Sustainable Energy Partnership (NPS 96A) **APPENDIX**

	refs	2010	2015	2020	2030	2040	2050
1 a) Total electricity supply (TWh, govt figures)	*1a	387	383	386	386 -450	386 -515	386 -579
1 b) % saving from energy efficiency compared to Govt plan	***1b**	***1**	***3**	***5**	***10**	***10**	***10**
GAS							
2 a) CHP (which is mainly based on Gas)	*2a	7	13	17	25	25	25
2 b) Other Gas	*2b	38	27	12	12	12	12
2 c) Total from Gas	***2c**	**45**	**40**	**29**	**37**	**37**	**37**
COAL							
3 a) CCS Coal	*3a	0	0	0	22	22	22
3 b) Other Coal	*3b	32	28	22	0	0	0
3 c) Total from Coal	***3c**	**32**	**28**	**22**	**22**	**22**	**22**
NUCLEAR							
4) Nuclear	***4**	**13**	**10**	**8**	**1**	**0**	**0**
MICROGENERATION (up to 50Kw)							
5 a) Micro - Solar PV	*5a	0	0	0	0.2	2.0	3.7
5 b) Micro - Wind	*5b	0	0	0	1.3	3.6	5.9
5 c) Micro - CHP	*5c	0	0	0	5.4	5.9	6.3
5 d) Micro - Fuel Cells	*5d	0	0	0	5.0	16.5	28
5 e) Total from Microgeneration	***5e**	***0**	***0**	***0**	**11.9**	**28**	**43.9**
MICRO AND SMALL SCALE GENERATION MIXED (up to 5Mw)							
5 f) Feed in tariff for some small scale generation	***5f**	**0**	***3**	***6**	***6**	***6**	***6**
LARGE SCALE GENERATION/OTHER RENEWABLES							
6 a) Imported Solar from the Sahara	*6a		0	0	***10	***10	***10
6 b) Severn Tidal Barrage	*6b		0	0	9	9	9
6 c) Offshore Wind	*6c		8.6	17.1	30	36.5	43
6 d) Onshore Wind	*6d		3.5	7.0	8.7	10.5	12.2
6 e) Solar PV	*6e		1.9	4.4	9.6	9.6	9.6
6 f) Hydro	*6f		1.2	1.2	1.3	1.3	1.3
6 g) Wave	*6g		0	0.1	1	1	1
6 h) Tidal Stream	*6h		0.3	0.6	0.9	0.9	0.9
6 i) Tidal Range	*6i		0	0.23	0.46	0.46	0.46
6 j) Landfill Gas	*6j		1.6	1.4	0.9	0.7	0.6
6 k) Sewage Gas	*6k		0.23	0.24	0.27	0.27	0.27

6 l) Biomass	*6l		1.77	3.07	5.03	5.03	5.03
6 m) Total from Renewables	***6m**	**6**	**19.1**	**35.34**	**77.16**	**85.26**	**93.36**
OIL							
7) Oil and other non-renewable sources	***7**	**3**	**5**	**10**	**10**	**10**	**10**
TOTALS							
8. Total electricity supply as a percentage of row 1a		**100%**	**108.1 %**	**115.34 %**	**175 %**	**198 %**	**222.3 %**
8 a Total electricity supply in TWh		**387 TWh**	**414 TWh**	**445 TWh**	**675 TWh**	**764 TWh**	**858 Twh**

Erring on the side of caution/figures marked ***

*** This indicates where the figures we have quoted have erred on the side of caution – i.e. the actual contribution could be higher as explained below.

(i) Row 1 a) – For the years 2030, 2040, 2050 we've quoted a worst case scenario of a 50% increase, however, the government admits that no assessments have been made for these years, there are other scenarios which state that there may not be such an increase.

(ii) Row 1b) - this figure is only for the potential saving in the domestic sector: we have not been able to find any reliable long term figures for the potential energy reductions and savings in any other sectors – e.g. commercial, industry, and agriculture. **It would seem therefore that we have an energy strategy that is is not based on achieving the maximum possible reduction and saving – but one that is too based on generation.** And, indeed, even for the domestic sector they may be on the low side as the main source quoted (Clarke et al – see footnote 1b) below) does not include use of developing technologies such as voltage minimization and daylight saving technology. Estimates of the savings that these could produce are 8% of demand for the former (http://www.voltageoptimisation.com/); and 5% for the latter (Doulos, Tsangrassoulis, and Topalis 2008 "Quantifying energy savings in daylight responsive systems: The role of dimming electronic ballasts"). But these have NOT been included.

(iii) Row 5e) - the figure for microgeneration for 2010, 2015 and 2020 is listed as zero. However, a Statutory Report produced by Element Energy for BERR pursuant to the Climate Change and Sustainable Energy Act 2006 clearly said that with the right policy framework there could **realistically** be 500,000 microgeneration installations by 2015 and 2-3 million by 2020. The Report did not break this down for each technology, so no figure is given for heat and electricity. But clearly the zero entry is an under-statement. **The Report has been largely ignored by government.**

(iv) Row 5f) – the figure for small scale generation accepts the government's lack of intention to include small scale wave and tidal and geothermal in this scheme. This makes no sense but for this Table we have accepted it. **The government does not seem to want the feed-in tariff to achieve its maximum potential.**

(v) Row 6a) – we have included a 10% figure for 'solar form the Sahara' – but David Mackay's detailed study (see ref for row 6a) below) gives far greater alternative potentials of up to 25%. **We have used the lowest scenario.**

Sources for the Rows

*1a)

2010 – We have used the 2008 figure from the The UK Renewable Energy Strategy as it is the latest available figure from the government. Renewable Energy Strategy. July 2009. Page 37 Table 2.1

2015 – Figure taken from spreadsheet used as a background paper for the RES supplied to us by DECC on the 19th January 2010.

2020 - From RES. July 2009 Page 37, Table 2.1

2030 – Figures here are uncertain. The government concedes that no assessments have been made for these years. Our figure is based upon the government's worst case scenario (i.e the highest demand) this is based upon a statement in the Low Carbon Transition Plan. 2009 Pg 170 which states '…we can expect to see demand for electricity to at least stay the same and probably increase…In some scenarios demand could increase by as much as 50%.' However, the LCTP also makes the point that 'not all scenarios' would lead to an increase in electricity. Pg 171. The demand prediction is calculated as an even trajectory, where demand increases from 386 in 2020 to 570 in 2050.

2040 – The demand prediction is calculated as an even trajectory, where demand increases from 386 in 2020 to 570 in 2050.

2050 - The demand prediction is calculated as an even trajectory, where demand increases from 386 in 2020 to 570 in 2050

*1b)

2010 - J.A Clarke et al. Energy Systems Research Unit. University of Strathclyde
www.foresight.gov.uk/Energy/The_role__of_built_environemnt_energy_efficiency_in_a_sustainable_UK_energy_economy.pdf Pg 3. This shows that with the right policy framework we can reduce the carbon footprint re **energy** used by households by 50%. The study covers 'fabric' use – water and space heating – and appliances. It is unclear whether it includes cooking, so in the calculations below we have excluded the cooking element of domestic electricity use. Total electricity use is 307 Twh (see refs to row 1a) above). Domestic electricity consumption is 35% of total electricity consumption (XXX) so = 107 TwH. The breakdown of domestic electricity use is as follows (XXX): Light and appliances is 67.3%; Cooking 5.7%; Water 13.4% ; Space heating 11.5. Clarke et al says we can save 50% of fabric (inc appliances) use. So deduct the cooking element (5.7%) - leaves 94%. 94% of 107 Twh is 100 TwH. However, Clarke et al says that the 50% saving is of **energy** use not electricity use and we will assume that most of this (say 80%) will come from NON electricity sources. That leaves a saving of 20% of electricity. Thus 20% of **50% saving = 10%. 10% of** 100 Twh = **10Twh.** The figures for 2010, 2015 and 2020 are estimates based on an even trajectory to achieving the potential in 2030.
2015 - See note re 2010
2020 - See note re 2010
2030 - J.A Clarke et al. Energy Systems Research Unit. University of Strathclyde
www.foresight.gov.uk/Energy/The_role__of_built_environemnt_energy_efficiency_in_a_sustainable_UK_energy_economy.pdf Pg 3. See calculations referred to in note re 2010.
2040 - See note re 2030. We have assumed no further increase
2050 - See note re 2030. We have assumed no further increase

*2a)
2010 - Cogeneration and District Energy: Sustainable energy technologies for today…and tomorrow. International Energy Agency. Paris 2009. Pg 11 http://www.iea.org/files/CHPbrochure09.pdf
2015 - Cogeneration and District Energy: Sustainable energy technologies for today…and tomorrow. International Energy Agency. Paris 2009. Pg 12 http://www.iea.org/files/CHPbrochure09.pdf
2020 - Estimate given 13% potential in 2015 and 25% in 2030
2030 - Cogeneration and District Energy: Sustainable energy technologies for today…and tomorrow. International Energy Agency. Paris 2009. Pg 12 http://www.iea.org/files/CHPbrochure09.pdf
2040 - See note re 2030. We have assumed no further increase
2050 - See note re 2030. We have assumed no further increase

*2b)
2010 - The UK Low Carbon Transition Plan. DECC July 2009 pg 54, states that 45% of the UK's electricity generation comes from Gas. This 2010 figure has been derived by subtracting the 2010 figure for CHP from the DECC figure for this year.
2015 - This figure is an estimate, which has been derived by subtracting the 2015 figure for CHP from an estimated DECC figure for this year from The UK Low Carbon Transition Plan Emissions Projections, Table 7.1 page 26
2020 - The UK Low Carbon Transition Plan. DECC July 2009 states that 29% of the UK's electricity generation will come from Gas. This 2020 figure has been derived by subtracting the 2020 figure for CHP from the DECC figure for this year
2030 - This figure is an estimate based on the assumption that non-CHP gas stays the same in 2030 and beyond as it was in 2020(12%)
2040 - As above
2050 - As above

*2c)
2010 - Total from rows 2a) and 2b)
2020 - Total from rows 2a) and 2b)
2030 - Total from rows 2a) and 2b)
2040 - Total from rows 2a) and 2b)
2050 - Total from rows 2a) and 2b)

*3a)
2010 - Zero entry till 2030
2015 - Zero entry till 2030
2020 - Zero entry till 2030
2030 - This is based on the idea that by 2030 all coal will be CCS. This is also the Government's assumption - see 'The UK Low Carbon Transition Plan Emission Projections' DECC July 2009. Page 26. By 2020 22% of the UK's electricity will be generated by coal, therefore 22% will be CCS. See UK Low Carbon Transition Plan. DECC July 2009 Pg. 54.
2040 - See 2030
2050 - See 2030

*3b)
2010 - UK Low Carbon Transition Plan. DECC July 2009. Pg 54. Chart 2
2015 - UK Low Carbon Transition Plan Emissions Projections, Table 7.1 Pg 26
2020 - UK Low Carbon Transition Plan. DECC July 2009. Pg 54. Chart 2
2030 - CCS proven, no non-CCS coal
2040 - CCS proven, no non-CCS coal
2050 - CCS proven, no non-CCS coal

*3c)
2010 - Total from row 3a) and 3b)
2020 - Total from row 3a) and 3b)
2030 - Total from row 3a) and 3b)
2040 - Total from row 3a) and 3b)
2050 - Total from row 3a) and 3b)

*4)
2010 - UK Low Carbon Transition Plan. DECC July 2009 Pg 54. Chart 2
2015 - This figure is an estimate based on the UK Low Carbon Transition Plan Emissions Projections, Table 7.1 pg. 26
2020 - UK Low Carbon Transition Plan. DECC July 2009 Pg 54. Chart 2
2030 - www.world-nuclear.org/info/inf84.html For 2030, the only operating nuclear power station is Sizewell B, representing a bit under 10% of nuclear capacity, so roughly 1% of total electricity supply,
2040 - www.world-nuclear.org/info/inf84.html
2050 - www.world-nuclear.org/info/inf84.html

*5a)
2010 - Zero entry till 2030
2015 - Zero entry till 2030
2020 - Zero entry till 2030
2030 - Potential for Microgeneration Study and Analysis: Final Report, Energy Saving Trust November 2005, page 18 http://www.berr.gov.uk/files/file27559.pdf
2040 - Estimate based on figures for 2030 and 2050
2050 - Potential for Microgeneration Study and Analysis: Final Report, Energy Saving Trust November 2005, page 18 http://www.berr.gov.uk/files/file27559.pdf

*5b)
2010 - Zero entry till 2030
2015 - Zero entry till 2030
2020 - Zero entry till 2030
2030 - Potential for Microgeneration Study and Analysis: Final Report, Energy Saving Trust November 2005, page 18 http://www.berr.gov.uk/files/file27559.pdf
2040 - Estimate based on figures for 2030 and 2050
2050 - Potential for Microgeneration Study and Analysis: Final Report, Energy Saving Trust November 2005, page 18 http://www.berr.gov.uk/files/file27559.pdf

*5c)
2010 - Zero entry till 2030
2015 - Zero entry till 2030
2020 - Zero entry till 2030
2030 - Potential for Microgeneration Study and Analysis: Final Report, Energy Saving Trust November 2005, page 18 http://www.berr.gov.uk/files/file27559.pdf
2040 - Estimate based on figures for 2030 and 2050
2050 - Potential for Microgeneration Study and Analysis: Final Report, Energy Saving Trust November 2005, page 18 http://www.berr.gov.uk/files/file27559.pdf

*5d)

2010 - Zero entry till 2030
2015 - Zero entry till 2030
2020 - Zero entry till 2030
2030 - Potential for Microgeneration Study and Analysis: Final Report, Energy Saving Trust November 2005, page 18 http://www.berr.gov.uk/files/file27559.pdf
2040 - Estimate based on figures for 2030 and 2050
2050 - Potential for Microgeneration Study and Analysis: Final Report, Energy Saving Trust November 2005, page 18 http://www.berr.gov.uk/files/file27559.pdf

*5e)
2010 - Total from rows 5a) to 5d)
2015 - Total from rows 5a) to 5d)
2020 - Total from rows 5a) to 5d)
2030 - Total from rows 5a) to 5d)
2040 - Total from rows 5a) to 5d)
2050 - Total from rows 5a) to 5d)

*5f)
2010 – Zero entry
2015 – See 2020 figure below
2020 – Calculations by Friends of the Earth based entirely upon modeling commissioned by DECC: Design of Feed-in Tariffs for sub 5Mw Electricity in Britain, Quantitative Analysis for DECC – Poyry and Element Energy June 2009 - The figure for 2015 assumes a trajectory towards the 2020 figure
2030 – Assuming no further increase
2040 – Assuming no further increase
2050 – Assuming no further increase

*6a)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - Zero entry till 2030
2020 - Zero entry till 2030
2030 -Sustainable Energy - without the hot air. David J.C. MacKay pages 177-185; and p212, where the figure given in Plan G is 7 kWh per day per person. This is a conservative estimate as alternative scenarios suggest a greater amount could be produced by imported solar
2040 - Estimated to be the same as 2030
2050 - Estimated to be the same as 2030

*6b)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - Zero entry till 2030
2020 - Zero entry till 2030
2030 - Several Tidal Barrage Phase One Consultation: Government Response", DECC July 2009, page 1
2040 - See 2030
2050 - See 2030

*6c)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - This figure is an estimate based on the National Grid figures for 2020, assuming gradual progress over the next 10 years; therefore 2015 figure is half-way
2020 -'Gone Green', a Scenario for 2020", National Grid Dec 08: http://www.nationalgrid.com/NR/rdonlyres/554D4B87-75E2-4AC7-B222-6B40836249B5/32656/ScenarioNarrative.pdf The figure is quoted as 19GW, this is converted into 66TWh per year using the conversion rates in the SKM paper(http://www.berr.gov.uk/files/file46779.pdf) (where every 1GW installed capacity of offshore wind provides 3.5TWh)

2030 - Renewable Energy Strategy Consultation", BERR June 2008, page 11: http://www.berr.gov.uk/files/file46799.pdf The figure is quoted as 33GW which is converted into 116TWh per year, using the conversion rates in the SKM paper
2040 - Figures are estimates based on the assumption that the rate of expansion of offshore will halve from 2030
2050 - As above

*6d)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - This figure is an estimate based on the National Grid figures for 2020, assuming gradual progress over the next 10 years; therefore 2015 figure is half-way
2020 -'Gone Green', a Scenario for 2020", National Grid Dec 08: http://www.nationalgrid.com/NR/rdonlyres/554D4B87-75E2-4AC7-B222-6B40836249B5/32656/ScenarioNarrative.pdf . The 2020 figure is quoted as 11GW which is converted to 26.95TWh using the conversion rate in the SKM paper (http://www.berr.gov.uk/files/file46779.pdf) (where every 1GW of installed capacity provides 2.54TWh per year)
2030 - Figures are estimates based on the assumption that the rate of expansion of onshore wind will halve from 2020
2040 - As above
2050 - As above

*6e)
2010 - Zero entry till 2015
2015 - Centre for Alternative Energy. Zero Carbon Britain 2007 Pg 86. Because we are starting later than CAT envisaged we have reflected these findings in our table in the figures for 2015 and 2030 (rather than 2010 and 2025 as in the CAT report)
2020 - Figure is an estimate based on the figures for 2015 and 2030
2030 - Centre for Alternative Energy. Zero Carbon Britain 2007 Pg 86 www.zerocarbonbritain.com . Because we are starting later than CAT envisaged we have reflected these findings in our table in the figures for 2015 and 2030 (rather than 2010 and 2025 as in the CAT report)
2040 - As above
2050 - As above

*6f)
2010 - BERR Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%.
2015 - Extrapolated from 2010 and 2030 figures, assuming steady growth, as on page 29 of Knight Merz(SKM) paper ' Quantification of constraints on the Growth of UK renewable generating capacity' page 27 http://www.berr.gov.uk/files/file46779.pdf.
2020 - Extrapolated from 2010 and 2030 figures, assuming steady growth, as on page 29 of above document.
2030 - BERR figures on potential max capacity by 2030 2040 - As above (2030), therefore potentially underestimated
2040 - ???
2050 - As above (2030), therefore potentially underestimated

*6g)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - Limited growth until 2020 See SKM paper http://www.berr.gov.uk/files/file46779.pdf
2020 - Extrapolated from 2030 figure and growth graph on page 44
2030 - Max capacity predicted at 2030, with medium growth rates, 1.7GW equates to 4KWh, or 1.3%
2040 - As 2030 figure because not predicted further, but likely to be an underestimate as growth may rise
2050 - As 2030 figure because not predicted further, but likely to be an underestimate as growth may rise

*6h)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - Extrapolated from 2030 figure assuming steady growth (page 47) see SKM paper http://www.berr.gov.uk/files/file46779.pdf
2020 - Extrapolated from 2030 figure assuming steady growth (page 47)
2030 - Max predicted by 2030 is 3.5TWh, or 1.1%
2040 - As 2030 figure because not predicted further, but likely to be underestimated as growth may rise

2050 - As 2030 figure because not predicted further, but likely to be underestimated as growth may rise

*6i)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - Limited growth until 2020, assuming medium growth rate see SKM paper (page 50) http://www.berr.gov.uk/files/file46779.pdf
2020 - Extrapolated from 2030 figure
2030 - Maximum at 2030 predicted to be 1.8TWh, or 0.5% See Pg 49 - excluding Severn Barrage figures
2040 - As 2030 figure because not predicted further, but likely to underestimated as growth may rise
2050 - As 2030 figure because not predicted further, but likely to underestimated as growth may rise

*6j)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - As above - averaged from 2010 and 2020 figures. see SKM paper Pg 52 http://www.berr.gov.uk/files/file46779.pdf
2020 - Taken from medium growth projection
2030 - Taken from medium growth projection
2040 - Extrapolated from predicted decline in resource, shown on graph on page 32
2050 - Extrapolated from predicted decline in resource, shown on graph on page 32

*6k)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - Averaged from 2010 and 2020 figures. Taken from medium growth projection see SKM paper pg 52 http://www.berr.gov.uk/files/file46779.pdf
2020 - Taken from medium growth projection
2030 - Taken from medium growth projection
2040 - No figures shown after 2030, but assumed as steady, from graph on page 34
2050 - No figures shown after 2030, but assumed as steady, from graph on page 34

*6l)
2010 - Unknown, Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - Averaged from 2010 and 2020 figures. Taken from medium growth projection as above see SKM paper
2020 - Taken from medium growth projection
2030 - Taken from medium growth projection
2040 - No figures shown after 2030, but assumed as steady, see graph on page 37,
2050 - No figures shown after 2030, but assumed as steady, see graph on page 37

*6m)
2010 - Low Carbon Transition Plan DECC 2009, page 54 Chart 2 quotes total electricity from renewables as 6%
2015 - Total from row 6a) to 6l)
2020 - Total from row 6a) to 6l)
2030 - Total from row 6a) to 6l)
2040 - Total from row 6a) to 6l)
2050 - Total from row 6a) to 6l)

*7
2010 - UK Low Carbon Transition Plan. DECC July 2009 Pg 54
2015 - Estimate based on the figures for 2010 and 2020

2020 - UK Low Carbon Transition Plan. DECC July 2009 Pg 54
2030 - We are assuming no increase in oil so this figure stays the same
2040 - Same as 2030
2050 - Same as 2030

*8
2010 – The Total of rows 1b), 2c), 3c), 4, 5e), 5f), 6m) & 7. Figures in this column are all expressed as a percentage of demand in row 1a, i.e. as a percentage of 387
2015 – As above. Figures in this column are all expressed as a percentage of demand in row 1a, i.e. as a percentage of 383
2020 – As above. Figures in this column are all expressed as a percentage of demand in row 1a, i.e. as a percentage of 386
2030 – As above. Figures in this column are all expressed as a percentage of demand in row 1a, i.e. as a percentage of 386
2040 – As above. Figures in this column are all expressed as a percentage of demand in row 1a, i.e. as a percentage of 386
2050 – As above. Figures in this column are all expressed as a percentage of demand in row 1a, i.e. as a percentage of 386

*8a
2010 – Total electricity supply in TWh is calculated by multiplying the demand for that year (row 1a) by the achievable percentage in row. E.g. in 2010 it's 100% of 387TWh i.e. 387 TWh
2015 – Row 1a multiplied by row 8, i.e. 108.1% of 383TWh = 414 TWh
2020 – Row 1a multiplied by row 8
2030 – Row 1a multiplied by row 8
2040 – Row 1a multiplied by row 8
2050 – Row 1a multiplied by row 8