counts only the *cost* of the generation in excess of £20/MWh.

- The cost of achieving 30% in 2020 is £1,300m–2,000m, or between 5% and above 7% of the household bill, for the low and high scenarios, respectively.

The cost of government grants to support photovoltaics (PV) has not been included. These will be determined by government decision, and cannot be estimated by modelling.

The charts that follow show the results for 2010 (high and low scenarios), and 2020 (high and low scenarios). Within each chart, the results from the alternative assumptions are shown. The charts show the costs expressed as an increase in the household electricity bill, as a supplement to electricity prices in £/MWh or p/kWh, and converted into a carbon tax equivalent, £/tC.

2. Results for 2010

Figure 2.1a: High scenario, variation of generation output with price uplift

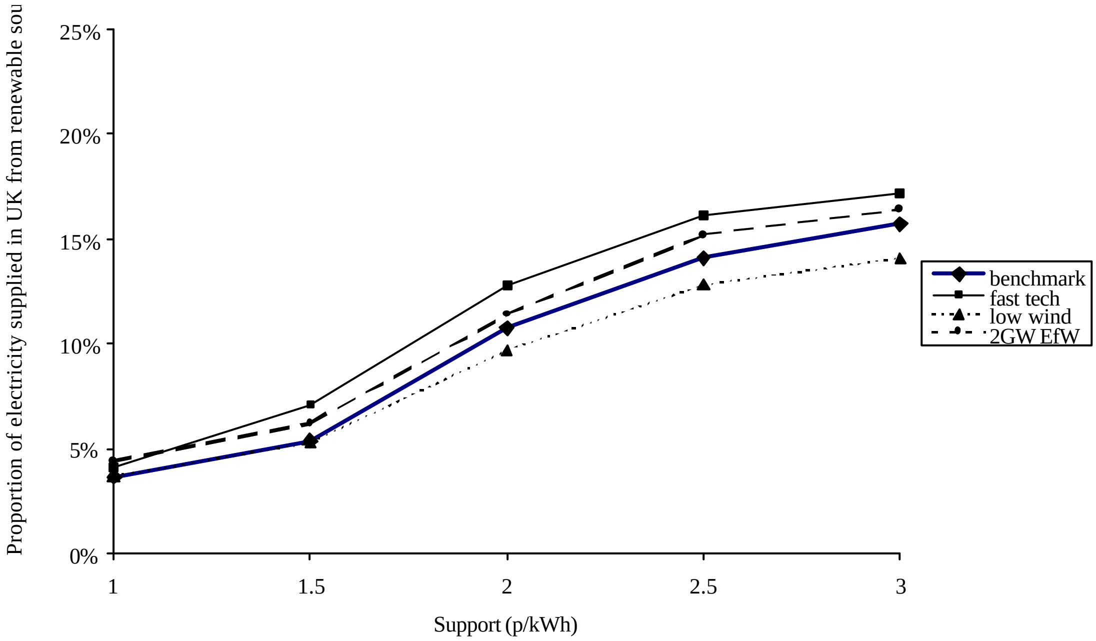


Figure 2.1b: Low scenario, variation of generation output with price uplift

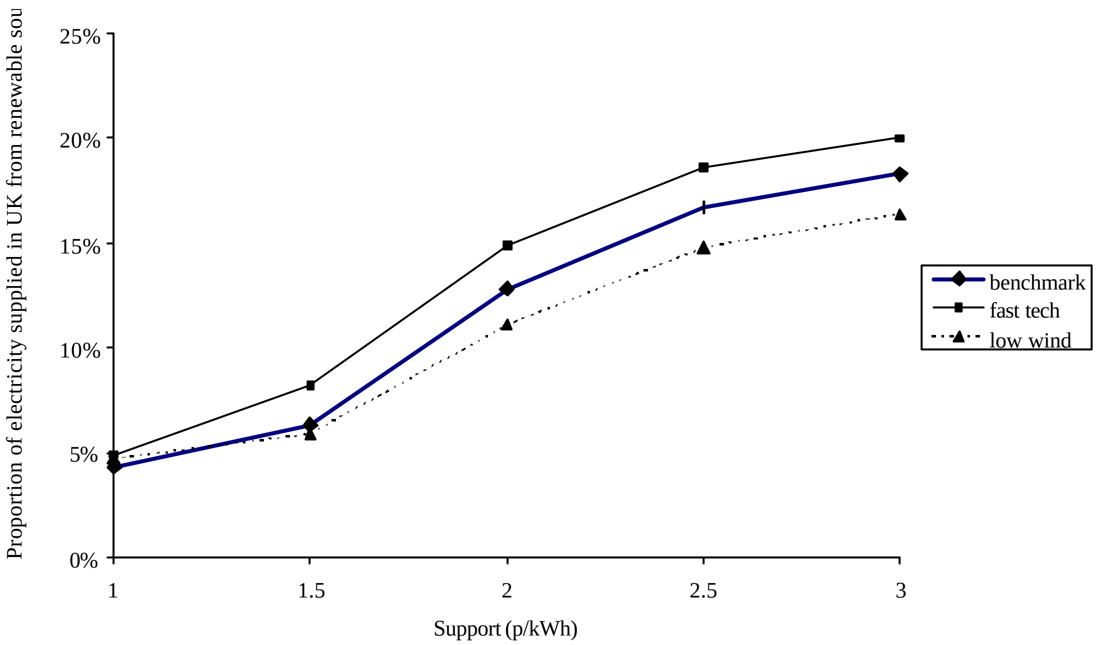


Figure 2.2a: High scenario, variation of generation output with cost to customers

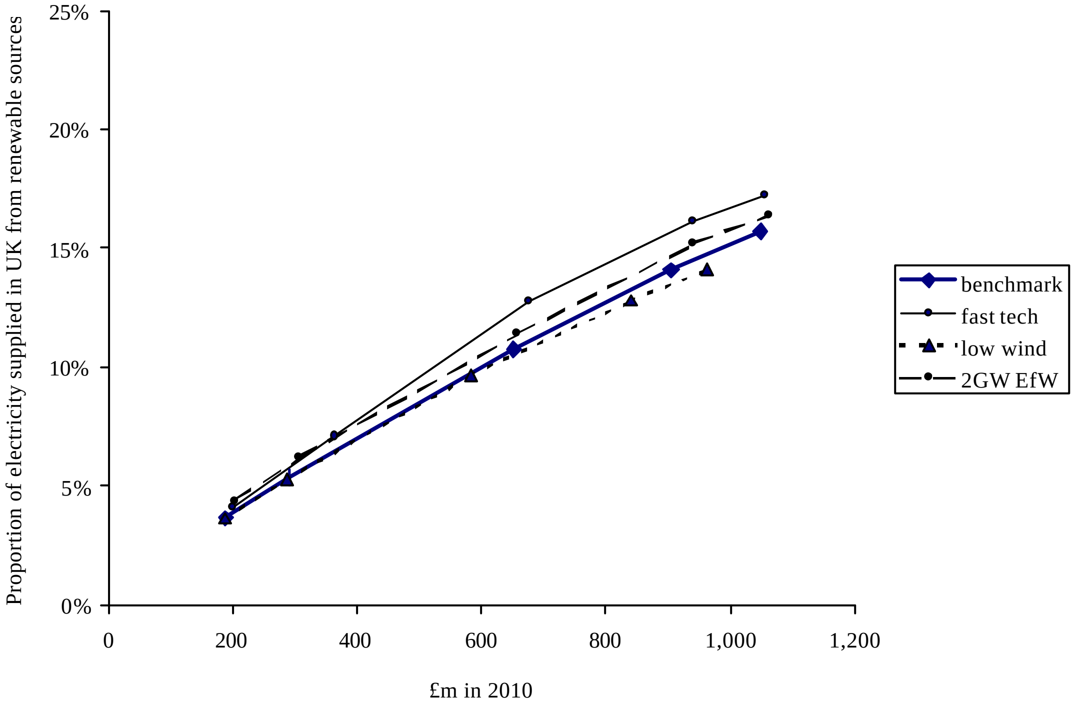


Figure 2.2b: Low scenario, variation of generation output with cost to customers

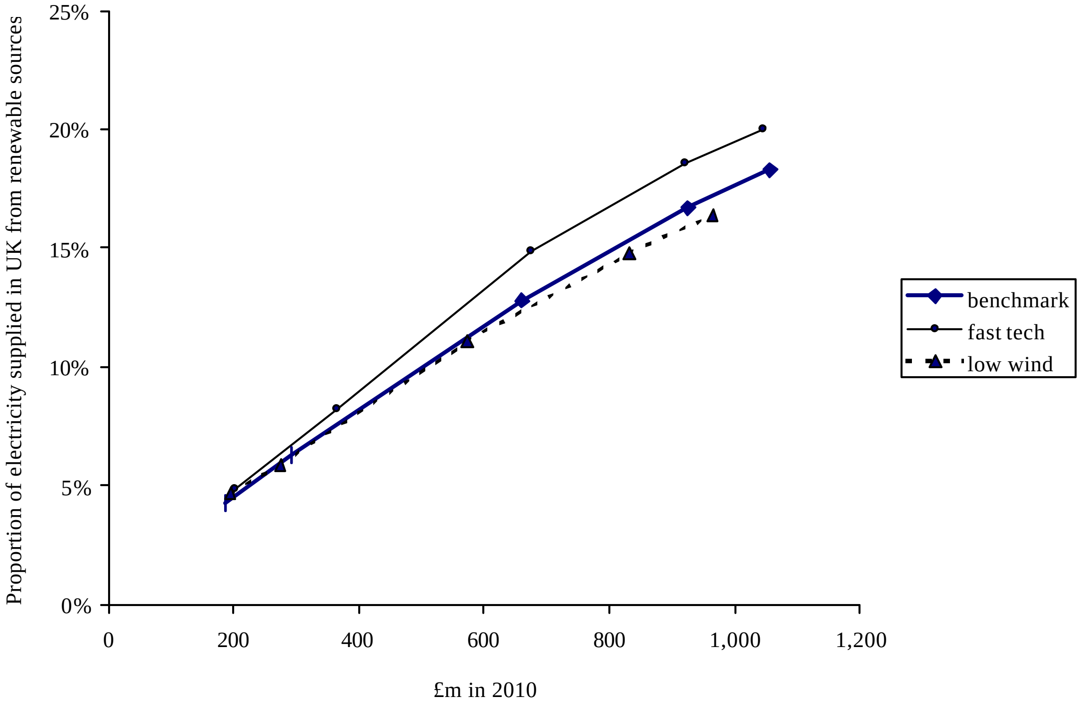


Figure 2.3a: High scenario, variation of generation output with increase in householder's bill

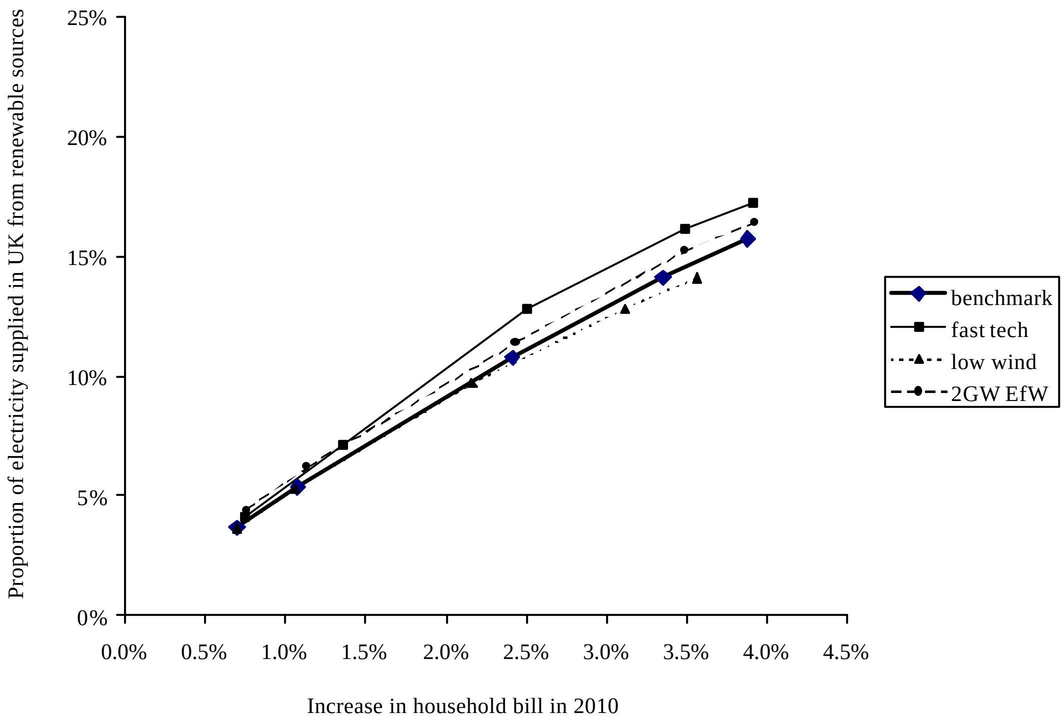


Figure 2.3b: Low scenario, variation of generation output with increase in householder's bill

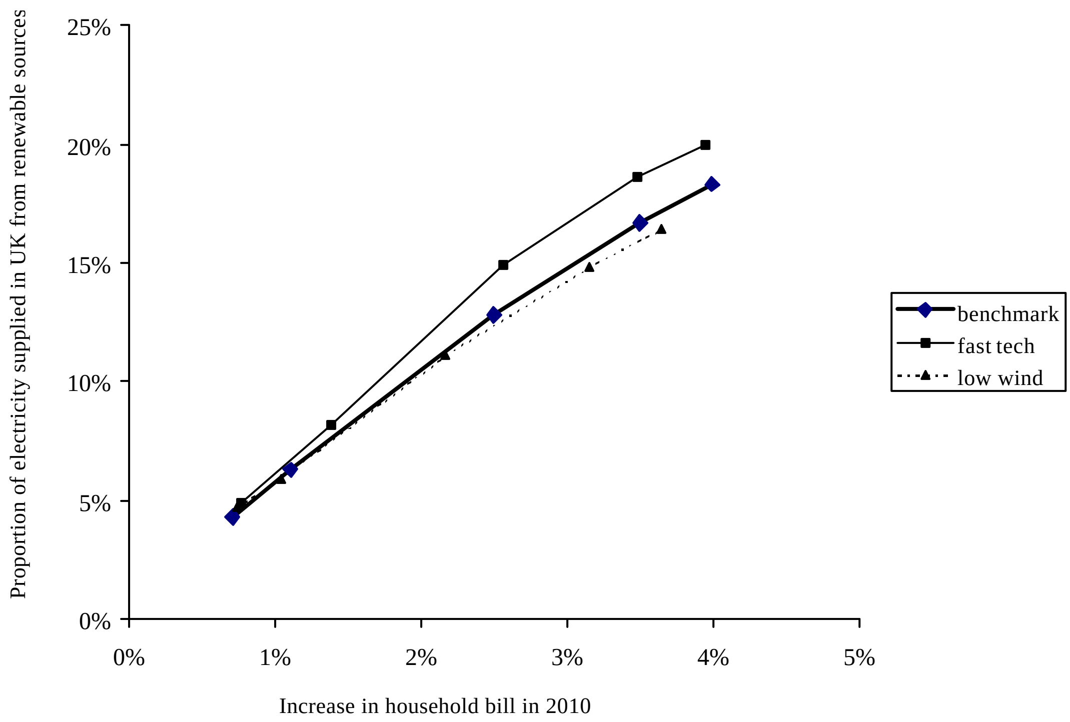


Figure 2.4a: High scenario, variation of generation output with equivalent carbon tax

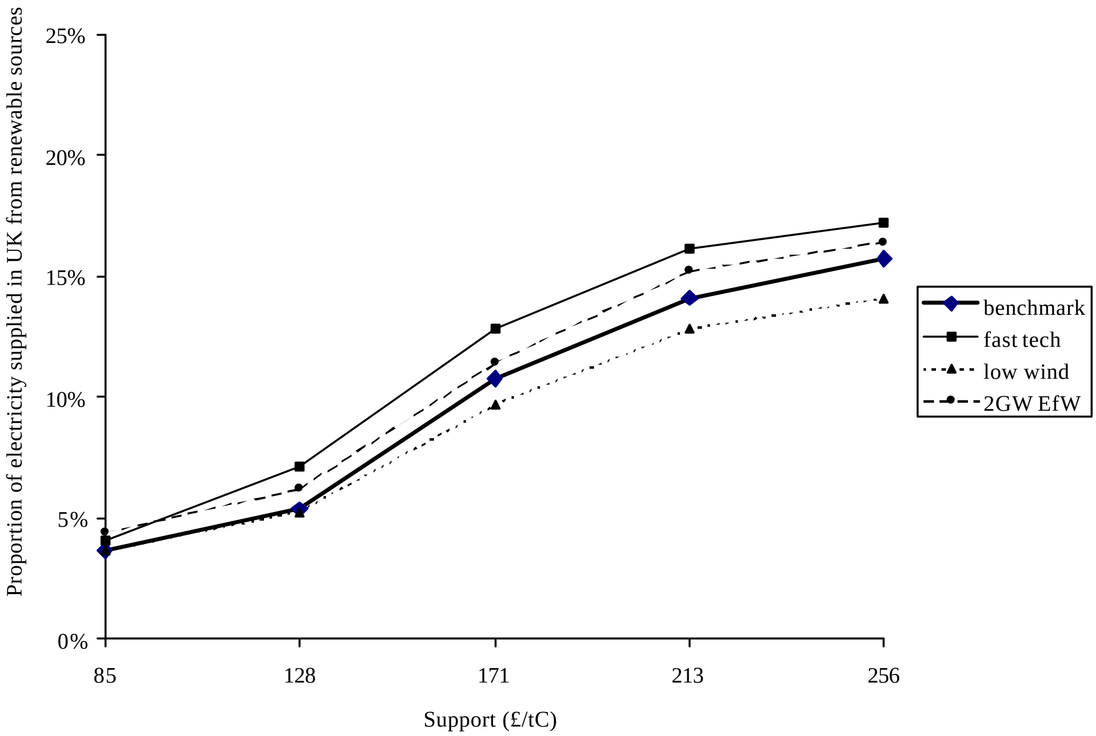
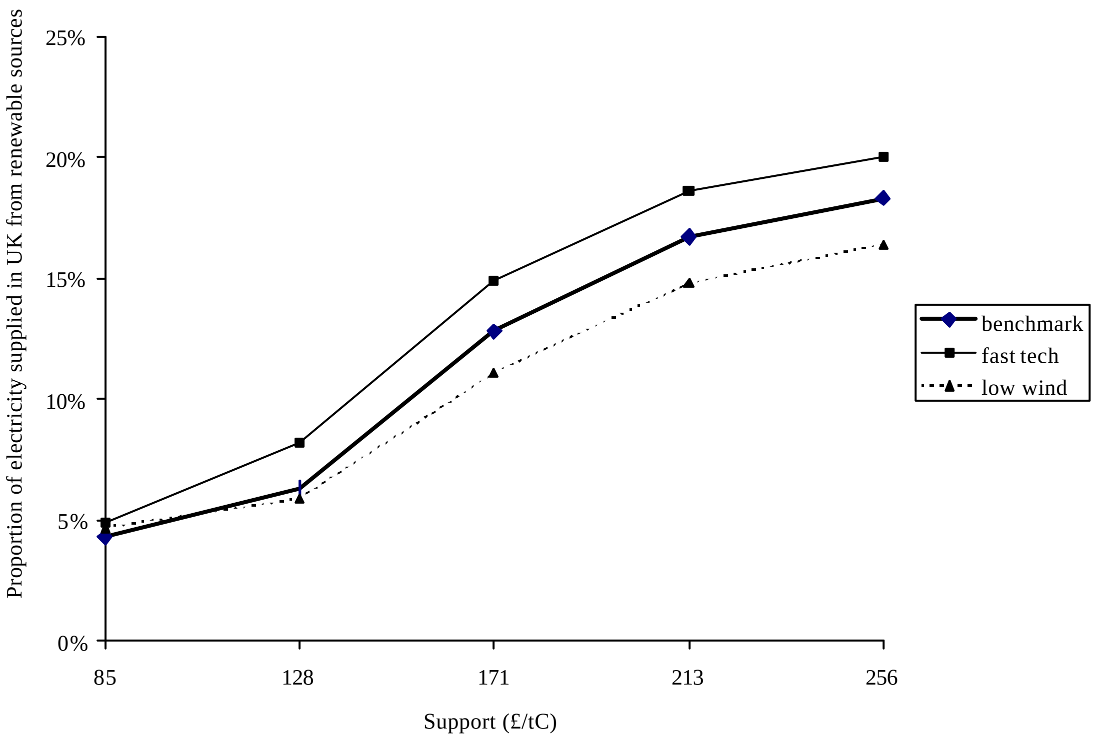


Figure 2.4b: Low scenario, variation of generation output with equivalent carbon tax



3. Results for 2020

Figure 3.1a: High scenario, variation of generation output with price uplift

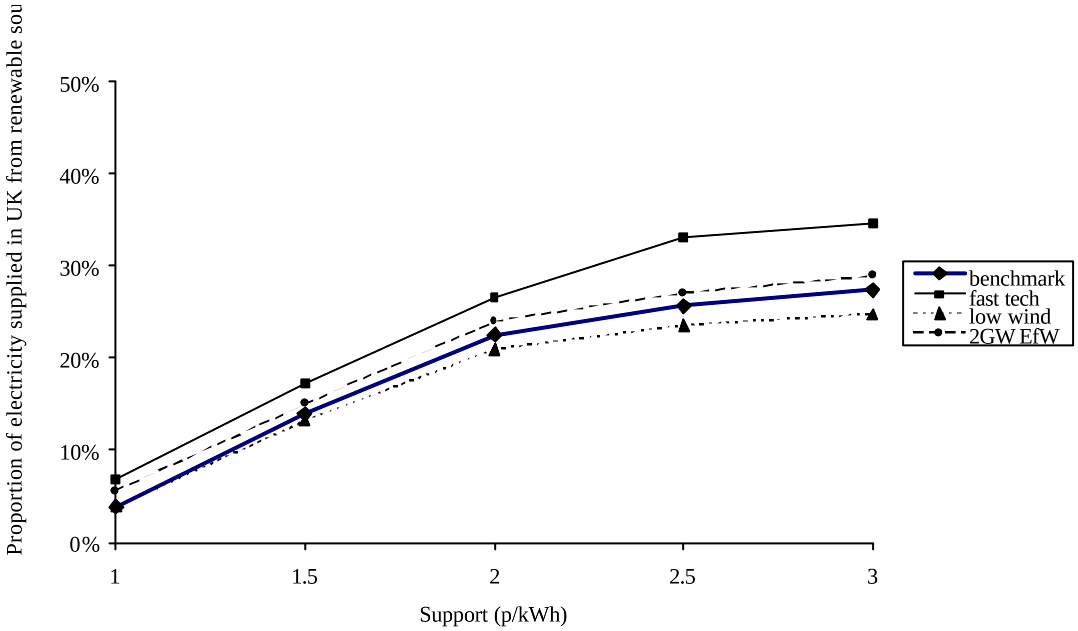


Figure 3.1b: Low scenario, variation of generation output with price uplift

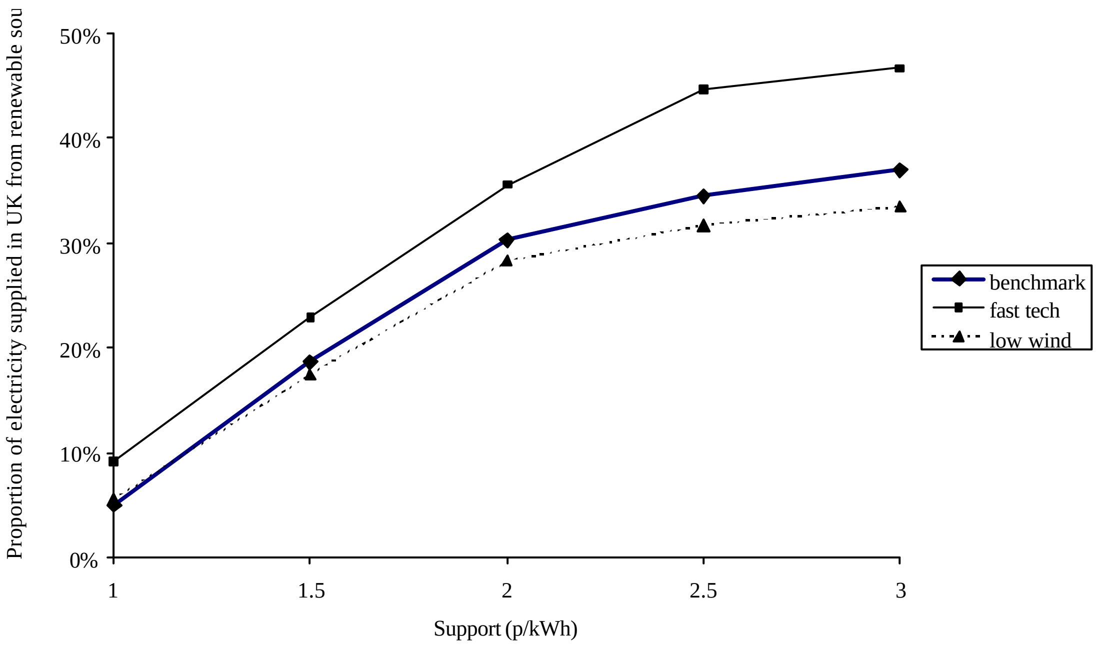


Figure 3.2a: High scenario, variation of generation output with cost to customers

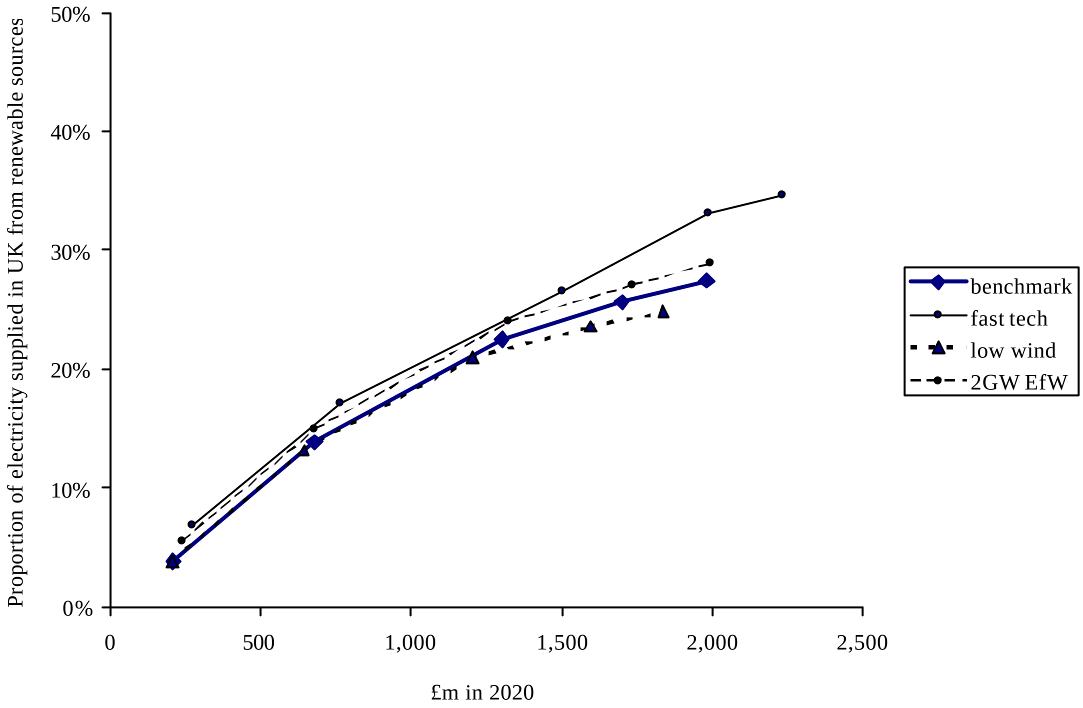


Figure 3.2b: Low scenario, variation of generation output with cost to customers

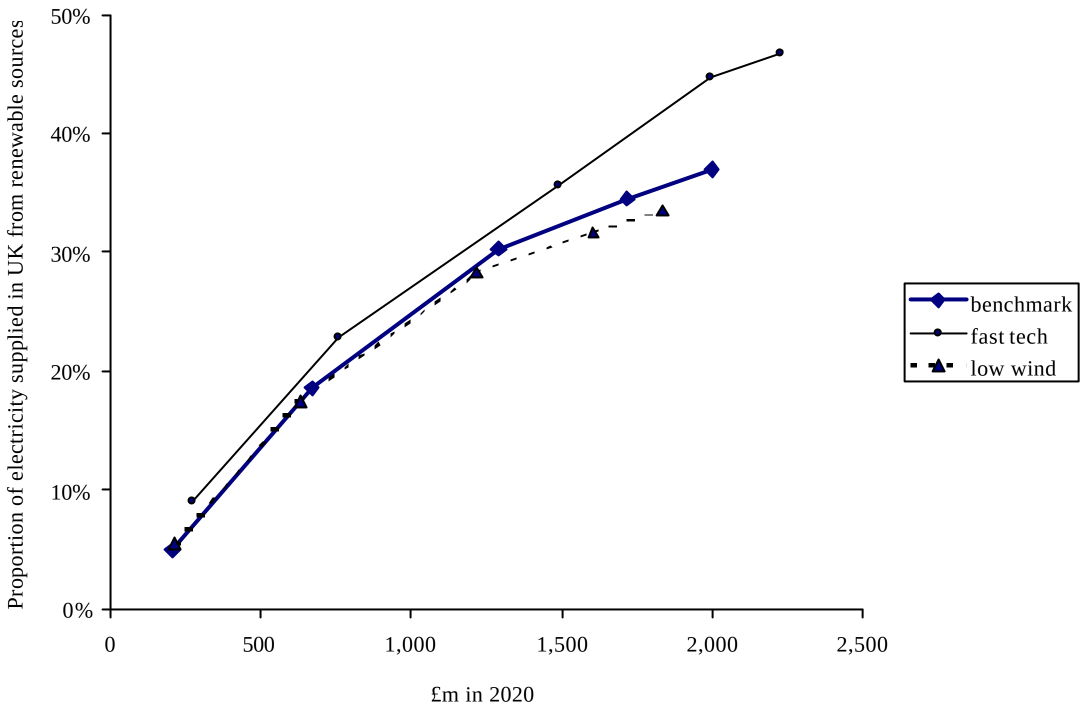


Figure 3.3a: High scenario, variation of generation output with increase in householder's bill

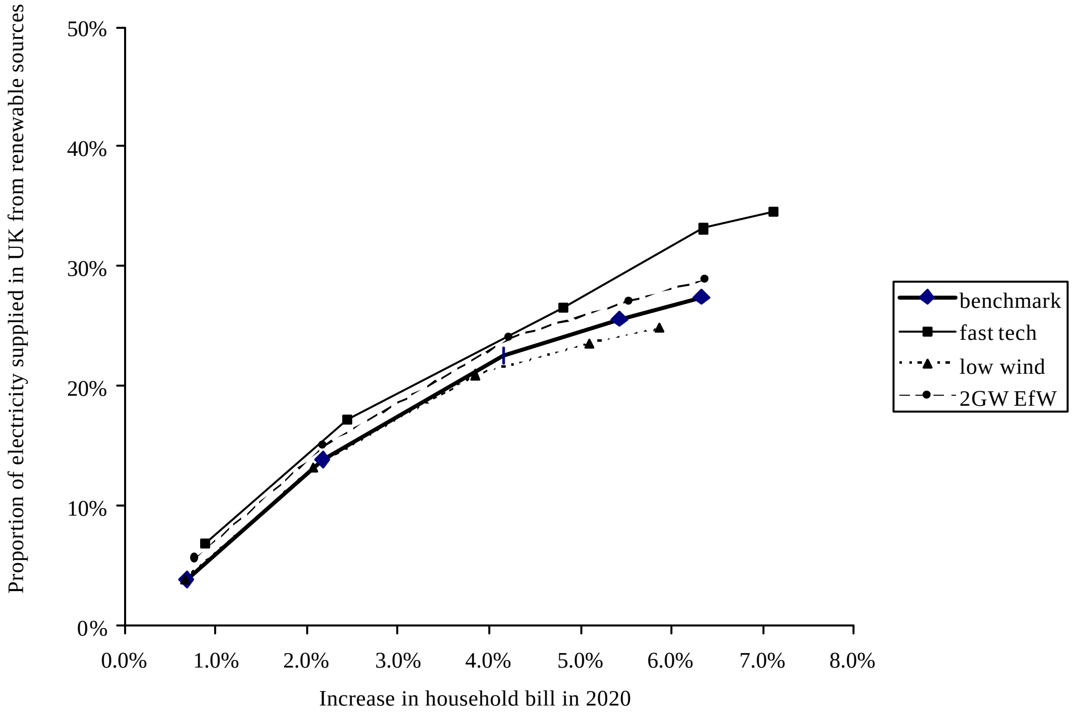


Figure 3.3b: Low scenario, variation of generation output with increase in householder's bill

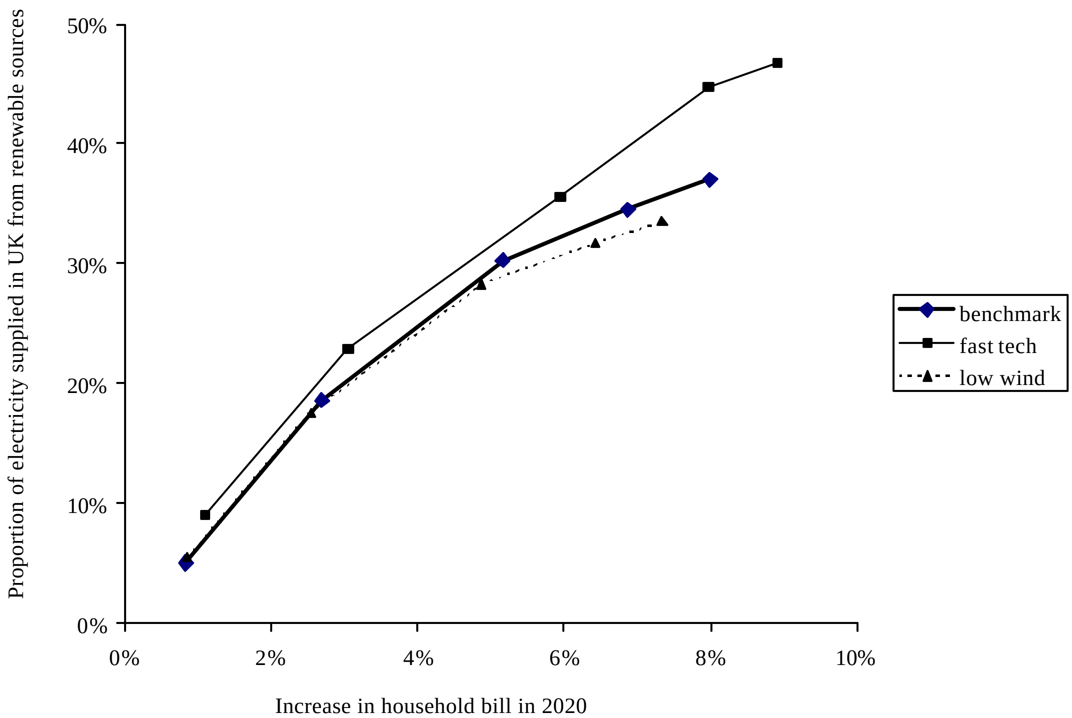


Figure 3.4a: High scenario, variation of generation output with equivalent carbon tax

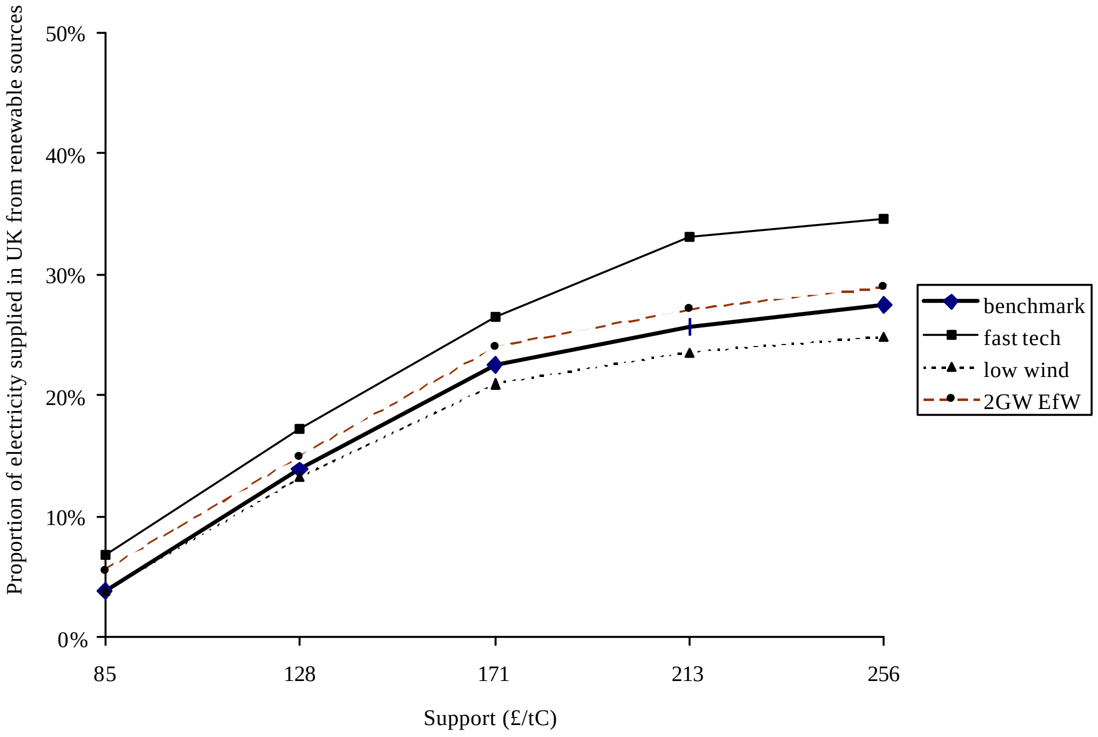
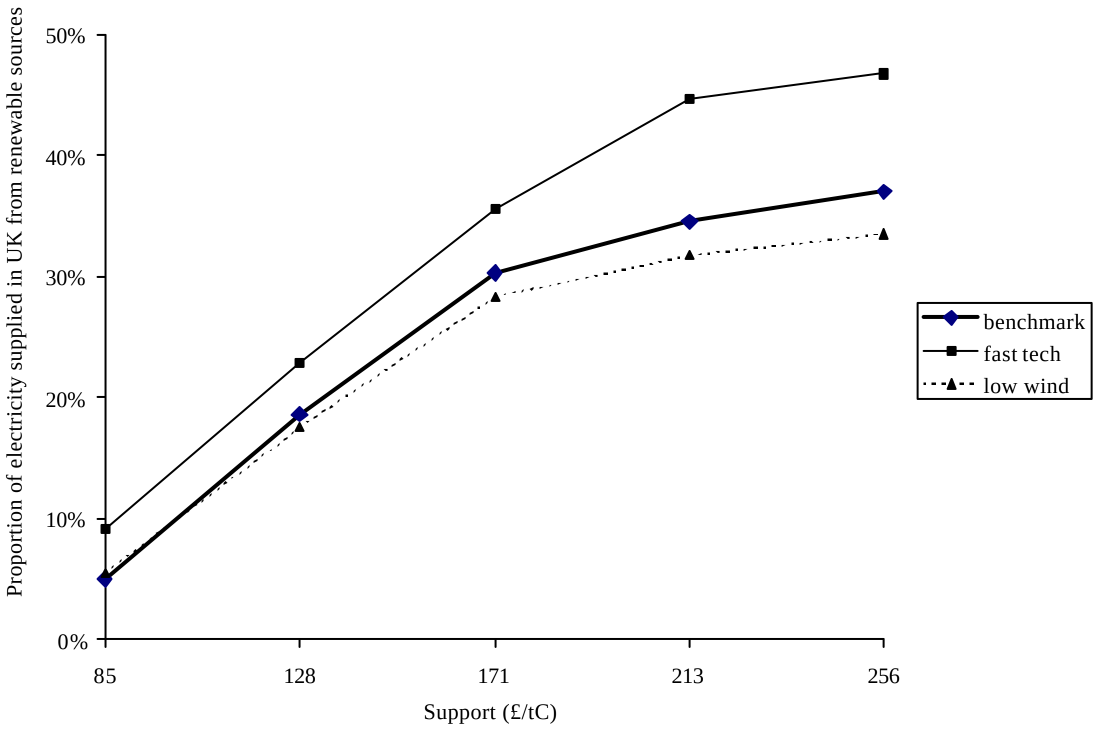


Figure 3.4b: Low scenario, variation of generation output with equivalent carbon tax



4. Technology Mix

This section shows the capacity built by mix of technology for each scenario and set of assumptions.

Figure 4.1: High scenario, benchmark assumptions

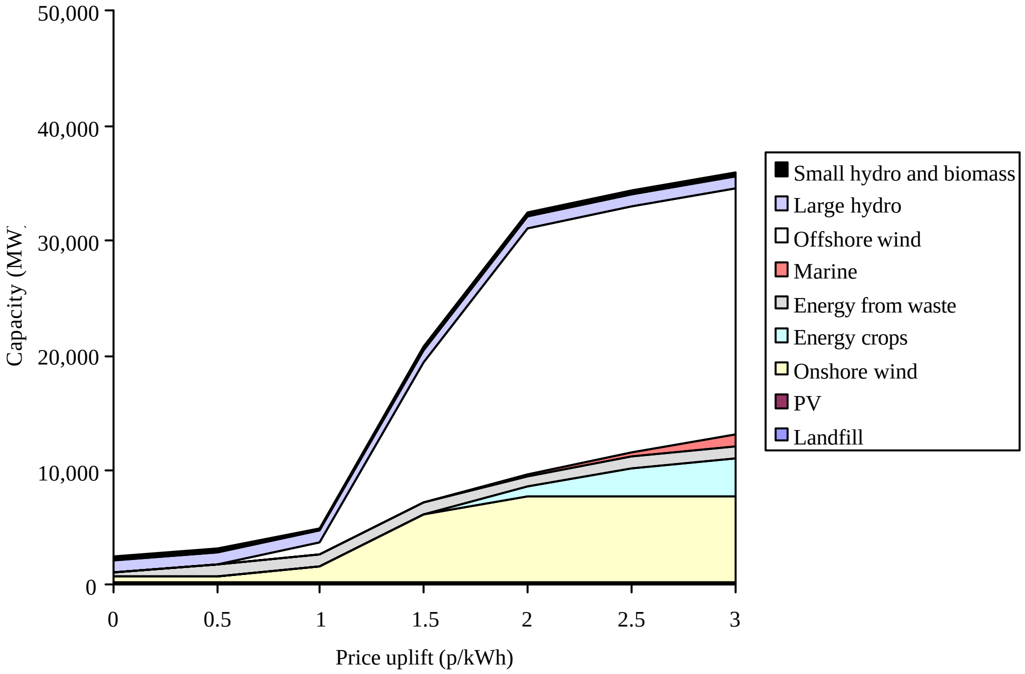


Figure 4.2: Low scenario, benchmark assumptions

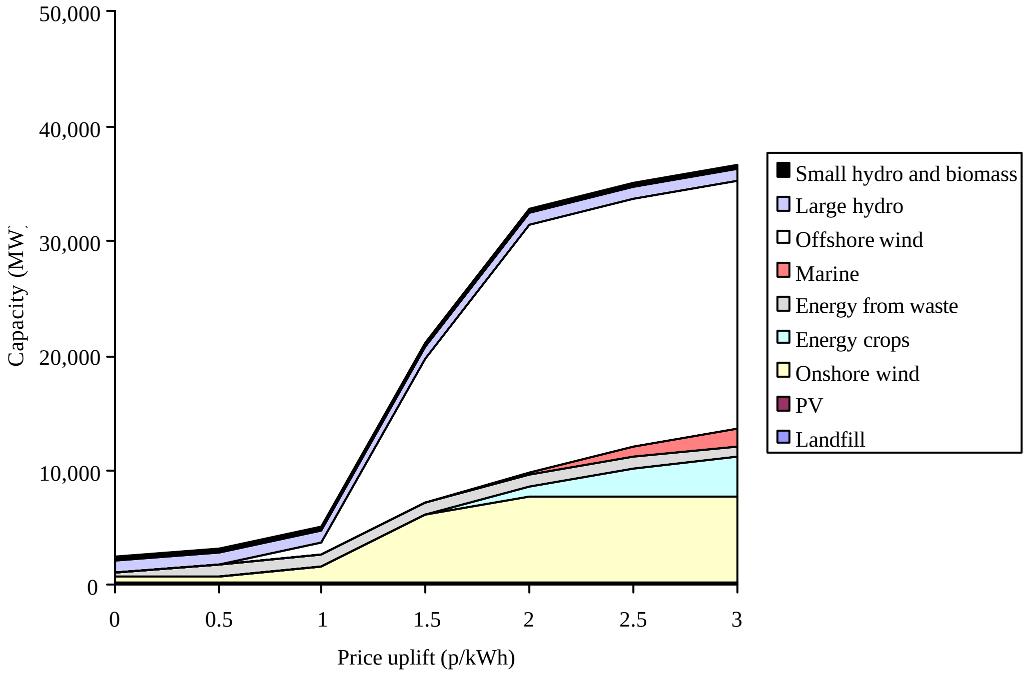


Figure 4.3: High scenario, fast technical change assumptions

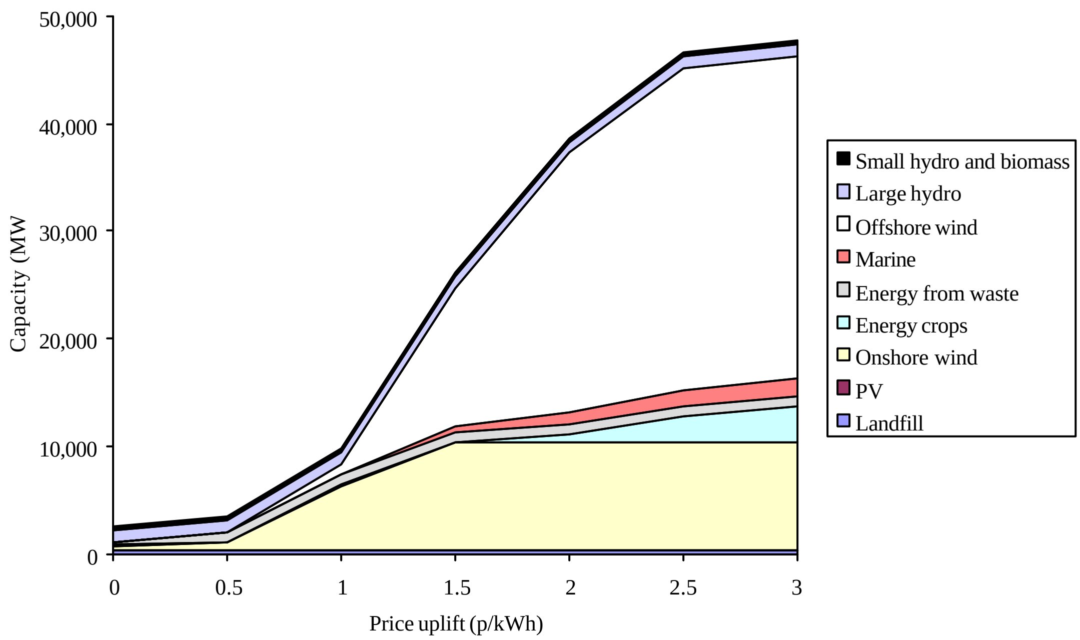


Figure 4.4: Low scenario, fast technical change assumptions

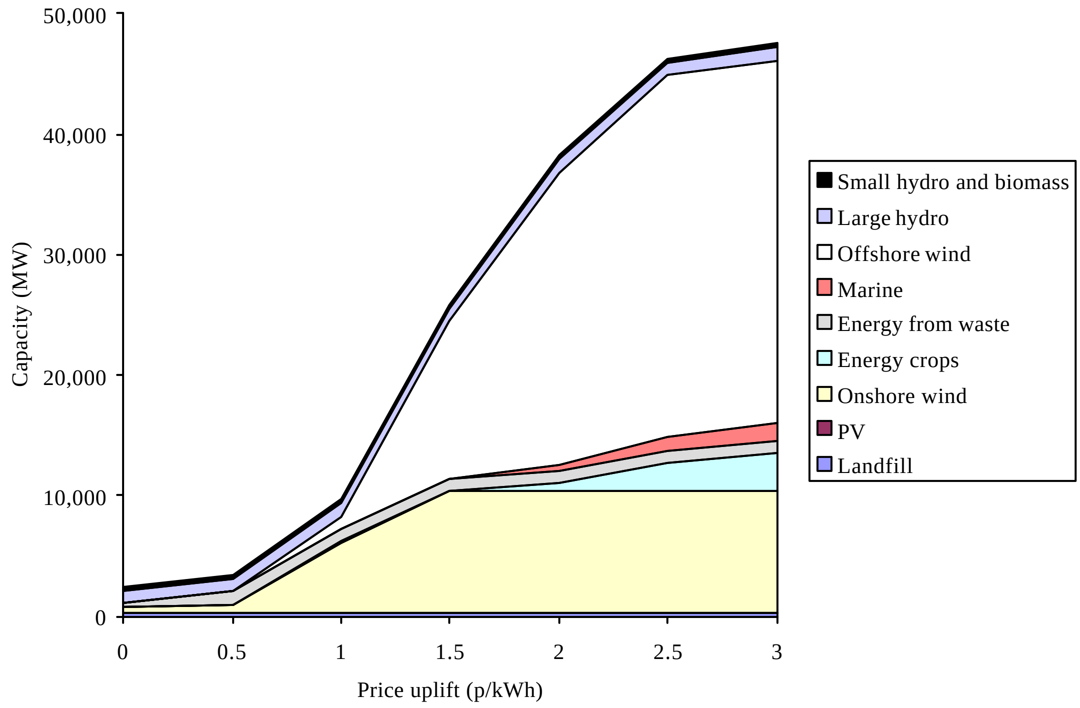


Figure 4.5: High scenario, low wind resource assumptions

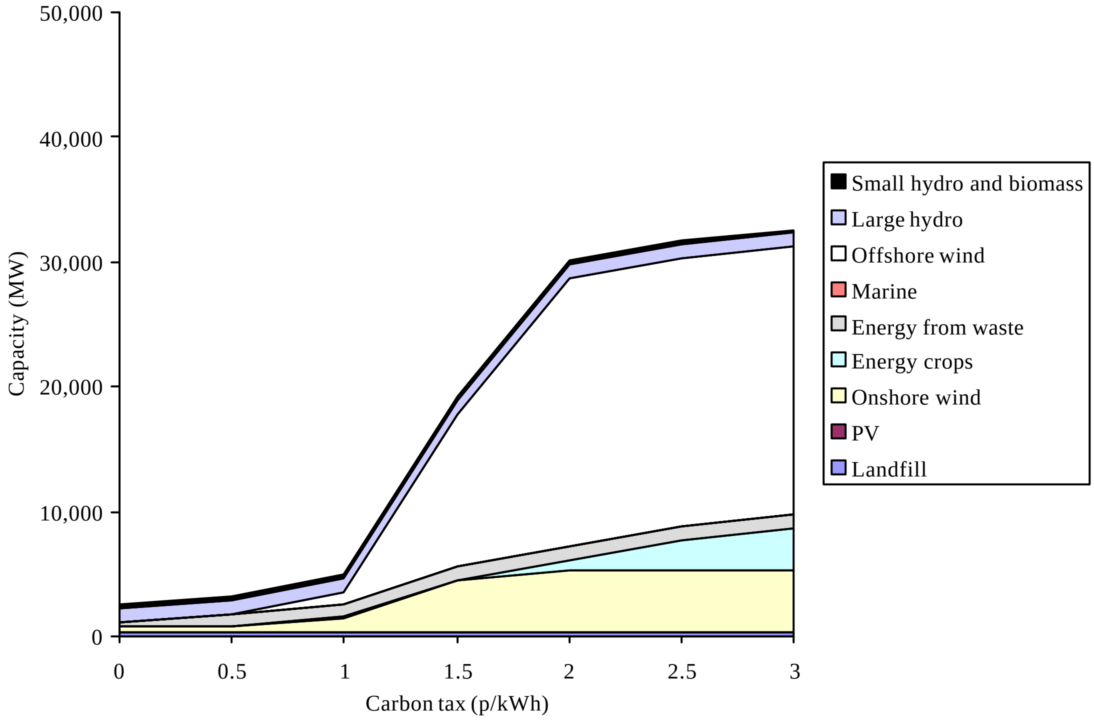
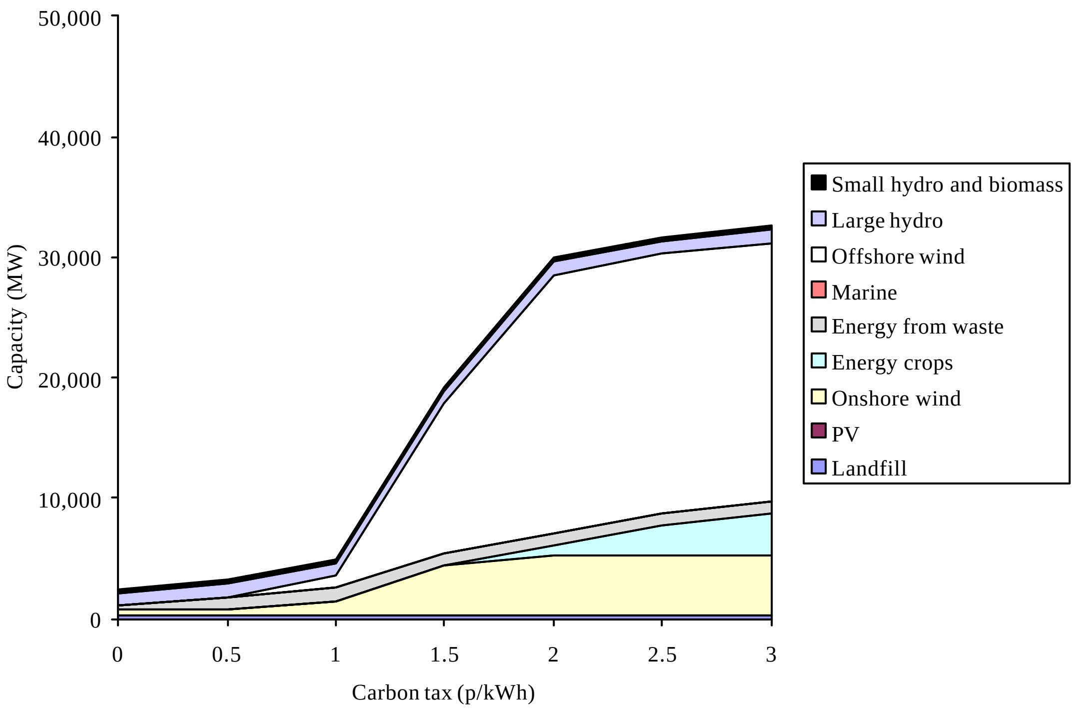


Figure 4.6: Low scenario, low wind resource assumptions



5. Assumptions

The following assumptions were used in the modelling.

The resource for offshore wind was taken to be 75% of 100 TWh—ie, 21,500 MW capacity.

The biomass potential (including energy crops) has been compared with the figure used by Paul Ekins in the report ‘The UK’s Transition to a Low-carbon Economy’, which was 5,000 MW realised in 2020 under an Accelerated Renewables Scenario.

Table 5.1: Benchmark scenario assumptions

Technology	Practicable capacity (MW)	2001 entry cost (p/kWh)	% Annual cost reduction through technological progress
Onshore wind	**7,500**	2.8–3.8	**2** (2001–2010)
			0 (2010–2020)
Offshore wind	**21,500**	4–5	5 (2001–2010)
			0 (2010–2020)
Energy from waste	1,000	2.3–2.6	1 (2001–2010)
			0 (2010–2020)
Energy crops	**5,000**	8–9	**5.5** (2004–2014)
			3 (2014–2020)
Tidal stream and wave power	15,000	9–10	**10** (2004–2014)
			1 (2014–2020)
Landfill	900	2.4–2.6	0.5 (2001–2010)
			0 (2010–2020)

Table 5.2: Low onshore wind scenario

Technology	Practicable capacity (MW)	2001 entry cost (p/kWh)	% Annual cost reduction through technological progress
Onshore wind	**5,000**	2.8–3.8	*2* (2001–2010) 0 (2010–2020)
Offshore wind	**21,500**	4–5	5 (2001–2010) 0 (2010–2020)
Energy from waste	1,000	2.3–2.6	1 (2001–2010) 0 (2010–2020)
Energy crops	**5,000**	8 - 9	**5.5** (2004–2014) 3 (2014–2020)
Tidal stream and wave power	15,000	9–10	**5** (2004–2014) 1 (2014–2020)
Landfill	900	2.4–2.6	0.5 (2001–2010) 0 (2010–2020)

Table 5.3: Fast technological progress

Technology	Practicable capacity (MW)	2001 entry cost (p/kWh)	% Annual cost reduction through technological progress
Onshore wind	**10,000**	2.8–3.8	**3.5** (2001–2010) *0*(2010–2020)
Offshore wind	**30,000**	4–5	5 (2001–2010) *2* (2010–2020)
Energy from waste	1,000	2.3–2.6	1 (2001–2010) 0 (2010–2020)
Energy crops	**5,000**	8 - 9	**5.5** (2004–2014) 3 (2014–2020)
Tidal stream and wave power	15,000	9–10	**10** (2004–2014) 1 (2014–2020)
Landfill	900	2.4–2.6	0.5 (2001–2010) 0 (2010–2020)