ESME v4.3

The technology input data for ESME is grouped into different sections of the energy system (each displayed on a separate worksheet) as listed to the right	Conversion Infrastructure Industry Buildings Transport
Other input data, including product emission factors, resource prices, availablility of resources, demand for energy services can be found on these worksheets	Products Resource Prices Resource Limits Demand Data
A glossary of terms used throughout this document and some reference data for currency conversions and inflation data	Glossary Financial Data
Changes made to subsequent versions the dataset are listed in the Change Log worksheet	Change Log

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Technology Name	Indicative Scale	Capacity Unit	Economic Life (years)	Technical Life (years)	Construction Period (years)	Max Annual Build Rate (capacity units / year) 2010	2020	2030	2040	2050	Exponential growth constraint (see notes for details)	Capex (capital cost) £ / capacity unit 2010	2050	Fixed O&M costs £ / capacity unit / year 2010	2050	Variable O&M costs £ / unit of outputs 2010	2050	Peak Contrib. Factor %	Flexibility Factor %	Annual availability factor % 2010	2050	Notes (Text)
PC Coal	1GW	kW	30	40	4	2.0E+06	2.0E+06	2.0E+06	2.0E+06	2.0E+06		1.57E+03	1.33E+03	7.10E+01	7.10E+01	1.24E-03	1.24E-03	87	75	90	90	Optional 10% biomass cofiring is also included
PC Coal with CCS	1GW	kW	30	40	4.5	0.0E+00	1.0E+06	2.0E+06	2.0E+06	2.0E+06		2.87E+03	2.23E+03	1.23E+02	1.13E+02	3.58E-03	3.58E-03	87	65	85	85	95% CO2 capture rate; Optional 10% biomass cofiring is also included; CCS Retrofit (only after 2020) capex is assumed to be 120% of the difference between base plant capex. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
IGCC Coal	1GW	kW	30	40	4	2.0E+06	2.0E+06	2.0E+06	2.0E+06	2.0E+06		1.83E+03	1.37E+03	8.03E+01	8.03E+01	7.35E-04	7.35E-04	87	75	90	90	Optional 10% biomass cofiring is also included
IGCC Coal with CCS	1GW	kW	30	30	4	0.0E+00	1.0E+06	2.0E+06	2.0E+06	2.0E+06		2.34E+03	1.72E+03	1.00E+02	1.00E+02	1.09E-03	1.09E-03	87	75	85	85	95% CO2 capture rate; Optional 10% biomass cofiring is also included; CCS Retrofit (only after 2020) capex is assumed to be 120% of the difference between base plant capex. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
CCGT	1GW	kW	20	30	2.5	2.0E+06	2.0E+06	2.0E+06	2.0E+06	2.0E+06		5.89E+02	4.96E+02	2.72E+01	2.72E+01			90	75	90	90	
CCGT with CCS	1GW	kW	20	30	3.5	0.0E+00	1.0E+06	2.0E+06	2.0E+06	2.0E+06		9.97E+02	7.77E+02	5.23E+01	5.23E+01	3.90E-04	3.90E-04	90	65	85	85	95% CO2 capture rate; CCS Retrofit (only after 2020) capex is assumed to be 120% of the difference between base plant capex. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
OCGT	500MW	kW	30	30	2							4.50E+02	4.28E+02	2.72E+01	2.72E+01			94	100	90	90	
H2 Turbine	500MW	kW	20	20	2	2.0E+06	2.0E+06	2.0E+06	2.0E+06	2.0E+06		5.90E+02	5.00E+02	3.00E+01	3.00E+01			94	100	90	90	Based on variant of OCGT
Gas Macro CHP	500MW	kW	20	30	2							5.62E+02	4.89E+02	2.72E+01	2.72E+01			90	50	90	90	Based on variant of OCGT
Biomass Macro CHP	150 MWe	kW	25	30	2	2.0E+05	4.0E+05	4.0E+05	4.0E+05	4.0E+05		3.56E+03	3.47E+03	2.76E+01	2.76E+01	1.48E-02	1.48E-02	87	50	85	85	Based on Biodedicated steam cycle CHP from BVCM (v4.0.3)
Nuclear (Legacy)	1.6GW	kW	50	50	5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.00E+00	0.00E+00	6.78E+01	6.78E+01	5.00E-03	5.00E-03	84.4	38	70	70	Note that the VOM cost includes a payment to waste and decommissioning fund.
Nuclear (Gen III)	1.6GW	kW	50	50	5	0.0E+00	1.0E+06	1.0E+06	2.0E+06	2.0E+06		3.80E+03	3.04E+03	6.78E+01	6.78E+01	5.00E-03	5.00E-03	90	38	90	90	Available sites limited to 35GW. Note that the VOM cost includes a payment to waste and decommissioning fund.
Nuclear (Gen IV)	1.6GW	kW	50	50	5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+06		4.56E+03	3.65E+03	6.78E+01	6.78E+01	6.00E-03	6.00E-03	90	38	90	90	Available sites limited to 1.2GW. Note that the VOM cost includes a payment to waste and decommissioning fund.
Nuclear (SMR)	300MW	kW	50	50	3	0.0E+00	0.0E+00	4.0E+05	1.2E+06	1.2E+06		4.70E+03	4.70E+03	1.20E+02	1.05E+02	5.00E-03	5.00E-03	90	30	85	85	Available sites limited to 21GWe. Note that the VOM cost includes a payment to waste and decommissioning fund.
Biomass Fired Generation	500MW	kW	30	30	4	2.0E+06	2.0E+06	2.0E+06	2.0E+06	2.0E+06		2.42E+03	2.36E+03	2.88E+01	2.80E+01	1.46E-02	1.46E-02	87	75	90	90	Detailed characterisation of bioenergy resources & technology routes forms part of the ETI Biomass Value Chain Modelling project.
Biomass Fired Generation with CCS	500MW	kW	30	30	4	2.0E+06	2.0E+06	2.0E+06	2.0E+06	2.0E+06		3.63E+03	2.86E+03	1.39E+02	1.10E+02	9.14E-03	5.27E-03	87	75	90	90	90% CO2 capture rate. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
Converted Biomass Plant	500MW	kW	13	13	1							2.50E+02	2.50E+02	3.50E+01	3.50E+01	1.50E-03	1.50E-03	87	75	78	78	Only available as a retrofit option for PC Coal plant, which suffers a 30% capacity derating during conversion. Costs shown here are per kW(e) of converted plant, and should be scaled down by 30% to translate into costs per kW(e) of base plant. Min load factor of 56% in winter timeslices to reflect historical operation of DRAX
IGCC Biomass	500MW	kW	30	30	4	0.0E+00	2.0E+06	2.0E+06	2.0E+06	2.0E+06		1.91E+03	1.51E+03	4.02E+01	1.10E+02	2.29E-03	1.80E-03	87	75	85	85	
IGCC Biomass with CCS	500MW	kW	30	30	4	0.0E+00	0.0E+00	2.0E+06	2.0E+06	2.0E+06		4.07E+03	2.66E+03	1.57E+02	1.02E+02	4.98E-04	3.26E-04	87	75	85	85	95% CO2 capture rate; Detailed characterisation of bioenergy resources & technology routes forms part of the ETI Biomass Value Chain Modelling project. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
Incineration of Waste	50MW	kW	30	30	2							1.71E+03	1.47E+03	5.57E+02	2.57E+02			87	75	90	90	
Waste Gasification	50MW	kW	20	20	2	0.0E+00	0.0E+00	2.0E+06	2.0E+06	2.0E+06		3.75E+03	3.75E+03					87		90	90	
Waste Gasification with CCS	50MW	kW	20	20	2	0.0E+00	0.0E+00	0.0E+00	2.0E+06	2.0E+06		5.80E+03	5.80E+03					87		90	90	90% CO2 capture rate. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
Anaerobic Digestion Gas Plant	1MW	kW	20	20	2							1.49E+03	1.22E+03	3.26E+02	2.77E+02					80	80	
Anaerobic Digestion CHP Plant	1MW	kW	20	20	2							3.16E+03	2.58E+03	2.11E+02	1.72E+02			87	50	80	80	
Oil Fired Generation			30	30	2							5.00E+02	5.00E+02					94	100	90	90	
Offshore Wind (fixed)	500MW	kW	20	20	2	2.0E+06	2.0E+06	3.0E+06	3.0E+06	3.0E+06		3.00E+03	1.50E+03	8.60E+01	5.00E+01			23	-15	35	40	Minimum build of 5.1GW by 2015.
Offshore Wind (floating)	500MW	kW	20	20	2	0.0E+00	0.0E+00	1.0E+06	3.0E+06	3.0E+06		3.00E+03	1.26E+03	8.60E+01	4.86E+01			23	-15	40	45	
Onshore Wind	500MW	kW	20	20	2	1.5E+06	1.0E+06	1.0E+06	1.0E+06	1.0E+06		1.49E+03	1.25E+03	1.76E+01	1.76E+01			19	-15	25	25	Load factors vary by region - from 16-31%. Minimum build of 3.2GW by 2015.
Hydro Power	500MW	kW	30	100	4	1.0E+06	1.0E+06	1.0E+06	1.0E+06	1.0E+06		1.65E+03	1.65E+03			2.00E-02	2.00E-02	86	0	42	42	
Tidal Stream	500MW	kW	20	20	2	1.0E+04	1.0E+04	5.0E+05	5.0E+05	5.0E+05		1.89E+03	1.05E+03	4.20E+01	1.80E+01			22	-10	27	39	
Wave Power	500MW	kW	20	20	2	1.0E+04	1.0E+04	2.0E+06	2.0E+06	2.0E+06		7.81E+03	3.54E+03	7.00E+01	1.50E+01			22	-10	27	40	
Tidal Range	500MW	kW	30	60	4	0.0E+00	1.0E+06	1.0E+06	1.0E+06	1.0E+06		3.03E+03	2.58E+03	2.30E+01	2.30E+01			22	0	20	20	
Severn Barrage	10GW	kW	30	60	4	1.0E+06	1.0E+06	1.0E+06	1.0E+06	1.0E+06		2.33E+03	2.33E+03	2.30E+01	2.30E+01			22	0	20	20	
Geothermal Plant (HSA) Heat Only	1MWth	kW	25	25	4							1.46E+03	1.31E+03	8.58E+01	8.24E+01			0		90	90	Available sites limited to 5.2GW(e), based on resource
Geothermal Plant (HSA) Electricity & Heat	1MWe	kW	25	25	4							2.59E+04	2.33E+04	1.10E+03	9.80E+02			88	0	90	90	Available sites limited to 5.2GW(e), based on resource
Geothermal Plant (EGS) Electricity & Heat	1MWe	kW	25	25	4							8.51E+03	6.56E+03	3.35E+02	3.21E+02			88	0	90	90	Available sites limited to 5.2GW(e), based on resource
Lighting (CFL)	Domestic	light	5	5	0							1.00E+00	5.00E-01							12	12	Technical Life equiv. 5250 hours
Lighting (Incandescent)	Domestic	light	1	1	0							5.00E-01	5.00E-01							12	12	Technical Life equiv. 1050 hours
Lighting (LED)	Domestic	light	10	10	0							1.00E+01	2.00E+00							12	12	Technical Life equiv. 10500 hours
Domestic Cooking (Electric)	Domestic	kW	14	14	0							4.61E+02	4.61E+02							9	9	Load factors vary by season and time of day. See ESME model for full details.
Domestic Cooking (Gas)	Domestic	kW	14	14	0							4.61E+02	4.61E+02							9	9	Load factor varies by season and time of day. See ESME model for full details.
Oil boiler - space heat	Domestic	kW	15	15	0							1.87E+02	1.87E+02	2.25E+00	2.25E+00			95		72	72	Minimum loadfactors and minimum build quantities employed for this technology in early years to ensure that the existing stock continues to be used and is not replaced unrealisitcally quickly. 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice. After 2030 minimum winter loadfactor of 5% to represent potential use as back up for ASHP in a hybrid system
Oil Boiler - hot water	Domestic	kW	15	15	0							1.87E+02	1.87E+02					95		67	67	Minimum loadfactors and minimum build quantities employed for this technology in early years to ensure that the existing stock continues to be used and is not replaced unrealisitcally quickly. 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice. After 2030 minimum winter loadfactor of 5% to represent potential use as back up for ASHP in a hybrid system
Gas boiler - space heat	Domestic	kW	15	15	0							1.67E+02	1.67E+02					95		72	72	90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice. Minimum winter loadfactor of 5% to represent use of gas heating as back up for ASHP in a hybrid system
Gas Boiler - hot water	Domestic	kW	15	15	0							1.67E+02	1.67E+02					95		67	67	90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice. Minimum winter loadfactor of 5% to represent use of gas heating as back up for ASHP in a hybrid system
Micro CHP - space heat	Domestic	kW	15	15	0							3.50E+03	2.75E+03					95	50	72	72	Solid Oxide Fuel Cell CHP. 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice
Micro CHP - hot water	Domestic	kW	15	15	0							3.50E+03	2.75E+03					95	50	67	67	Solid Oxide Fuel Cell CHP. 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice
Biomass Boiler - space heat	Domestic	kW	15	15	0							5.28E+02	4.54E+02					95		31	31	Capacity limited to 2010 capacity of oil boilers and constrained to LD dwellings and public/commercial (giving a max 35% of capacity for those building types). Availability Factor in summer and overnight timeslices curtailed to avoid 'cheating' when balancing regional heat demand and supply (prevent biomass boilers providing all the heat during these periods while other tech capacity sits idle). Minimum build of 1.5GW by 2015
Biomass Boiler - hot water	Domestic	kW	15	15	0							5.28E+02	4.54E+02					95		67	67	Capacity limited to 2010 capacity of oil boilers and constrained to LD dwellings and public/commercial (giving a max 35% of capacity for those building types). 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice.
Electric Resistive Heating - space heat	Domestic	kW	15	15	0							1.75E+02	1.75E+02					95		72	72	Minimum loadfactors and minimum build quantities employed for this technology in early years to ensure that the existing stock continues to be used and is not replaced unrealisitcally quickly (NB the minimum loadfactors reflect a mixture of overnight sotrgae heaters and on-demand heaters). 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice
Electric Resistive Heating - hot water	Domestic	kW	15	15	0							1.75E+02	1.75E+02					95		67	67	Minimum loadfactors and minimum build quantities employed for this technology in early years to ensure that the existing stock continues to be used and is not replaced unrealisitcally quickly (NB the minimum loadfactors reflect a mixture of overnight sotrgae heaters and on-demand heaters). 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice
Heat Pump (Air Source, space heat)	Domestic	kW	20	20	0						Yes	7.50E+02	5.85E+02					95		72	72	Not available for thermally poor dwellings. Winter COP downrated by 20% on the day of peak demand for heat. Can provide space heat to max 20% of Commercial/Public floorspace. 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice. Uptake: max 10,000 per yr to 2015 (to match historical deployment) then exponential uptake constraint starting at 200,000kW +10%
Heat Pump (Air Source, hot water)	Domestic	kW	20	20	0						Yes	7.50E+02	5.85E+02					95		67	67	Not available for thermally poor dwellings. Winter COP downrated by 30% on the day of peak demand for heat. Can provide space heat to max 20% of Commercial/Public floorspace. 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice. Uptake: max 10,000 per yr to 2015 (to match historical deployment) then exponential uptake constraint starting at 200,000kW +10%
Heat Pump (Ground Source, space heat)	Domestic	kW	20	20	0						Yes	1.20E+03	9.36E+02					95		72	72	Restricted to Low Density dwellings only and not applicable to thermally poor dwellings. 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice. Uptake: max 1,000 per yr to 2015 (to match historical deployment) then exponential uptake constraint starting at 50000kW +10%
Heat Pump (Ground Source, hot water)	Domestic	kW	20	20	0						Yes	1.20E+03	9.36E+02					95		67	67	Restricted to Low Density dwellings only and not applicable to thermally poor dwellings. 90% availability factor is modelled, downrated to account for smoothing of the heat demand when aggregated onto an ESME timeslice. Uptake: max 1,000 per yr to 2015 (to match historical deployment) then exponential uptake constraint starting at 50000kW +10%
Solar Thermal (Domestic south facing)	Domestic	kW	20	20	0							1.62E+03	1.25E+03					95		7.5	7.5	Regional and seasonal variations in load factor included in detailed data. Applicable to 50% MD dwellings and 75% LD dwellings. Load factor varies further by season and time of day. See ESME model for full details.
Solar Thermal (Domestic non south facing)	Domestic	kW	20	20	0							3.05E+03	2.26E+03					95		7.5	7.5	Regional and seasonal variations in load factor included in detailed data. Applicable to 50% MD dwellings and 25% LD dwellings. Load factor varies further by season and time of day. See ESME model for full details.
Solar PV (Domestic)	Domestic	kW	25	25	0	7.0E+06	7.0E+06	7.0E+06	7.0E+06	7.0E+06	Yes	3.30E+03	6.73E+02	5.00E+01	1.43E+01			0	-10	9.9	9.9	Capex declines non-linearly (e.g. 1600 in 2015, 938 in 2020). Same for fixed cost. Load factor varies by region, season and time of day. See ESME database for full details. Minimum build of 3.7GW by 2015. Exponential uptake constraint starting 1GW, +20%pa (alongside upper limit of 7GW) copied from Solar PV Farm assumptions
Solar PV (Farm)	10 MW	kW	25	30	1	7.0E+06	7.0E+06	7.0E+06	7.0E+06	7.0E+06	Yes	1.40E+03	4.49E+02	5.00E+01	1.30E+01			0	-10	9.9	9.9	Capex declines non-linearly (e.g. 925 in 2015, 625 in 2020). Same for fixed cost. Load factor varies by region, season and time of day. See ESME database for full details. Minimum build of 5.7GW by 2015. no solar farms in London. Exponential uptake constraint starting 1GW, +20%pa (alongside upper limit of 7GW)
Micro Wind	Domestic	kW	20	20	0							9.00E+03	9.00E+03					19	-10	2	2	Assumes pole mounted
Domestic Air Conditioning	Domestic	kW	15	15	0							2.50E+02	2.50E+02									
District Heating (HD)	Domestic	dwelling	30	100	1						Yes	3376-7059	3376-7059							100	100	Costs vary by region and tranche: 3 cost tranches defined for 3 levels of geographical heat density. 20.6% loss factor in T & D. Group build rate on 'DH for Dwellings': Uptake constrained by exponential growth at 10% per year and year 1 deployment to 0.5% of compatible buildings.
District Heating (MD)	Domestic	dwelling	30	100	1						Yes	5818-9906	5818-9906							100	100	Costs vary by region and tranche: 3 cost tranches defined for 3 levels of geographical heat density. 20.6% loss factor in T & D. Group build rate on 'DH for Dwellings': Uptake constrained by exponential growth at 10% per year and year 1 deployment to 0.5% of compatible buildings.
District Heating (LD)	Domestic	dwelling	30	100	1						Yes	8365-12903	8365-12903							100	100	Costs vary by region and tranche: 3 cost tranches defined for 3 levels of geographical heat density. 20.6% loss factor in T & D. Group build rate on 'DH for Dwellings': Uptake constrained by exponential growth at 10% per year and year 1 deployment to 0.5% of compatible buildings.
District Heating (Commercial floorspace)	Office	sq metre	30	100	1							1.00E+02	1.00E+02							100	100	10% Loss factor in T & D. Restricted to 20.6% of
District Heating (Public floorspace)	Office	sq metre	30	100	1							1.00E+02	1.00E+02							100	100	10% Loss factor in T & D. Restricted to 20.6% of
District Heating Biomass Boiler	50MW	kW	15	15	1							4.23E+02	3.17E+02	2.10E+01	1.60E+01			95		90	90	
District Heating Gas Boiler	50MW	kW	15	15	1							6.50E+01	6.50E+01	1.00E+00	1.00E+00			95		90	90	
Heat Pump (Large Scale Marine)	100MW	kW	20	20	1							3.00E+02	3.00E+02							90	90	
Heat Offtake for District Heat Network	500MW	kW	30	30	1	0.0E+00	5.0E+04	2.0E+05	5.0E+05	5.0E+05		1.80E+02	1.80E+02							100	100	
H2 Plant (Electrolysis)	500MW	kW	20	20	1	2.0E+06	3.0E+06	3.0E+06	3.0E+06	3.0E+06		1.27E+03	6.11E+02	5.49E+01	2.04E+01	1.00E-03	1.00E-03			90	90	
H2 Plant (Coal Gasification with CCS)	500MW	kW	40	40	4	0.0E+00	1.0E+06	2.0E+06	3.0E+06	3.0E+06		9.50E+02	6.98E+02	2.60E+01	2.60E+01	4.60E-04	4.60E-04			80	90	95% CO2 capture rate; Optional 10% biomass cofiring is also included. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
H2 Plant (Biomass Gasification)	500MW	kW	40	40	4	0.0E+00	1.0E+06	2.0E+06	3.0E+06	3.0E+06		1.06E+03	7.63E+02	4.29E+01	3.09E+01	5.77E-03	4.15E-03			80	90	
H2 Plant (Biomass Gasification with CCS)	500 MW	kW	40	40	4	0.0E+00	1.0E+06	2.0E+06	3.0E+06	3.0E+06		1.20E+03	8.28E+02	4.87E+01	3.35E+01	6.55E-03	4.50E-03			80	90	95% CO2 capture rate. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
H2 Plant (SMR)	500MW	kW	30	30	3	1.5E+06	1.5E+06	3.0E+06	3.0E+06	3.0E+06		3.00E+02	2.70E+02	2.50E+01	2.50E+01	2.40E-04	2.40E-04			90	90	
H2 Plant (SMR with CCS)	500MW	kW	30	30	4	0.0E+00	1.0E+06	2.0E+06	3.0E+06	3.0E+06		5.53E+02	4.59E+02	2.50E+01	2.50E+01	1.00E-03	1.00E-03			90	90	95% CO2 capture rate. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
Biodiesel Production	500MW	kW	25	25	2.5							1.68E+02	1.68E+02	1.60E+02	1.60E+02	5.30E-03	5.30E-03			85	85	Detailed characterisation of bioenergy resources & technology routes forms part of the ETI Biomass Value Chain Modelling project.
Biokerosine Production	500MW	kW	25	25	2.5							2.19E+02	2.19E+02	4.73E+02	4.73E+02					85	85	Detailed characterisation of bioenergy resources & technology routes forms part of the ETI Biomass Value Chain Modelling project.
Biopetrol Production	500MW	kW	25	25	2.5							8.83E+02	6.41E+02	2.08E+02	1.06E+02					85	85	Detailed characterisation of bioenergy resources & technology routes forms part of the ETI Biomass Value Chain Modelling project.
Biopetrol Production with CCS	500MW	kW	25	25	2.5	0.0E+00	1.0E+06	2.0E+06	3.0E+06	3.0E+06		8.83E+02	6.71E+02	2.08E+02	1.06E+02					85	85	100% of pure CO2 stream collected. Detailed characterisation of bioenergy resources & technology routes forms part of the ETI Biomass Value Chain Modelling project. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
SNG Plant (Biomass Gasification)	500MW	kW	30	30	4	0.0E+00	1.0E+06	2.0E+06	3.0E+06	3.0E+06		9.69E+02	7.64E+02	3.11E+01	2.45E+01	1.42E-03	1.12E-03			90	90	
SNG Plant (Biomass Gasification with CCS	500MW	kW	30	30	4	0.0E+00	1.0E+06	2.0E+06	3.0E+06	3.0E+06		1.21E+03	8.31E+02	3.88E+01	2.67E+01	1.78E-03	1.22E-03			90	90	63% CO2 capture rate; Detailed characterisation of bioenergy resources & technology routes forms part of the ETI Biomass Value Chain Modelling project. All CCS as a group limited to 0.2GW/yr for 2020-25 (demo phase), commercial deployment possible from 2025 onwards.
SNG Plant (Power to SNG)	500MW	kW	20	20	1							4.65E+03	2.10E+03	1.13E+02	4.80E+01					90	90	
Domestic Appliances			10	10	0																	Placeholder technology. Consumes electricity for appliance usage. Load factor varies by season and time of day. See ESME model for full details.
Biofuel Substitution CO2 Credit					0																	Placeholder technology. Substitutes biofuels for fossil fuels (biodiesel for diesel, biopetrol for petrol) and gives the energy system the appropriate CO2 credit
Biomass Importing CO2 Credit		TWh/yr			0	11	235	127	83	34												Placeholder technology. Substitutes the "Biomass imports" resource for the "biomass" energy vector and gives the energy system the appropriate CO2 credit. Max build rates are used to limit the annual import quantity.
Dry waste carbon accounting																						Placeholder technology. Substitutes "Dry Waste Resource" for the "Dry Waste" energy vector and gives the energy system the appropriate CO2 credit.
Biomass Production (UK)																						Placeholder technology. Substitutes "UK Biomass" resource for the "biomass" energy vector and gives the energy system the appropriate CO2 credit.
Air Capture of CO2	Plant captu	tph	20	20	2.5							1.6E+07	1.2E+07	678900	514650							Based on a hydroxide absorbent system. Note that all CO2 from gas combustion is also captured.

Technology Name	Time period to define I/O	Input 1 (per time period) 2010	2050	Product	Input 2 2010	2050	Product	Output 1 2010	2050	Product	Output 2 2010	2050	Product	Uncertainty	Distribution	Deterministic value taken to be	Relative % to ref value Min	Max	Index value	Index Min	Index Max	Ref value	Actual Min	Actual Max	Correlations
PC Coal	hour	2.444	2.087	kWh of coal				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	L	Triangular	Mean	-10	10	0.8473	0.7626	0.9320	1,326	1,193	1,459	Coal, Gas and Biomass power stations
PC Coal with CCS	hour	3.130	2.654	kWh of coal				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	H	Triangular	Mean	-40	60	0.7782	0.4669	1.2451	2,232	1,339	3,571	Coal, Gas and Biomass power stations
IGCC Coal	hour	2.324	1.775	kWh of coal				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	M	Triangular	Mean	-30	40	0.7493	0.5245	1.0490	1,369	958	1,917	Gasification plants
IGCC Coal with CCS	hour	2.920	2.330	kWh of coal				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	VH	Triangular	Mean	-40	60	0.7337	0.4402	1.1740	1,719	1,031	2,751	Gasification plants
CCGT	hour	1.871	1.653	kWh of gas				1.000	1.000	kWh of electricity	0.300	0.300	kWh of Recoverable Heat	L	Triangular	Mean	-10	10	0.8421	0.7579	0.9263	496	446	546	Coal, Gas and Biomass power stations
CCGT with CCS	hour	2.030	1.734	kWh of gas				1.000	1.000	kWh of electricity	0.300	0.300	kWh of Recoverable Heat	H	Triangular	Mean	-40	60	0.7788	0.4673	1.2461	777	466	1,242	Coal, Gas and Biomass power stations
OCGT	hour	2.632	2.326	kWh of gas				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	L					0.9500			428			
H2 Turbine	hour	2.000	1.770	kWh of hydrogen				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	MH	Triangular	Mean	-30	30	0.8475	0.5932	1.1017	500	350	650	
Gas Macro CHP	hour	2.632	2.326	kWh of gas				1.000	1.000	kWh of electricity	1.000	1.000	kWh of network hot water	L	Triangular	Mean	-10	10	0.8700	0.7830	0.9570	489	440	538	
Biomass Macro CHP	hour	5.410	5.350	kWh of biomass				1.000	1.000	kWh of electricity	3.000	3.000	kWh of network hot water	L	Triangular	Mean	-10	10	0.9750	0.8775	1.0725	3,472	3,125	3,819	
Nuclear (Legacy)	hour	2.640	2.640	kWh of nuclear				1.000	1.000	kWh of electricity															
Nuclear (Gen III)	hour	2.632	2.439	kWh of nuclear				1.000	1.000	kWh of electricity				L	Triangular	Mean	-30	40	0.8000	0.5600	1.1200	3,040	2,128	4,256	Nuclear Power Plants
Nuclear (Gen IV)	hour	2.632	2.439	kWh of nuclear				1.000	1.000	kWh of electricity				L	Triangular	Mean	-30	40	0.8000	0.5600	1.1200	3,648	2,554	5,107	Nuclear Power Plants
Nuclear (SMR)	hour	2.941	2.941	kWh of nuclear				0.800	0.800	kWh of electricity	1.800	1.800	kWh of network hot water	L	Triangular	Mean	-20	40	1.0000	0.8000	1.4000	4,700	3,760	6,580	Nuclear Power Plants
Biomass Fired Generation	hour	3.000	2.727	kWh of biomass				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	M/L	Triangular	Mode	-10	10	0.9750	0.8775	1.0725	2,357	2,121	2,592	Coal, Gas and Biomass power stations
Biomass Fired Generation with CCS	hour	3.559	2.711	kWh of biomass				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	M/L	Triangular	Mode	-40	60	0.7885	0.4731	1.2615	2,859	1,716	4,575	Coal, Gas and Biomass power stations
Converted Biomass Plant	hour	2.059	2.059	kWh of biomass				0.700	0.700	kWh of electricity	0.280	0.280	kWh of Recoverable Heat												
IGCC Biomass	hour	2.289	2.163	kWh of biomass				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	H	Triangular	Mode	-40	60	0.7885	0.4731	1.2615	1,507	904	2,411	Gasification plants
IGCC Biomass with CCS	hour	3.030	2.925	kWh of biomass				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat	H	Triangular	Mode	-40	60	0.6538	0.3923	1.0462	2,661	1,596	4,257	Gasification plants
Incineration of Waste	hour	7.143	5.556	kWh of dry waste				1.000	1.000	kWh of electricity	0.800	0.800	kWh of Recoverable Heat	L	Triangular	Mean	-10	10	0.8600	0.7740	0.9460	1,472	1,325	1,620	
Waste Gasification	hour	3.236	3.236	kWh of dry waste				1.000	1.000	kWh of electricity	0.800	0.800	kWh of Recoverable Heat	H	Triangular	Mean	-40	60	1.0000	0.6000	1.6000	3,750	2,250	6,000	Gasification plants
Waste Gasification with CCS	hour	3.846	3.846	kWh of dry waste				1.000	1.000	kWh of electricity	0.800	0.800	kWh of Recoverable Heat	H	Triangular	Mean	-40	60	1.0000	0.6000	1.6000	5,800	3,480	9,280	Gasification plants
Anaerobic Digestion Gas Plant	hour	4.720	3.650	kWh of wet waste				1.000	1.000	kWh of gas				M	Triangular	Mean	-25	35	0.8182	0.6137	1.1046	1,220	915	1,647	
Anaerobic Digestion CHP Plant	hour	7.040	6.220	kWh of wet waste				1.000	1.000	kWh of electricity	1.000	1.000	kWh of network hot water	M	Triangular	Mean	-25	35	0.8182	0.6137	1.1046	2,584	1,938	3,488	
Oil Fired Generation	hour	3.367	3.367	kWh of liquid fuel				1.000	1.000	kWh of electricity	0.400	0.400	kWh of Recoverable Heat												
Offshore Wind (fixed)		1.000	1.000	kWh of wind resource				1.000	1.000	kWh of electricity				H	Triangular	Mean	-30	50	0.5000	0.3500	0.7500	1,500	1,050	2,250	Onshore & Offshore Wind
Offshore Wind (floating)		1.000	1.000	kWh of wind resource				1.000	1.000	kWh of electricity				H	Triangular	Mean	-30	50	0.4203	0.2942	0.6305	1,261	883	1,892	Onshore & Offshore Wind
Onshore Wind		1.000	1.000	kWh of wind resource				1.000	1.000	kWh of electricity				L/M	Triangular	Mean	-30	30	0.8394	0.5876	1.0913	1,250	875	1,625	Onshore & Offshore Wind
Hydro Power		1.000	1.000	kWh of hydro resource				1.000	1.000	kWh of electricity				L											Hydro Power & Pumped Storage
Tidal Stream		1.000	1.000	kWh of tidal stream resource				1.000	1.000	kWh of electricity				H	Triangular	Mode	-5	40	0.5556	0.5278	0.7778	1,050	998	1,470	
Wave Power		1.000	1.000	kWh of wave resource				1.000	1.000	kWh of electricity				H	Triangular	Mean	-40	60	0.4533	0.2720	0.7252	3,540	2,124	5,664	
Tidal Range		1.000	1.000	kWh of tidal range resource				1.000	1.000	kWh of electricity				L	Triangular	Mean	-30	50	0.8515	0.5960	1.2772	2,580	1,806	3,870	Tidal Range & Severn Barrage
Severn Barrage		1.000	1.000	kWh of tidal range resource				1.000	1.000	kWh of electricity				L	Triangular	Mean	-30	50	1.0000	0.7000	1.5000	2,330	1,631	3,495	Tidal Range & Severn Barrage
Geothermal Plant (HSA) Heat Only		2.129	2.129	Geothermal Heat				1.000	1.000	Network Hot Water				L	Triangular	Mean	-12	12	0.9000	0.7942	1.0058	1,313	1,158	1,467	Geothermal
Geothermal Plant (HSA) Electricity & Heat		19.533	19.533	Geothermal Heat				1.000	1.000	Electricity	6.444	6.444	Network Hot Water	M	Triangular	Mean	-22	22	0.9000	0.7045	1.0955	23,282	18,225	28,339	Geothermal
Geothermal Plant (EGS) Electricity & Heat		6.874	6.874	Geothermal Heat				1.000	1.000	Electricity	3.226	3.226	Network Hot Water	M	Triangular	Mean	-39	39	0.9000	0.5523	1.2477	8,556	5,251	11,861	Geothermal
Lighting (CFL)		0.024	0.024	kWh of electricity				1500	1500	Lumen hours of light				L											
Lighting (Incandescent)		0.102	0.102	kWh of electricity				1500	1500	Lumen hours of light				L											
Lighting (LED)		0.019	0.013	kWh of electricity				1500	1500	Lumen hours of light				M	Triangular	Mean	-30	30	0.2000	0.1400	0.2600	2	1	3	
Domestic Cooking (Electric)	hour	1.330	1.330	kWh of electricity				1.000	1.000	kWh of cooking				L											
Domestic Cooking (Gas)	hour	1.670	1.670	kWh of gas				1.000	1.000	kWh of cooking				L											
Oil boiler - space heat	hour	1.150	1.100	kWh of liquid fuel				1.000	1.000	kWh of space Heat				L											
Oil Boiler - hot water	hour	1.370	1.310	kWh of liquid fuel				1.000	1.000	kWh of hot Water				L											
Gas boiler - space heat	hour	1.150	1.100	kWh of gas				1.000	1.000	kWh of space Heat				L											
Gas Boiler - hot water	hour	1.370	1.310	kWh of gas				1.000	1.000	kWh of hot Water				L											
Micro CHP - space heat	hour	8.300	8.300	kWh of gas				5.500	5.500	kWh of space Heat	1.000	1.000	kWh of electricity												
Micro CHP - hot water	hour	8.300	8.300	kWh of gas				3.262	3.262	kWh of hot Water	1.000	1.000	kWh of electricity												
Biomass Boiler - space heat	hour	1.149	1.149	kWh of biomass				1.000	1.000	kWh of space Heat				L											
Biomass Boiler - hot water	hour	1.716	1.716	kWh of biomass				1.000	1.000	kWh of hot Water				L											
Electric Resistive Heating - space heat	hour	1.111	1.111	kWh of electricity				1.000	1.000	kWh of space Heat				L											
Electric Resistive Heating - hot water	hour	1.111	1.111	kWh of electricity				1.000	1.000	kWh of hot Water				L											
Heat Pump (Air Source, space heat)	hour	0.336	0.280	kWh of electricity in winter	0.233	0.196	kWh of electricity in sum	1.000	1.000	kWh of space Heat				L/M	Triangular	Mean	-30	30	0.7800	0.5460	1.0140	585	410	761	A/C & Heat pumps
Heat Pump (Air Source, hot water)	hour	0.595	0.496	kWh of electricity in winter	0.350	0.294	kWh of electricity in sum	1.000	1.000	kWh of hot Water				L/M	Triangular	Mean	-30	30	0.7800	0.5460	1.0140	585	410	761	A/C & Heat pumps
Heat Pump (Ground Source, space heat)	hour	0.318	0.260	kWh of electricity				1.000	1.000	kWh of space Heat				L/M	Triangular	Mean	-30	30	0.7800	0.5460	1.0140	936	655	1,217	A/C & Heat pumps
Heat Pump (Ground Source, hot water)	hour	0.635	0.530	kWh of electricity				1.000	1.000	kWh of hot Water				L/M	Triangular	Mean	-30	30	0.7800	0.5460	1.0140	936	655	1,217	A/C & Heat pumps
Solar Thermal (Domestic south facing)	hour	2.000	2.000	kWh of solar resource				1.000	1.000	kWh of hot Water				M	Triangular	Mean	-40	60	0.7729	0.4637	1.2366	1,249	749	1,998	
Solar Thermal (Domestic non south facing)	hour	2.000	2.000	kWh of solar resource				1.000	1.000	kWh of hot Water				M	Triangular	Mean	-40	60	0.7433	0.4460	1.1892	2,264	1,358	3,622	
Solar PV (Domestic)	hour	5.000	3.571	kWh of solar resource				1.000	1.000	kWh of electricity				H	Triangular	Mode	-44	39	0.2039	0.1135	0.2836	673	374	936	Solar PV
Solar PV (Farm)	hour	5.000	3.571	kWh of solar resource				1.000	1.000	kWh of electricity				H	Triangular	Mode	-44	39	0.3207	0.1784	0.4460	449	250	624	Solar PV
Micro Wind	hour							1.000	1.000	kWh of electricity				M											
Domestic Air Conditioning	hour	0.330	0.270	kWh of electricity				1.000	1.000	kWh of cooling															A/C & Heat pumps
District Heating (HD)	year			kWh of network hot water						kWh of hot Water			kWh of space Heat		Triangular	Mean	-17	17	1.0000	0.8300	1.1700				District Heating Connections
District Heating (MD)	year			kWh of network hot water						kWh of hot Water			kWh of space Heat		Triangular	Mean	-17	17	1.0000	0.8300	1.1700				District Heating Connections
District Heating (LD)	year			kWh of network hot water						kWh of hot Water			kWh of space Heat		Triangular	Mean	-17	17	1.0000	0.8300	1.1700				District Heating Connections
District Heating (Commercial floorspace)	year			kWh of network hot water						kWh of hot Water			kWh of space Heat												District Heating Connections
District Heating (Public floorspace)	year			kWh of network hot water						kWh of hot Water			kWh of space Heat												District Heating Connections
District Heating Biomass Boiler		1.230	1.230	kWh of biomass				1.000	1.000	kWh of network hot water															
District Heating Gas Boiler		1.060	1.060	kWh of gas				1.000	1.000	kWh of network hot water															
Heat Pump (Large Scale Marine)		0.285	0.285	kWh of electricity				1.000	1.000	kWh of network hot water															
Heat Offtake for District Heat Network	hour	1.000	1.000	kWh of Recoverable Heat	0.160	0.160	kWh of electricity	1.000	1.000	kWh of network hot water				L											
H2 Plant (Electrolysis)	hour	1.449	1.099	kWh of electricity				1.000	1.000	kWh of hydrogen				M/H	Triangular	Mean	-25	35	0.4824	0.3618	0.6512	611	458	824	
H2 Plant (Coal Gasification with CCS)	hour	1.330	1.180	kWh of coal	0.067	0.067	kWh of electricity	1.000	1.000	kWh of hydrogen				M	Triangular	Mean	-40	60	0.7347	0.4408	1.1756	698	419	1,117	Gasification plants
H2 Plant (Biomass Gasification)	hour	1.818	1.694	kWh of biomass				1.000	1.000	kWh of hydrogen				M	Triangular	Mode	-40	60	0.7188	0.4313	1.1500	763	458	1,220	Gasification plants
H2 Plant (Biomass Gasification with CCS)	hour	2.180	1.865	kWh of biomass				1.000	1.000	kWh of hydrogen				M	Triangular	Mode	-40	60	0.6875	0.4125	1.1000	828	497	1,325	Gasification plants
H2 Plant (SMR)	hour	1.330	1.200	kWh of gas	0.003	0.003	kWh electricity	1.000	1.000	kWh of Hydrogen															
H2 Plant (SMR with CCS)	hour	1.430	1.238	kWh of gas	0.074	0.074	kWh of electricity	1.000	1.000	kWh of hydrogen				M	Triangular	Mean	-40	60	0.8291	0.4975	1.3266	459	275	734	Gasification plants
Biodiesel Production	hour	1.810	1.810	kWh of biomass	0.190	0.190	kWh of gas	1.000	1.000	kWh of liquid fuel															
Biokerosine Production	hour	1.430	1.430	kWh of biomass	0.375	0.375	kWh of electricity	1.000	1.000	kWh of liquid fuel															
Biopetrol Production	hour	2.090	2.090	kWh of biomass				1.000	1.000	kWh of liquid fuel															
Biopetrol Production with CCS	hour	2.090	2.090	kWh of biomass				1.000	1.000	kWh of liquid fuel															
SNG Plant (Biomass Gasification)	hour	1.562	1.428	kWh of biomass				1.000	1.000	kWh of gas				VH	Triangular	Mode	-40	60	0.7885	0.4731	1.2615	764	458	1,222	Gasification plants
SNG Plant (Biomass Gasification with CCS	hour	1.660	1.540	kWh of biomass				1.000	1.000	kWh of gas				VH	Triangular	Mode	-40	60	0.6875	0.4125	1.1000	831	499	1,330	Gasification plants
SNG Plant (Power to SNG)	hour	1.936	1.825	kWh of electricity				1.000	1.000	kWh of gas															
Domestic Appliances																									
Biofuel Substitution CO2 Credit																									
Biomass Importing CO2 Credit																									
Dry waste carbon accounting																									
Biomass Production (UK)																									
Air Capture of CO2	hour	######	######	kWh of electricity	#######	#######	kWh of gas	1.409	1.409	tonnes of captured CO2				VH	Triangular	Mean	-40	60	0.7586	0.4552	1.2138	########	7,227,000	########	

Technology Name	Indicatve Scale	Capacity Unit	Economic Life	Technical Life	Construction Period	Max annual build rate					Investment cost		Diurnal Storage Power costs		Diurnal Storage Power to Volume constraints		Peak Contribution Factor (if electricity)	Flexibility Factor	% loss factor			Distribution Info	Correlations	Additional Comments	2050 Cost Distribution
			years	years	years	capacity units / year					£ / capacity unit		£ / kW		Disharge time (hours)		%	%	2010	2050	Type	2050 Capex Uncertainty		Text	Text
						2010	2020	2030	2040	2050	2010	2050	2010	2050	Min	Max									
Electricity Transmission Offshore	175km, 1200M	kW-km	50	50	1						6.00E+00	4.74E+00							1.50%	1.38%	Delivered electricity	L			
Electricity Transmission Onshore	220kV, 300MV	kW-km	50	50	1						1.16E+00	9.16E-01							1.50%	1.38%	Delivered electricity	L	Electrictiy T & D		
Electricity Distribution Network	Average dome	kW	50	50	1						6.30E+01	9.50E+01							5-7%	4-5%	Delivered electricity	L	Electrictiy T & D	Distribution loss factors vary by region and by year.	
Captured CO2 transmission Offshore	No sizing assu	tCO2/hr-km	30	30	1						1100-4200	1100-4200										L	H2 and CO2 pipe	Cost vary by storage region. Also additional fixed costs of 15-150 £/(km t/hr) per year.	
Captured CO2 transmission Onshore	No sizing assu	tCO2/hr-km	30	30	1						1.05E+03	1.05E+03										L	H2 and CO2 pipe		
Hydrogen Transmission	15" main, 300	kW-km	50	50	1						2.54E-01	2.54E-01							0.50%	0.50%		L	H2 and CO2 pipe		
EV Charging Point (private off street)	Per vehicle sh	vehicle	9	13	1						5.00E+02	5.00E+02												Represents the cost per electric vehicle. Available to LGVs and 60% of cars	
EV Charging Point (workplace)	Per vehicle sh	vehicle	9	13	1						1.00E+03	1.00E+03												Represents the cost per electric vehicle. Available to 5% of cars	
EV Charging Point (on street outside home)	Per vehicle sh	vehicle	9	13	1						2.00E+03	2.00E+03												Represents the cost per electric vehicle. Available to 10% of cars	
Natural gas vehicle refuelling	Per vehicle sh	vehicle	9	13	1						7.80E+02	7.80E+02												Represents the cost per vehicle.	
Hydrogen vehicle refuelling	Per vehicle sh	vehicle	9	13	1						1.65E+03	1.65E+03												Represents the cost per vehicle.	
Pumped Storage of Electricity	10GWh	kWh	30	100	4	1.00E+06	1.00E+06	1.00E+06	1.00E+06	1.00E+06	78	78	453	453	4	24	96	100	19%	19%	per cycle	L	Hydro Power & F	Wales & Scotland only. Existing stock 10.4 & 16.4GWh resp. Further potential assumed to be 19 & 40GWh resp.	
Compressed Air Storage of Electricity	10GWh	kWh	30	30	4	7.30E+05	7.30E+05	7.30E+05	7.30E+05	7.30E+05	10	10	518	518	8	26	96	100	40%	40%	per cycle	L	CAES & H2 Stor	Represents below-ground storage. Restricted to regions with suitable geology: North West and Yorkshire & Humber only	
Battery - NaS	100MWh	kWh	15	15	1						241	229	350	333	6.000	8	96	100	25%	25%	per cycle	L			Triangular cost distribution: +/-5% for both energy and power costs
Battery - Li-ion	5MWh	kWh	15	15	1						668	267	405	271	1.000	4	96	100	9%	9%	per cycle	H			Triangular cost distribution: +/-50% for the energy costs
Flow battery - Redox	10MWh	kWh	15	15	1						443	266	598	359	2.000	8	96	100	25%	25%	per cycle	H			Triangular cost distribution: +/-40% for both energy and power costs
Flow battery - Zn-Br	10MWh	kWh	15	15	1						280	252	385	347	1.000	5	96	100	40%	40%	per cycle	M			Triangular cost distribution: +/-10% for both energy and power costs
Pumped Heat Storage of Electricity	50MWh	kWh	20	20	1						50	10	600	300	5	20	96	100	30%	25%	per cycle				
Hydrogen storage - shallow salt cavern	10GWh	kWh	20	100	4	0.00E+00	1.50E+06				9.50E+00	9.50E+00							3%	3%	per cycle			Additional Fixed Costs of £0.6/year/kWh of working volume. Restricted to regions with suitable geology: North East only. Capable of seasonal storage equiavlant to 4 times daily working volume	
Hydrogen storage - medium salt cavern	10GWh	kWh	20	100	4	0.00E+00	1.50E+06				9.50E+00	9.50E+00							5%	5%	per cycle			Additional Fixed Costs of £0.6/year/kWh of working volume. Restricted to regions with suitable geology: North West only. Capable of seasonal storage equiavlant to 10 times daily working volume	
Hydrogen storage - deep salt cavern	10GWh	kWh	20	100	4	0.00E+00	1.50E+06				9.50E+00	9.50E+00							8%	8%	per cycle			Additional Fixed Costs of £0.6/year/kWh of working volume. Restricted to regions with suitable geology: Yorkshire & Humber only. Capable of seasonal storage equiavlant to 10 times daily working volume	
Geological Storage of CO2 - Southern North Sea		tCO2/hour	30	30	5						See notes											H		Capex £327,000/(t/hr), fixed cost £8,800/(t/hr)/yr. Implied total cost of storage: 4.8/LF £/tCO2, where LF is the annual loadfactor for CO2 injection.	
Geological Storage of CO2 - Central North Sea		tCO2/hour	30	30	5						See notes											H		Capex £526,000/(t/hr), fixed cost £56,000/(t/hr)/yr. Implied total cost of storage: 13.8/LF £/tCO2, where LF is the annual loadfactor for CO2 injection.	
Geological Storage of CO2 - East Irish Sea		tCO2/hour	30	30	5						See notes											H		Capex £280,000/(t/hr), fixed cost £39,000/(t/hr)/yr. Implied total cost of storage: 8.1/LF £/tCO2, where LF is the annual loadfactor for CO2 injection.	
Building Space Heat Storage	Domestic: 50-	kWh	15	15	0						4.30E+01	4.30E+01			2	2			0.56%	0.56%	per hour	L		Space heat storage limited to a maximum of 3.3kWh per house (52litres) for HD dwellings, 6.2kWh (99litres) for MD dwellings and 7.2kWh (115litres) for LD dwellings.	
Building Hot Water Storage	Domestic: 85	kWh	15	15	0						4.30E+01	4.30E+01			2	2			0.56%	0.56%	per hour	L		Hot water storage limited to a maximum of 5.3kWh per house (85litres) for all dwellings.	
District Heat Storage	Large hot wate	kWh	30	30	1						1.90E+00	1.90E+00			1	1			0.56%	0.56%	per hour	L			
Interconnector Benelux-Germany (Electricity)	GW	kW	35	50	1.5						Not costed in ESME. F						75	0						1GW existing. Assume further 0GW built by 2050 in reference case	
Interconnector France (Electricity)	GW	kW	35	50	1.5						Not costed in ESME. F						62	0						2GW existing. Assume further 3GW built by 2050 in reference case	
Interconnector Ireland (Electricity)	GW	kW	35	50	1.5						Not costed in ESME. F						26	0						0.5GW existing. Assume further 1.5GW built by 2050 in reference case	
Interconnector Nordel (Electricity)	GW	kW	35	50	1.5						Not costed in ESME. F						78	0						0GW existing. Assume further 2GW built by 2050 in reference case	
Gas Distribution Network	Average dome	kW	50	50	1						Not costed in ESME. F								0.53%	0.53%	Delivered gas				
Gas NCS Entry Point	GW	kW		9999							Not costed in ESME. F													32GW fixed capacity	
Gas UKCS Entry Point	GW	kW		9999							Not costed in ESME. F													Total of 102GW fixed capacity, across 7 nodes.	
Interconnector BBL (Gas)	GW	kW		9999							Not costed in ESME. F													20GW fixed capacity	
Interconnector IUK (Gas)	GW	kW		9999							Not costed in ESME. F													32GW fixed capacity	
Interconnector Moffat (Gas)	GW	kW		9999							Not costed in ESME. F													22GW fixed capacity. Demand for an export flow of 27.8 TWh specified.	
LNG Regasification Terminal	GW	kW		9999							Not costed in ESME. F													Total of 77GW fixed capacity, across 3 nodes.	
Gas Long Range Storage	TWh	kWh	20	100	4						6.07E-02	6.07E-02			2400	2400			1%	1%	per cycle			35TWh of existing capacity. Capable of seasonal storage equiavlant to 10 times daily working volume.	
Gas Medium Range Storage	TWh	kWh	20	100	4						7.51E-02	7.51E-02			1500	1500			1%	1%	per cycle			15TWh of existing capacity. Capable of seasonal storage equiavlant to 10 times daily working volume.	
Gas Short Range Storage	GWh	kWh	20	100	4						8.96E-02	8.96E-02			600	600			1%	1%	per cycle			0.5 TWh of existing capacity. Capable of seasonal storage equiavlant to 4 times daily working volume.	
Gas T Linepack	GWh	kWh	20	100	4						Not costed in ESME. F				1	24			1%	1%	per cycle			0.4 TWh of existing capacity.	
Gas Transmission		kW-km	50	50	1						Not costed in ESME. F														

Technology Name	Capacity Unit	Technical Life (years)	Energy Inputs per year per unit (kWh)						Process emissions (Mt CO2 per year)	CCS Capture Rate		Capital Cost		Fixed Costs		Additional Comments
			kWh of coal	kWh of gas	kWh of biomass	kWh of hydrogen	kWh of electricity	kWh of liquid fuel		% Capture		£ / unit		£ / unit / year		
										2010	2050	2010	2050	2010	2050	
Industry I7 HTP Baseline	Process energy demand relative to 2010	0	3.9E+09	1.4E+10	2.5E+09	0.0E+00	2.8E+09	3.7E+08	3.8	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	Load factor varies by season and time of day. Deployment of all non-baseline technologies restricted to 0.005 units in year 1 and max growth of 15% pa. Industry CCS not permitted before 2025.
Industry I7 HTP Bio Sw	Process energy demand relative to 2010	33	0.0E+00	0.0E+00	2.0E+10	0.0E+00	2.8E+09	0.0E+00	3.8	0	0	1.6E+09	1.6E+09	4.9E+07	4.9E+07	As above
Industry I7 HTP Gas Sw	Process energy demand relative to 2010	30	2.6E+07	1.7E+10	2.5E+09	0.0E+00	2.8E+09	3.7E+08	3.8	0	0	2.0E+08	1.6E+08	0.0E+00	0.0E+00	As above
Industry I7 HTP Hyd Sw	Process energy demand relative to 2010	20	2.6E+07	3.0E+09	2.5E+09	1.4E+10	2.8E+09	3.7E+08	3.8	0	0	8.0E+07	8.0E+07	1.2E+08	1.2E+08	As above
Industry I7 HTP CCS	Process energy demand relative to 2010	20	3.9E+09	1.4E+10	2.5E+09	0.0E+00	2.8E+09	3.7E+08	3.8	76	81	4.6E+09	4.5E+09	0.0E+00	0.0E+00	As above
Industry I7 HTP Bio Sw CCS	Process energy demand relative to 2010	23	0.0E+00	0.0E+00	2.0E+10	0.0E+00	2.8E+09	0.0E+00	3.8	76	81	7.6E+09	7.4E+09	4.9E+07	4.9E+07	As above
Industry I7 HTP Gas Sw CCS	Process energy demand relative to 2010	20	2.6E+07	1.7E+10	2.5E+09	0.0E+00	2.8E+09	3.7E+08	3.8	76	81	4.5E+09	4.4E+09	0.0E+00	0.0E+00	As above
Industry I7 HTP Hyd Sw CCS	Process energy demand relative to 2010	23	2.6E+07	3.0E+09	2.5E+09	1.4E+10	2.8E+09	3.7E+08	3.8	54	58	2.1E+09	2.1E+09	1.2E+08	1.2E+08	As above
Industry I7 HTP Low Carbon Cement CCS	Process energy demand relative to 2010	33	3.9E+09	1.4E+10	2.5E+09	0.0E+00	2.8E+09	3.7E+08	3.8	34	44	2.0E+09	2.6E+09	1.5E+08	1.9E+08	As above
Industry I7 LTP Baseline	Process energy demand relative to 2010	0	2.9E+08	1.0E+09	1.9E+08	0.0E+00	2.1E+08	2.8E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I7 DaS Baseline	Process energy demand relative to 2010	0	2.8E+08	9.6E+08	1.8E+08	0.0E+00	2.0E+08	2.6E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I7 Mot Baseline	Process energy demand relative to 2010	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+09	0.0E+00	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I7 SpH Baseline	Process energy demand relative to 2010	0	7.8E+07	2.7E+08	4.9E+07	0.0E+00	5.6E+07	7.3E+06	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I7 SpH Bio Sw	Process energy demand relative to 2010	15	1.9E+07	6.7E+07	3.1E+08	0.0E+00	5.6E+07	1.8E+06	0.0	0	0	2.2E+07	2.2E+07	5.9E+05	5.9E+05	As above
Industry I7 Oth Baseline	Process energy demand relative to 2010	0	4.2E+08	1.4E+09	2.6E+08	0.0E+00	3.0E+08	3.9E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I1 HTP Baseline	Process energy demand relative to 2010	0	5.6E+09	7.5E+09	0.0E+00	0.0E+00	8.3E+09	4.0E+08	3.1	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I1 HTP CCS	Process energy demand relative to 2010	20	5.6E+09	7.5E+09	0.0E+00	0.0E+00	8.3E+09	4.0E+08	3.1	80	80	2.2E+09	1.9E+09	0.0E+00	0.0E+00	As above
Industry I1 HTP Bio Sw	Process energy demand relative to 2010	25	4.1E+09	4.2E+09	1.2E+10	0.0E+00	1.6E+09	3.3E+08	1.8	0	0	9.8E+08	9.8E+08	2.7E+07	2.7E+07	As above
Industry I1 HTP Bio Sw CCS	Process energy demand relative to 2010	21	4.1E+09	4.2E+09	1.2E+10	0.0E+00	1.6E+09	3.3E+08	1.8	80	80	3.8E+09	3.5E+09	2.7E+07	2.7E+07	As above
Industry I1 HTP Elec Sw	Process energy demand relative to 2010	25	5.3E+08	3.1E+09	0.0E+00	0.0E+00	1.8E+10	2.5E+07	6.7	0	0	6.0E+08	6.0E+08	1.0E+08	1.0E+08	As above
Industry I1 HTP Gas Sw	Process energy demand relative to 2010	25	5.5E+08	1.7E+10	0.0E+00	0.0E+00	3.9E+09	2.5E+07	-1.5	0	0	7.3E+08	7.3E+08	1.3E+08	1.3E+08	As above
Industry I1 HTP Gas Sw CCS	Process energy demand relative to 2010	20	5.5E+08	1.7E+10	0.0E+00	0.0E+00	3.9E+09	2.5E+07	-1.5	80	80	1.4E+09	1.3E+09	1.3E+08	1.3E+08	As above
Industry I1 HTP Hyd Sw	Process energy demand relative to 2010	20	1.9E+08	0.0E+00	0.0E+00	2.1E+10	0.0E+00	4.0E+08	3.1	0	0	1.2E+08	1.2E+08	1.7E+08	1.7E+08	As above
Industry I1 HTP Hyd Sw CCS	Process energy demand relative to 2010	20	1.9E+08	0.0E+00	0.0E+00	2.1E+10	0.0E+00	4.0E+08	3.1	76	76	1.2E+09	1.1E+09	1.7E+08	1.7E+08	As above
Industry I1 Mot Baseline	Process energy demand relative to 2010	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+09	0.0E+00	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I1 Oth Baseline	Process energy demand relative to 2010	0	6.9E+08	9.2E+08	0.0E+00	0.0E+00	1.0E+09	4.9E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I4 LTP Baseline	Process energy demand relative to 2010	0	2.6E+08	1.7E+10	0.0E+00	0.0E+00	4.0E+09	2.0E+09	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I4 LTP Heat pumps	Process energy demand relative to 2010	20	2.1E+08	1.7E+10	0.0E+00	0.0E+00	4.4E+09	1.7E+09	0.0	0	0	1.0E+08	1.0E+08	5.1E+06	5.1E+06	As above
Industry I4 DaS Baseline	Process energy demand relative to 2010	0	2.4E+07	1.9E+09	0.0E+00	0.0E+00	4.6E+08	2.3E+08	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I4 Mot Baseline	Process energy demand relative to 2010	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+09	0.0E+00	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I4 Oth Baseline	Process energy demand relative to 2010	0	5.8E+07	3.8E+09	0.0E+00	0.0E+00	4.0E+09	4.6E+08	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I2 HTP Baseline	Process energy demand relative to 2010	0	9.0E+07	3.9E+09	0.0E+00	0.0E+00	5.1E+08	2.3E+08	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I2 HTP Bio Sw	Process energy demand relative to 2010	30	9.0E+07	2.0E+09	2.0E+09	0.0E+00	5.1E+08	2.3E+08	0.0	0	0	1.7E+08	1.7E+08	4.6E+06	4.6E+06	As above
Industry I2 HTP Bio Sw CCS	Process energy demand relative to 2010	24	9.0E+07	2.0E+09	2.0E+09	0.0E+00	5.1E+08	2.3E+08	0.0	66	66	4.7E+08	4.5E+08	4.6E+06	4.6E+06	As above
Industry I2 HTP Hyd Sw	Process energy demand relative to 2010	20	9.0E+07	2.0E+09	0.0E+00	2.0E+09	5.1E+08	2.3E+08	0.0	0	0	1.1E+07	1.1E+07	1.6E+07	1.6E+07	As above
Industry I2 LTP Baseline	Process energy demand relative to 2010	0	3.9E+08	1.7E+10	0.0E+00	0.0E+00	2.2E+09	9.8E+08	1.4	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I2 LTP CCS	Process energy demand relative to 2010	15	3.9E+08	1.7E+10	0.0E+00	0.0E+00	2.2E+09	9.8E+08	1.4	66	66	1.3E+09	1.3E+09	0.0E+00	0.0E+00	As above
Industry I2 LTP Bio Sw	Process energy demand relative to 2010	15	3.9E+08	1.2E+10	5.6E+09	0.0E+00	2.2E+09	0.0E+00	1.4	0	0	4.6E+08	4.6E+08	1.2E+07	1.2E+07	As above
Industry I2 LTP Bio Sw CCS	Process energy demand relative to 2010	19	3.9E+08	1.2E+10	5.6E+09	0.0E+00	2.2E+09	0.0E+00	1.4	66	66	2.0E+09	1.9E+09	1.2E+07	1.2E+07	As above
Industry I2 LTP Gas Sw	Process energy demand relative to 2010	15	3.9E+08	1.8E+10	0.0E+00	0.0E+00	2.2E+09	0.0E+00	1.4	0	0	5.3E+06	4.4E+06	0.0E+00	0.0E+00	As above
Industry I2 LTP Gas Sw CCS	Process energy demand relative to 2010	20	3.9E+08	1.8E+10	0.0E+00	0.0E+00	2.2E+09	0.0E+00	1.4	68	68	1.4E+09	1.3E+09	0.0E+00	0.0E+00	As above
Industry I2 LTP Hyd Sw	Process energy demand relative to 2010	20	3.9E+08	2.5E+09	0.0E+00	1.4E+10	2.2E+09	9.8E+08	1.4	0	0	8.0E+07	8.0E+07	1.2E+08	1.2E+08	As above
Industry I2 LTP Hyd Sw CCS	Process energy demand relative to 2010	20	3.9E+08	2.5E+09	0.0E+00	1.4E+10	2.2E+09	9.8E+08	1.4	41	41	4.6E+08	4.3E+08	1.2E+08	1.2E+08	As above
Industry I2 Mot Baseline	Process energy demand relative to 2010	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.8E+09	0.0E+00	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I2 SpH Baseline	Process energy demand relative to 2010	0	1.8E+07	8.7E+08	0.0E+00	0.0E+00	1.1E+08	5.1E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I2 SpH Bio Sw	Process energy demand relative to 2010	15	4.5E+06	2.2E+08	7.0E+08	0.0E+00	1.1E+08	1.3E+07	0.0	0	0	5.7E+07	5.7E+07	1.6E+06	1.6E+06	As above
Industry I2 Oth Baseline	Process energy demand relative to 2010	0	9.8E+07	4.3E+09	0.0E+00	0.0E+00	5.9E+09	2.5E+08	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I8 LTP Baseline	Process energy demand relative to 2010	0	0.0E+00	3.0E+09	0.0E+00	0.0E+00	9.0E+08	3.8E+10	2.1	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I8 LTP CCS	Process energy demand relative to 2010	20	0.0E+00	3.0E+09	0.0E+00	0.0E+00	9.0E+08	3.8E+10	2.1	43	55	4.2E+09	5.3E+09	0.0E+00	0.0E+00	As above
Industry I8 LTP Bio Sw	Process energy demand relative to 2010	30	0.0E+00	1.4E+09	4.0E+10	0.0E+00	9.0E+08	0.0E+00	2.1	0	0	3.2E+09	3.2E+09	0.0E+00	0.0E+00	As above
Industry I8 LTP Bio Sw CCS	Process energy demand relative to 2010	25	0.0E+00	1.4E+09	4.0E+10	0.0E+00	9.0E+08	0.0E+00	2.1	43	55	8.6E+09	1.0E+10	0.0E+00	0.0E+00	As above
Industry I8 LTP Gas Sw	Process energy demand relative to 2010	30	0.0E+00	4.1E+10	0.0E+00	0.0E+00	9.0E+08	0.0E+00	2.1	0	0	1.9E+09	1.6E+09	0.0E+00	0.0E+00	As above
Industry I8 LTP Gas Sw CCS	Process energy demand relative to 2010	24	0.0E+00	4.1E+10	0.0E+00	0.0E+00	9.0E+08	0.0E+00	2.1	43	55	5.3E+09	5.9E+09	0.0E+00	0.0E+00	As above
Industry I8 LTP Hyd Sw	Process energy demand relative to 2010	20	0.0E+00	1.4E+09	0.0E+00	4.0E+10	9.0E+08	0.0E+00	2.1	0	0	2.2E+08	2.2E+08	3.2E+08	3.2E+08	As above
Industry I8 LTP Hyd Sw CCS	Process energy demand relative to 2010	20	0.0E+00	1.4E+09	0.0E+00	4.0E+10	9.0E+08	0.0E+00	2.1	38	49	9.6E+08	1.1E+09	3.2E+08	3.2E+08	As above
Industry I8 Mot Baseline	Process energy demand relative to 2010	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+09	0.0E+00	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I8 SpH Baseline	Process energy demand relative to 2010	0	0.0E+00	7.7E+08	0.0E+00	0.0E+00	2.3E+08	9.8E+09	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I8 SpH Bio Sw	Process energy demand relative to 2010	15	0.0E+00	1.9E+08	7.9E+09	0.0E+00	2.3E+08	2.4E+09	0.0	0	0	6.5E+08	6.5E+08	1.8E+07	1.8E+07	As above
Industry I8 Oth Baseline	Process energy demand relative to 2010	0	0.0E+00	5.7E+08	0.0E+00	0.0E+00	9.0E+08	7.2E+09	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I3 HTP Baseline	Process energy demand relative to 2010	0	2.0E+07	8.9E+08	0.0E+00	0.0E+00	6.9E+08	6.7E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I3 LTP Baseline	Process energy demand relative to 2010	0	2.4E+08	8.6E+09	0.0E+00	0.0E+00	6.8E+09	9.7E+08	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I3 Mot Baseline	Process energy demand relative to 2010	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E+08	0.0E+00	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I3 SpH Baseline	Process energy demand relative to 2010	0	2.7E+08	7.3E+09	0.0E+00	0.0E+00	6.0E+09	1.2E+09	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I3 SpH Bio Sw	Process energy demand relative to 2010	15	6.6E+07	1.8E+09	6.6E+09	0.0E+00	6.0E+09	3.0E+08	0.0	0	0	5.4E+08	5.4E+08	1.5E+07	1.5E+07	As above
Industry I3 Oth Baseline	Process energy demand relative to 2010	0	2.8E+07	9.5E+08	0.0E+00	0.0E+00	5.6E+09	1.7E+08	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I5 LTP Baseline	Process energy demand relative to 2010	0	2.6E+08	4.6E+09	0.0E+00	0.0E+00	2.1E+09	1.8E+08	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I5 DaS Baseline	Process energy demand relative to 2010	0	4.0E+08	7.3E+09	0.0E+00	0.0E+00	3.3E+09	2.9E+08	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I5 DaS Bio Sw	Process energy demand relative to 2010	15	1.0E+08	1.8E+09	6.0E+09	0.0E+00	3.3E+09	7.3E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I5 Mot Baseline	Process energy demand relative to 2010	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E+09	0.0E+00	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I5 SpH Baseline	Process energy demand relative to 2010	0	6.7E+07	1.2E+09	0.0E+00	0.0E+00	5.5E+08	4.3E+07	0.0	0	0	5.4E+08	5.4E+08	1.5E+07	1.5E+07	As above
Industry I5 SpH Bio Sw	Process energy demand relative to 2010	15	1.7E+07	3.1E+08	1.0E+09	0.0E+00	5.5E+08	1.1E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I5 Oth Baseline	Process energy demand relative to 2010	0	9.8E+07	1.8E+09	0.0E+00	0.0E+00	3.1E+09	6.3E+07	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I6 HTP Baseline	Process energy demand relative to 2010	0	0.0E+00	1.3E+09	0.0E+00	0.0E+00	8.5E+08	2.4E+10	0.2	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I6 HTP CCS	Process energy demand relative to 2010	20	0.0E+00	1.3E+09	0.0E+00	0.0E+00	8.5E+08	2.4E+10	0.2	15	29	6.9E+08	1.2E+09	0.0E+00	0.0E+00	As above
Industry I6 HTP Bio Sw	Process energy demand relative to 2010	30	0.0E+00	1.3E+09	1.4E+10	0.0E+00	8.5E+08	1.0E+10	0.2	0	0	1.3E+09	1.3E+09	3.9E+07	3.9E+07	As above
Industry I6 HTP Bio Sw CCS	Process energy demand relative to 2010	26	0.0E+00	1.3E+09	1.4E+10	0.0E+00	8.5E+08	1.0E+10	0.2	15	29	2.1E+09	2.7E+09	3.9E+07	3.9E+07	As above
Industry I6 HTP Hyd Sw	Process energy demand relative to 2010	20	0.0E+00	1.3E+09	0.0E+00	1.4E+10	8.5E+08	1.0E+10	0.2	0	0	7.9E+07	7.9E+07	1.2E+08	1.2E+08	As above
Industry I6 LTP Baseline	Process energy demand relative to 2010	0	3.5E+09	6.1E+09	1.1E+09	0.0E+00	3.2E+09	1.1E+10	0.2	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I6 LTP CCS	Process energy demand relative to 2010	20	3.5E+09	6.1E+09	1.1E+09	0.0E+00	3.2E+09	1.1E+10	0.2	15	29	5.9E+08	1.0E+09	0.0E+00	0.0E+00	As above
Industry I6 LTP Bio Sw	Process energy demand relative to 2010	30	3.5E+09	3.3E+09	1.2E+10	0.0E+00	3.2E+09	3.2E+09	0.2	0	0	8.7E+08	8.7E+08	0.0E+00	0.0E+00	As above
Industry I6 LTP Bio Sw CCS	Process energy demand relative to 2010	26	3.5E+09	3.3E+09	1.2E+10	0.0E+00	3.2E+09	3.2E+09	0.2	15	29	1.6E+09	2.1E+09	0.0E+00	0.0E+00	As above
Industry I6 LTP Elec Sw	Process energy demand relative to 2010	30	3.5E+09	6.1E+09	1.1E+09	0.0E+00	9.8E+09	4.5E+09	0.2	0	0	1.7E+09	1.7E+09	8.4E+07	8.4E+07	As above
Industry I6 LTP Gas Sw	Process energy demand relative to 2010	30	3.5E+09	1.3E+10	1.1E+09	0.0E+00	3.2E+09	4.6E+09	0.2	0	0	3.3E+08	2.7E+08	0.0E+00	0.0E+00	As above
Industry I6 LTP Gas Sw CCS	Process energy demand relative to 2010	24	3.5E+09	1.3E+10	1.1E+09	0.0E+00	3.2E+09	4.6E+09	0.2	15	29	8.8E+08	1.2E+09	0.0E+00	0.0E+00	As above
Industry I6 LTP Hyd Sw	Process energy demand relative to 2010	20	1.3E+09	3.3E+09	1.1E+09	1.3E+10	3.2E+09	3.2E+09	0.2	0	0	7.2E+07	7.2E+07	1.0E+08	1.0E+08	As above
Industry I6 DaS Baseline	Process energy demand relative to 2010	0	1.5E+09	2.6E+09	5.0E+08	0.0E+00	1.6E+09	5.3E+09	0.1	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I6 Mot Baseline	Process energy demand relative to 2010	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+10	0.0E+00	0.1	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I6 SpH Baseline	Process energy demand relative to 2010	0	1.6E+09	4.0E+09	5.3E+08	0.0E+00	1.4E+09	6.6E+09	0.1	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I6 SpH Bio Sw	Process energy demand relative to 2010	15	4.1E+08	9.9E+08	9.6E+09	0.0E+00	1.4E+09	1.6E+09	0.1	0	0	7.4E+08	7.4E+08	2.0E+07	2.0E+07	As above
Industry I6 Oth Baseline	Process energy demand relative to 2010	0	8.5E+08	1.1E+09	2.8E+08	0.0E+00	4.1E+09	3.9E+09	0.1	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Industry I9 Oth Baseline	Process energy demand relative to 2010	0	1.2E+07	2.0E+09	2.1E+09	0.0E+00	4.0E+09	3.6E+09	0.0	0	0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	As above
Other CO2 Emissions																Dummy technology to produce appropriate quantity of CO2 emissions not covered elsewhere in ESME

Technology Name	Indicative Scale	Capacity Unit	Economic Life (years)	Technical Life (years)	Construction Period (years)	Max annual build rate (capacity units / year) 2010	2020	2030	2040	2050	Investment cost (£ / capacity unit) 2010	2050	Space heating (kW per HDD)	Hot Water (kW)
Floorspace (Commercial)		sq metre	100	100	0						0.00E+00	0.00E+00	2.15E-05	0.003
Floorspace (Public)		sq metre	100	100	0						0.00E+00	0.00E+00	2.15E-05	0.003
Dwelling (HD, ThE)	HD (High Density: flats & apartments) & ThE (Thermal performance Excellent)	dwelling	100	1300	0						5.26E+04	5.26E+04	1.65E-04	0.194
Dwelling (HD, ThG)	HD (High Density: flats & apartments) & ThG (Thermal performance Good)	dwelling	100	1300	0						4.80E+04	4.80E+04	4.41E-04	0.194
Dwelling (HD, ThM)	HD (High Density: flats & apartments) & ThM (Thermal performance Medium)	dwelling	100	1300	0						NA	NA	1.03E-03	0.194
Dwelling (HD, ThP)	HD (High Density: flats & apartments) & ThP (Thermal performance Poor)	dwelling	100	1300	0						NA	NA	2.56E-03	0.194
Dwelling (LD, ThE)	LD (Low Density: detached & bungalows) & ThE (Thermal performance Excellent)	dwelling	100	1300	0						7.68E+04	7.68E+04	2.41E-04	0.194
Dwelling (LD, ThG)	LD (Low Density: detached & bungalows) & ThG (Thermal performance Good)	dwelling	100	1300	0						7.01E+04	7.01E+04	6.02E-04	0.194
Dwelling (LD, ThM)	LD (Low Density: detached & bungalows) & ThM (Thermal performance Medium)	dwelling	100	1300	0						NA	NA	1.41E-03	0.194
Dwelling (LD, ThP)	LD (Low Density: detached & bungalows) & ThP (Thermal performance Poor)	dwelling	100	1300	0						NA	NA	3.34E-03	0.194
Dwelling (MD, ThE)	MD (Mid Density: semi-detached & terraced) & ThE (Thermal performance Excellent)	dwelling	100	1300	0						7.07E+04	7.07E+04	2.22E-04	0.194
Dwelling (MD, ThG)	MD (Mid Density: semi-detached & terraced) & ThG (Thermal performance Good)	dwelling	100	1300	0						6.46E+04	6.46E+04	5.54E-04	0.194
Dwelling (MD, ThM)	MD (Mid Density: semi-detached & terraced) & ThM (Thermal performance Medium)	dwelling	100	1300	0						NA	NA	1.30E-03	0.194
Dwelling (MD, ThP)	MD (Mid Density: semi-detached & terraced) & ThP (Thermal performance Poor)	dwelling	100	1300	0						NA	NA	3.08E-03	0.194
Retrofix (LD)	LD (Low Density: detached & bungalows)		100	100	0	1.00E+05					1.64E+04	1.02E+04		
Retrofix (MD)	MD (Mid Density: semi-detached & terraced)		100	100	0	1.00E+05					1.19E+04	7.28E+03		
Retrofix (HD)	HD (High Density: flats & apartments)		100	100	0	1.00E+05					7.63E+03	4.92E+03		
Retroplus (LD)	LD (Low Density: detached & bungalows)		100	100	0	1.00E+05					2.55E+04	1.82E+04		
Retroplus (MD)	MD (Mid Density: semi-detached & terraced)		100	100	0	1.00E+05					1.90E+04	1.36E+04		
Retroplus (HD)	HD (High Density: flats & apartments)		100	100	0	1.00E+05					1.48E+04	1.02E+04		

Technology Name	Energy Inputs: Light (lumens) Summer Overnight	Summer Morning	Summer Mid-Day	Summer Early Evening	Summer Late Evening	Winter Overnight	Winter Morning	Winter Mid-Day	Winter Early Evening	Winter Late Evening	Electricity (kW) Summer Overnight	Summer Morning	Summer Mid-Day	Summer Early Evening	Summer Late Evening	Winter Overnight	Winter Morning	Winter Mid-Day	Winter Early Evening	Winter Late Evening	Energy Efficiency improvement 2010 to 2050
Floorspace (Commercial)	205	313	455	319	239	252	378	550	361	291	3.3E-03	7.3E-03	9.3E-03	7.2E-03	4.8E-03	3.9E-03	9.0E-03	1.1E-02	9.1E-03	5.1E-03	12%
Floorspace (Public)	83	127	185	129	97	102	153	223	146	118	1.5E-03	3.2E-03	4.1E-03	3.2E-03	2.1E-03	1.7E-03	4.0E-03	4.7E-03	4.0E-03	2.3E-03	12%
Dwelling (HD, ThE)	991	1496	742	2798	4677	895	2274	965	4939	4318											n/a
Dwelling (HD, ThG)	991	1496	742	2798	4677	895	2274	965	4939	4318											n/a
Dwelling (HD, ThM)	991	1496	742	2798	4677	895	2274	965	4939	4318											n/a
Dwelling (HD, ThP)	991	1496	742	2798	4677	895	2274	965	4939	4318											n/a
Dwelling (LD, ThE)	1238	1870	927	3497	5846	1119	2842	1206	6174	5397											n/a
Dwelling (LD, ThG)	1238	1870	927	3497	5846	1119	2842	1206	6174	5397											n/a
Dwelling (LD, ThM)	1238	1870	927	3497	5846	1119	2842	1206	6174	5397											n/a
Dwelling (LD, ThP)	1238	1870	927	3497	5846	1119	2842	1206	6174	5397											n/a
Dwelling (MD, ThE)	1139	1721	853	3217	5378	1029	2615	1109	5680	4965											n/a
Dwelling (MD, ThG)	1139	1721	853	3217	5378	1029	2615	1109	5680	4965											n/a
Dwelling (MD, ThM)	1139	1721	853	3217	5378	1029	2615	1109	5680	4965											n/a
Dwelling (MD, ThP)	1139	1721	853	3217	5378	1029	2615	1109	5680	4965											n/a
Retrofix (LD)																					
Retrofix (MD)																					
Retrofix (HD)																					
Retroplus (LD)																					
Retroplus (MD)																					
Retroplus (HD)																					

Technology Name	Additional Comments		Distribution Info: 2050 Capex — Uncertainty	Distribution	Deterministic value taken to be	Relative % to ref value Min	Max	Index Ref value	Min	Max	Actual Ref value	Min	Max	Correlations
Floorspace (Commercial)														
Floorspace (Public)														
Dwelling (HD, ThE)	Available as new-build stock only													
Dwelling (HD, ThG)	Existing stock and available as new-build. Equivalent to SAP rating A/B.	Existing HD stock is 38% ThP, 61% ThM, 1% ThG												
Dwelling (HD, ThM)	Existing stock only. Equivalent to SAP rating C/D.	Existing HD stock is 38% ThP, 61% ThM, 1% ThG												
Dwelling (HD, ThP)	Existing stock only. Equivalent to SAP rating E/F/G.	Existing HD stock is 38% ThP, 61% ThM, 1% ThG												
Dwelling (LD, ThE)	Available as new-build stock only													
Dwelling (LD, ThG)	Existing stock and available as new-build. Equivalent to SAP rating A/B.	Existing LD stock is 67% ThP, 33% ThM												
Dwelling (LD, ThM)	Existing stock only. Equivalent to SAP rating C/D.	Existing LD stock is 67% ThP, 33% ThM												
Dwelling (LD, ThP)	Existing stock only. Equivalent to SAP rating E/F/G.	Existing LD stock is 67% ThP, 33% ThM												
Dwelling (MD, ThE)	Available as new-build stock only													
Dwelling (MD, ThG)	Existing stock and available as new-build. Equivalent to SAP rating A/B.	Existing MD stock is 62% ThP, 38% ThM												
Dwelling (MD, ThM)	Existing stock only. Equivalent to SAP rating C/D.	Existing MD stock is 62% ThP, 38% ThM												
Dwelling (MD, ThP)	Existing stock only. Equivalent to SAP rating E/F/G.	Existing MD stock is 62% ThP, 38% ThM												
Retrofix (LD)	Applicable to ThP and ThM existing buildings only. Retrofix + Retroplus together limited to 3.6m LD properties. Exponential Uptake constraint allows max 100,000 retrofits (across all dwelling types) in year 1, with annual added capacity growing at 20% p.a. thereafter (max 120,000 added in year 2 for a total 220,000 etc)	Delivers 21.8% saving in space heat demand	H	Triangular	Mean	-20	10	0.623	0.498	0.685	10187	8150	11206	Retrofix Insulations
Retrofix (MD)	Applicable to ThP and ThM existing buildings only. Retrofix + Retroplus together limited to 6.7m MD properties. Exponential Uptake constraint allows max 100,000 retrofits (across all dwelling types) in year 1, with annual added capacity growing at 20% p.a. thereafter (max 120,000 added in year 2 for a total 220,000 etc)	Delivers 25.3% saving in space heat demand	H	Triangular	Mean	-20	10	0.612	0.490	0.673	7284	5827	8012	Retrofix Insulations
Retrofix (HD)	Applicable to ThP and ThM existing buildings only. Retrofix + Retroplus together limited to 1.5m HD properties. Exponential Uptake constraint allows max 100,000 retrofits (across all dwelling types) in year 1, with annual added capacity growing at 20% p.a. thereafter (max 120,000 added in year 2 for a total 220,000 etc)	Delivers 22.5% saving in space heat demand	H	Triangular	Mean	-20	10	0.645	0.516	0.709	4917	3934	5409	Retrofix Insulations
Retroplus (LD)	Applicable to ThP and ThM existing buildings only. Retrofix + Retroplus together limited to 3.6m LD properties. Exponential Uptake constraint allows max 100,000 retrofits (across all dwelling types) in year 1, with annual added capacity growing at 20% p.a. thereafter (max 120,000 added in year 2 for a total 220,000 etc)	Delivers 41.5% saving in space heat demand	H	Triangular	Mean	-20	10	0.715	0.572	0.787	18237	14590	20061	Retroplus Insulations
Retroplus (MD)	Applicable to ThP and ThM existing buildings only. Retrofix + Retroplus together limited to 6.7m MD properties. Exponential Uptake constraint allows max 100,000 retrofits (across all dwelling types) in year 1, with annual added capacity growing at 20% p.a. thereafter (max 120,000 added in year 2 for a total 220,000 etc)	Delivers 48.8% saving in space heat demand	H	Triangular	Mean	-20	10	0.717	0.574	0.789	13608	10886	14969	Retroplus Insulations
Retroplus (HD)	Applicable to ThP and ThM existing buildings only. Retrofix + Retroplus together limited to 1.5m HD properties. Exponential Uptake constraint allows max 100,000 retrofits (across all dwelling types) in year 1, with annual added capacity growing at 20% p.a. thereafter (max 120,000 added in year 2 for a total 220,000 etc)	Delivers 36.8% saving in space heat demand	H	Triangular	Mean	-20	10	0.694	0.555	0.763	10246	8197	11271	Retroplus Insulations

Technology Name	Indicative Class	Capacity Unit	Economic Life	Technical Life	Construction Period	Max annual build rate					Exponential growth constraint	Investment cost		Fixed O&M costs		Variable O&M costs		Average no. of km per vehicle per year	Average no. of people per vehicle		No. Of Passenger km per vehicle per year	Average tonnes of freight per vehicle	No. of tonne-km per vehicle per year	Usage mode	Input 1				Input 2				Notes	Notes	Notes	Distribution Info: 2050 Capex											Correlations
			years	years	years	capacity units / year						£ / capacity unit		£ / capacity unit / year		£ / capacity unit / km																															
						2010	2020	2030	2040	2050		2010	2050	2010	2050	2010	2050		2010	2050					2010	2050	Product		2010	2050	Product					Uncertainty	Distribution	Deterministic value taken to be	Relative % to ref value Min	Relative % to ref value Max	Index Ref value	Index Min	Index Max	Actual Ref value	Actual Min	Actual Max	
Car ICE	(A/B Segment)	vehicle	9	13	0							7.63E+03	5.66E+03	3.35E+02	2.44E+02			13,533	1.699	1.490				standard	0.6526	0.2998	kWh of liquid fuel	per km				per km				L	Triangular	Mode	-5	5	0.7420	0.7049	0.7791	5,662	5,379	5,945	ICE Cars & LGV
Car CNG	(A/B Segment)	vehicle	9	13	0						Yes	1.07E+04	8.19E+03	3.35E+02	2.44E+02			13,533	1.699	1.490				standard	0.6695	0.3407	kWh of gas	per km				per km	Uptake of CNG cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)	L	Triangular	Mode	-5	15	0.7674	0.7291	0.8826	8,186	7,777	9,414	CNG Cars & LGV
Car Hybrid	(A/B Segment)	vehicle	9	13	0						Yes	1.03E+04	6.12E+03	3.35E+02	2.44E+02			13,533	1.699	1.490				standard	0.5309	0.2261	kWh of liquid fuel	per km				per km	Uptake of hybrid cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles			M	Triangular	Mode	-10	15	0.5919	0.5327	0.6807	6,125	5,512	7,043	Hybrid Cars & LGV
Car PHEV	(A/B Segment)	vehicle	9	13	0						Yes	1.77E+04	6.83E+03	3.35E+02	2.74E+02			13,533	1.699	1.490				standard	0.1906	0.0792	kWh of liquid fuel	per km	0.1200	0.0809	kWh of electricity	per km	Uptake of PHEV cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles			H	Triangular	Mode	-10	25	0.3858	0.3472	0.4822	6,832	6,149	8,540	PHEV Cars & LGV
Car Battery	(A/B Segment)	vehicle	9	13	0						Yes	1.82E+04	7.57E+03	3.35E+02	2.90E+02			13,533	1.699	1.490				standard	0.1354	0.1065	kWh of electricity	per km				per km	Uptake of battery cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles			H	Triangular	Mode	-10	75	0.4157	0.3742	0.7275	7,567	6,810	13,241	BEV Cars & LGV
Car Hydrogen FCV	(A/B Segment)	vehicle	9	13	0						Yes	3.31E+04	8.19E+03	4.05E+02	3.21E+02			13,533	1.699	1.490				standard	0.4400	0.1940	kWh of hydrogen	per km				per km	Uptake of hydrogen cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles	Fixed cost includes 1.1p/kWh for the O&M cost running an H2 network.	Additional input of electricity for compression during refuelling (4.3% of the H2 input)	H	Triangular	Mode	-10	75	0.2478	0.2230	0.4336	8,192	7,373	14,336	FCV Car & LGV
Car Hydrogen ICE	(A/B Segment)	vehicle	9	13	0						Yes	2.99E+04	9.21E+03	4.48E+02	2.97E+02			13,533	1.699	1.490				standard	0.7100	0.3340	kWh of hydrogen	per km				per km	Uptake of hydrogen cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles	Fixed cost includes 1.1p/kWh for the O&M cost running an H2 network.	Additional input of electricity for compression during refuelling (4.3% of the H2 input)	H	Triangular	Mode	-10	50	0.3077	0.2769	0.4615	9,207	8,286	13,811	H2 ICE Cars & LGV
					0																																										
Car ICE	(C/D Segment)	vehicle	9	13	0							1.11E+04	8.46E+03	4.57E+02	3.33E+02			13,533	1.699	1.490				standard	0.7462	0.3508	kWh of liquid fuel	per km				per km				L	Triangular	Mode	-5	5	0.7603	0.7223	0.7983	8,456	8,034	8,879	ICE Cars & LGV
Car CNG	(C/D Segment)	vehicle	9	13	0						Yes	1.66E+04	1.29E+04	4.57E+02	3.33E+02			13,533	1.699	1.490				standard	0.7852	0.4072	kWh of gas	per km				per km	Uptake of CNG cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)	L	Triangular	Mode	-5	15	0.7717	0.7331	0.8874	12,949	12,302	14,892	CNG Cars & LGV
Car Hybrid	(C/D Segment)	vehicle	9	13	0						Yes	1.56E+04	9.15E+03	4.57E+02	3.33E+02			13,533	1.699	1.490				standard	0.5831	0.2482	kWh of liquid fuel	per km				per km	Uptake of hybrid cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles			M	Triangular	Mode	-10	15	0.5861	0.5275	0.6741	9,146	8,231	10,518	Hybrid Cars & LGV
Car PHEV	(C/D Segment)	vehicle	9	13	0						Yes	2.66E+04	1.03E+04	4.57E+02	3.33E+02			13,533	1.699	1.490				standard	0.2212	0.0862	kWh of liquid fuel	per km	0.1363	0.0934	kWh of electricity	per km	Uptake of PHEV cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles			H	Triangular	Mode	-10	25	0.3883	0.3495	0.4854	10,328	9,295	12,910	PHEV Cars & LGV
Car Battery	(C/D Segment)	vehicle	9	13	0						Yes	2.54E+04	1.32E+04	4.57E+02	3.75E+02			13,533	1.699	1.490				standard	0.1649	0.1264	kWh of electricity	per km				per km	Uptake of battery cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles			H	Triangular	Mode	-10	75	0.5187	0.4668	0.9077	13,161	11,845	23,032	BEV Cars & LGV
Car Hydrogen FCV	(C/D Segment)	vehicle	9	13	0						Yes	5.22E+04	1.42E+04	5.33E+02	4.06E+02			13,533	1.699	1.490				standard	0.4740	0.2100	kWh of hydrogen	per km				per km	Uptake of hydrogen cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles	Fixed cost includes 1.1p/kWh for the O&M cost running an H2 network.	Additional input of electricity for compression during refuelling (4.3% of the H2 input)	H	Triangular	Mode	-10	75	0.2726	0.2453	0.4770	14,234	12,810	24,909	FCV Car & LGV
Car Hydrogen ICE	(C/D Segment)	vehicle	9	13	0						Yes	4.75E+04	1.48E+04	5.92E+02	4.54E+02			13,533	1.699	1.490				standard	0.8500	0.3710	kWh of hydrogen	per km				per km	Uptake of hydrogen cars constrained by exponential growth at 12% per year and year 1 deployment of 200,000 vehicles	Fixed cost includes 1.1p/kWh for the O&M cost running an H2 network.	Additional input of electricity for compression during refuelling (4.3% of the H2 input)	H	Triangular	Mode	-10	50	0.3126	0.2814	0.4690	14,847	13,362	22,271	H2 ICE Cars & LGV
HGV (ICE)	mgw>17 tonnes	vehicle	10	15	0	1.0E+07	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00			6.41E+04				8.75	5.61E+05	standard	3.79	2.61	kWh of liquid fuel	per km																			
HGV (ICE Euro 6)	mgw>17 tonnes	vehicle	10	15	0	0.0E+00	1.0E+07	1.0E+07	1.0E+07	1.0E+07		7.23E+04	5.76E+04	8.70E+03	8.70E+03			6.41E+04				8.75	5.61E+05	standard	3.90	2.65	kWh of liquid fuel	per km																			
HGV (Gas SI)	mgw>17 tonnes	vehicle	10	15	0	1.0E+07	1.0E+07	1.0E+07	1.0E+07	1.0E+07	Yes	7.18E+04	5.67E+04	8.70E+03	8.70E+03			6.41E+04				8.75	5.61E+05	standard	4.55	3.14	kWh of gas	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 600 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
HGV (Dual Fuel Port)	mgw>17 tonnes	vehicle	10	15	0	1.0E+07	1.0E+07	1.0E+07	1.0E+07	1.0E+07	Yes	8.18E+04	5.81E+04	8.70E+03	8.70E+03			6.41E+04				8.75	5.61E+05	standard	2.50	1.72	kWh of gas	per km	1.67	1.15	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 600 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
HGV (Dual Fuel Direct)	mgw>17 tonnes	vehicle	10	15	0	1.0E+07	1.0E+07	1.0E+07	1.0E+07	1.0E+07	Yes	9.22E+04	5.93E+04	8.70E+03	8.70E+03			6.41E+04				8.75	5.61E+05	standard	3.03	2.09	kWh of gas	per km	0.76	0.52	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 600 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
HGV (Hydrogen FCV)	mgw>17 tonnes	vehicle	10	15	0	0.0E+00	1.0E+03	1.5E+04	1.0E+05	1.0E+05	Yes	1.73E+06	4.55E+05	2.41E+03	2.41E+03			6.41E+04				8.75	5.61E+05	standard	1.99	1.74	kWh of hydrogen	per km				per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 600 vehicles		Additional input of electricity for compression during refuelling (4.3% of the H2 input)												FCV HGV & Bus
HGV (Flywheel Hybrid)	mgw>17 tonnes	vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	8.11E+04	6.10E+04	8.70E+03	8.70E+03			6.41E+04				8.75	5.61E+05	standard	2.99	1.98	kWh of liquid fuel	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 600 vehicles														
HGV (Gas SI Flywheel Hybrid)	mgw>17 tonnes	vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	8.33E+04	6.22E+04	8.70E+03	8.70E+03			6.41E+04				8.75	5.61E+05	standard	3.58	2.38	kWh of gas	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 600 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
HGV (Dual Fuel Direct Flywheel Hybrid)	mgw>17 tonnes	vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	9.72E+04	6.48E+04	8.70E+03	8.70E+03			6.41E+04				8.75	5.61E+05	standard	2.39	1.58	kWh of gas	per km	0.60	0.40	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 600 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
MGV (ICE)	mgw 7-17 tonnes	vehicle	10	15	0	1.0E+07	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00			2.96E+04				0.667	1.97E+04	standard	2.73	1.88	kWh of liquid fuel	per km																			
MGV (ICE Euro 6)	mgw 7-17 tonnes	vehicle	10	15	0	0.0E+00	1.0E+07	1.0E+07	1.0E+07	1.0E+07		4.48E+04	3.56E+04	1.71E+03	1.71E+03			2.96E+04				0.667	1.97E+04	standard	2.81	1.91	kWh of liquid fuel	per km																			
MGV (Gas SI)	mgw 7-17 tonnes	vehicle	10	15	0	1.0E+07	1.0E+07	1.0E+07	1.0E+07	1.0E+07	Yes	4.63E+04	3.66E+04	1.71E+03	1.71E+03			2.96E+04				0.667	1.97E+04	standard	3.28	2.26	kWh of gas	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 250 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
MGV (Dual Fuel Port)	mgw 7-17 tonnes	vehicle	10	15	0	1.0E+07	1.0E+07	1.0E+07	1.0E+07	1.0E+07	Yes	5.63E+04	4.01E+04	1.71E+03	1.71E+03			2.96E+04				0.667	1.97E+04	standard	1.80	1.24	kWh of gas	per km	1.20	0.83	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 250 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
MGV (Dual Fuel Direct)	mgw 7-17 tonnes	vehicle	10	15	0	1.0E+07	1.0E+07	1.0E+07	1.0E+07	1.0E+07	Yes	5.97E+04	3.84E+04	1.71E+03	1.71E+03			2.96E+04				0.667	1.97E+04	standard	2.19	1.51	kWh of gas	per km	0.55	0.38	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 250 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
MGV (Hydrogen FCV)	mgw 7-17 tonnes	vehicle	10	15	0	0.0E+00	1.0E+03	1.5E+04	1.0E+05	1.0E+05	Yes	1.73E+06	4.55E+05	1.71E+03	1.71E+03			2.96E+04				0.667	1.97E+04	standard	1.99	1.74	kWh of hydrogen	per km				per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 250 vehicles		Additional input of electricity for compression during refuelling (4.3% of the H2 input)												FCV HGV & Bus
MGV (Flywheel Hybrid)	mgw 7-17 tonnes	vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	4.94E+04	3.96E+04	1.71E+03	1.71E+03			2.96E+04				0.667	1.97E+04	standard	2.12	1.60	kWh of liquid fuel	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 250 vehicles														
MGV (Gas SI Flywheel Hybrid)	mgw 7-17 tonnes	vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	5.23E+04	4.19E+04	1.71E+03	1.71E+03			2.96E+04				0.667	1.97E+04	standard	2.55	1.93	kWh of gas	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 250 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
MGV (Dual Fuel Direct Flywheel Hybrid)	mgw 7-17 tonnes	vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	6.13E+04	4.36E+04	1.71E+03	1.71E+03			2.96E+04				0.667	1.97E+04	standard	1.70	1.28	kWh of gas	per km	0.42	0.32	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 250 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
LGV (ICE)	mgw<7 tonnes	vehicle	10	15	0							2.19E+04	1.54E+04	6.17E+02	4.90E+02			2.19E+04				0.17	3.72E+03	standard	0.88	0.44	kWh of liquid fuel	per km				per km				L	Triangular	Mode	-5	5	0.7018	0.6667	0.7369	15,350	14,583	16,118	ICE Cars & LGV
LGV (Gas SI)	mgw<7 tonnes	vehicle	10	15	0						Yes	31120	30620	6.17E+02	4.90E+02			2.19E+04				0.17	3.72E+03	standard	1.05	0.52	kWh of gas	per km				per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 10,000 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)	L	Triangular	Mode	-5	15	0.9839	0.9347	1.1315	30,620	29,089	35,213	CNG Cars & LGV
LGV (Dual Fuel Port)	mgw<7 tonnes	vehicle	10	15	0						Yes	38140	37640	6.17E+02	4.90E+02			2.19E+04				0.17	3.72E+03	standard	0.56	0.39	kWh of gas	per km	0.374	0.258	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 10,000 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)	M	Triangular	Mode	-10	15	0.9869	0.8882	1.1349	37,640	33,876	43,286	CNG Cars & LGV
LGV (Dual Fuel Direct)	mgw<7 tonnes	vehicle	10	15	0						Yes	39140	38640	6.17E+02	4.90E+02			2.19E+04				0.17	3.72E+03	standard	0.68	0.47	kWh of gas	per km	0.170	0.117	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 10,000 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)	M	Triangular	Mode	-10	15	0.9872	0.8885	1.1353	38,640	34,776	44,436	CNG Cars & LGV
LGV (Hybrid)	mgw<7 tonnes	vehicle	10	15	0						Yes	3.03E+04	1.67E+04	6.46E+02	5.03E+02			2.19E+04				0.17	3.72E+03	standard	0.70	0.33	kWh of liquid fuel	per km				per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 10,000 vehicles			M	Triangular	Mode	-10	15	0.5507	0.4956	0.6333	16,680	15,012	19,182	Hybrid Cars & LGV
LGV (BEV)	mgw<7 tonnes	vehicle	10	15	0	1.0E+03	1.0E+05	1.0E+06	1.0E+06	1.0E+06	Yes	6.59E+04	2.12E+04	6.46E+02	5.58E+02			2.19E+04				0.17	3.72E+03	standard	0.28	0.15	kWh of electricity	per km				per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 10,000 vehicles			H	Triangular	Mode	-10	75	0.3219	0.2897	0.5633	21,200	19,080	37,100	BEV Cars & LGV
LGV (PHEV)	mgw<7 tonnes	vehicle	10	15	0	1.0E+03	1.0E+05	1.0E+06	1.0E+06	1.0E+06	Yes	3.63E+04	1.71E+04	6.46E+02	5.29E+02			2.19E+04				0.17	3.72E+03	standard	0.18	0.08	kWh of liquid fuel	per km	0.21	0.12	kWh of electricity	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 10,000 vehicles			H	Triangular	Mode	-10	25	0.4692	0.4223	0.5866	17,050	15,345	21,313	PHEV Cars & LGV
LGV (Hydrogen FCV)	mgw<7 tonnes	vehicle	10	15	0	0.0E+00	1.0E+04	1.0E+05	1.0E+06	1.0E+06	Yes	84780	25737	6.32E+02	5.58E+02			2.19E+04				0.17	3.72E+03	standard	0.54	0.24	kWh of hydrogen	per km				per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 10,000 vehicles	Fixed cost includes 1.1p/kWh for the O&M cost running an H2 network	Additional input of electricity for compression during refuelling (4.3% of the H2 input)	H	Triangular	Mode	-10	75	0.3036	0.2732	0.5313	25,737	23,164	45,040	FCV Car & LGV
LGV (Hydrogen ICE)	mgw<7 tonnes	vehicle	10	15	0	1.0E+03	1.0E+05	1.0E+06	1.0E+06	1.0E+06	Yes	81911	28773	6.17E+02	4.70E+02			2.19E+04				0.17	3.72E+03	standard	0.93	0.41	kWh of hydrogen	per km				per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 10,000 vehicles	Fixed cost includes 1.1p/kWh for the O&M cost running an H2 network	Additional input of electricity for compression during refuelling (4.3% of the H2 input)	H	Triangular	Mode	-10	50	0.3513	0.3161	0.5269	28,773	25,895	43,159	H2 ICE Cars & LGV
Bus (ICE)		vehicle	10	15	0	1.0E+05	1.0E+05	1.0E+05	1.0E+05	1.0E+05		1.30E+05	1.06E+05	2.03E+03	2.03E+03			3.53E+04	7.45	7.45	2.63E+05			standard	3.19	2.20	kWh of Liquid Fuel	per km																			
Bus (Gas SI)		vehicle	10	15	0	1.0E+05	1.0E+05	1.0E+05	1.0E+05	1.0E+05	Yes	1.41E+05	1.04E+05	2.03E+03	2.03E+03			3.53E+04	7.45	7.45	2.63E+05			standard	3.83	2.64	kWh of Gas	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
Bus (Dual Fuel Port)		vehicle	10	15	0	1.0E+05	1.0E+05	1.0E+05	1.0E+05	1.0E+05	Yes	1.46E+05	1.10E+05	2.03E+03	2.03E+03			3.53E+04	7.45	7.45	2.63E+05			standard	2.11	1.45	kWh of Gas	per km	1.40	0.97	kWh of Liquid Fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
Bus (Dual Fuel Direct)		vehicle	10	15	0	1.0E+05	1.0E+05	1.0E+05	1.0E+05	1.0E+05	Yes	1.46E+05	1.08E+05	2.03E+03	2.03E+03			3.53E+04	7.45	7.45	2.63E+05			standard	2.55	1.76	kWh of Gas	per km	0.64	0.44	kWh of Liquid Fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles		Additional input of electricity for compression during refuelling (4.3% of the gas input)												
Bus (BEV)		vehicle	10	15	0	0.0E+00	1.0E+05	1.0E+05	1.0E+05	1.0E+05	Yes	1.83E+05	1.17E+05	2.18E+03	2.18E+03			3.53E+04	6.00	7.45	2.12E+05			standard	1.26	1.07	kWh of Electric	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles														
Bus (Hybrid)		vehicle	10	15	0	1.0E+00	1.0E+05	1.0E+05	1.0E+05	1.0E+05	Yes	2.25E+05	1.57E+05	2.08E+03	2.08E+03			3.53E+04	7.45	7.45	2.63E+05			standard	2.57	1.77	kWh of Liquid Fuel	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles.														
Bus (Wireless PHEV)		vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	1.65E+05	1.13E+05	2.28E+03	2.28E+03			3.53E+04	7.45	7.45	2.63E+05			standard	0.80	0.64	kWh of Liquid Fuel	per km	0.48	0.38	kWh of Electricity	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles														
Bus (Hydrogen FCV)		vehicle	10	15	0	0.0E+00	2.5E+02	1.0E+05	1.0E+06	1.0E+06	Yes	5.20E+05	1.54E+05	2.41E+03	2.41E+03			3.53E+04	7.45	7.45	2.63E+05			standard	4.57	2.06	kWh of Hydrogen	per km				per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles		Additional input of electricity for compression during refuelling (4.3% of the H2 input)	H	Triangular	Mode	-40	60	0.2958	0.1775	0.4732	153,800	92,280	246,080	FCV HGV & Bus
Bus (Flywheel Hybrid)		vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	1.38E+05	1.11E+05	2.03E+03	2.03E+03			3.53E+04	7.45	7.45	2.63E+05			standard	2.55	1.76	kWh of liquid fuel	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles														
Bus (Gas SI Flywheel Hybrid)		vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	1.49E+05	1.09E+05	2.03E+03	2.03E+03			3.53E+04	7.45	7.45	2.63E+05			standard	3.06	2.11	kWh of gas	per km					Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles		Additional input of electricity for compression during refuelling (4.3% of the H2 input)												
Bus (Dual Fuel Direct Flywheel Hybrid)		vehicle	10	15	0	0.0E+00	0.0E+00	1.0E+05	1.0E+05	1.0E+05	Yes	1.53E+05	1.13E+05	2.03E+03	2.03E+03			3.53E+04	7.45	7.45	2.63E+05			standard	2.17	1.50	kWh of gas	per km	0.38	0.26	kWh of liquid fuel	per km	Uptake constrained by exponential growth at 12% per year and year 1 deployment of 500 vehicles		Additional input of electricity for compression during refuelling (4.3% of the H2 input)												
Rail (Passenger Diesel)		train	20	25	0							4.50E+06	4.50E+06					1.86E+05	185.5	185.5	3.45E+07			standard	6.35E+06	5.40E+06	kWh of liquid fuel	per year								L											
Rail (Freight Diesel)		train	20	25	0							4.50E+06	4.50E+06					1.86E+05				181.1	3.37E+07	standard	7.30E+06	6.20E+06	kWh of liquid fuel	per year								L											
Rail (Passenger Electric)		train	30	35	0							4.50E+06	4.50E+06					1.86E+05	372.4	372.4	6.93E+07			standard	8.87E+06	7.54E+06	kWh of electricity	per year								L											
Maritime (International)		vehicle	10	30	0	2.5E+01	2.5E+01	2.5E+01	2.5E+01	2.5E+01		2.63E+07	2.63E+07	1.00E+06	1.00E+06			2.00E+05				25000	5.00E+09	standard	1.93E+08	1.64E+08	kWh of liquid fuel	per year				per															
Maritime (Dual Fuel International)		vehicle	10	30	0	2.5E+01	2.5E+01	2.5E+01	2.5E+01	2.5E+01		2.76E+07	2.74E+07	1.00E+06	1.00E+06			2.00E+05				25000	5.00E+09	standard	1.64E+08	1.39E+08	kWh of Gas	per year	2.89E+07	2.46E+07	kWh of liquid fuel	per year															
Maritime (Domestic)		vehicle	10	30	0	1.0E+03	1.0E+03	1.0E+03	1.0E+03	1.0E+03		1.00E+06	1.00E+06	2.00E+05	2.00E+05			2.00E+03				2540	5.08E+06	standard	1.38E+06	1.17E+06	kWh of liquid fuel	per year				per															
Maritime (Dual Fuel Domestic)		vehicle	10	30	0	1.0E+03	1.0E+03	1.0E+03	1.0E+03	1.0E+03		1.08E+06	1.07E+06	2.00E+05	2.00E+05			2.00E+03				2540	5.08E+06	standard	1.17E+06	9.99E+05	kWh of Gas	per year	2.07E+05	1.76E+05	kWh of liquid fuel	per year															
Aviation (International)		aeroplane	10	22	0							8.24E+07	8.24E+07	2.12E+06	2.12E+06			2.70E+06	170	170	4.59E+08			standard	1.85E+08	1.01E+08	kWh of liquid fuel	per year																			
Aviation (Domestic)		aeroplane	10	27	0							2.42E+07	2.42E+07	2.12E+06	2.12E+06			1.00E+06	100	100	1.00E+08			standard	4.18E+07	2.77E+07	kWh of liquid fuel	per year								L											
Agricultural Vehicle (ICE)		vehicle	10	15	0	1.0E+06	5.0E+04	5.0E+04	5.0E+04	5.0E+04		4.00E+04	3.27E+04	1.50E+03	1.50E+03									standard	1.76E+05	1.44E+05	kWh of liquid fuel	per year																			
Wheeled Excavator (ICE)		vehicle	10	25	0	2.0E+04	1.0E+04	1.0E+04	1.0E+04	1.0E+04		9.00E+04	7.36E+04	2.50E+03	2.50E+03									standard	1.29E+05	1.05E+05	kWh of liquid fuel	per year																			
Crawler Excavator (ICE)		vehicle	10	25	0	1.0E+04	1.0E+04	1.0E+04	1.0E+04	1.0E+04		1.15E+05	9.41E+04	3.00E+03	3.00E+03									standard	7.39E+05	6.02E+05	kWh of liquid fuel	per year																			
Medium Articulated Truck (ICE)		vehicle	10	20	0	1.0E+04	1.0E+04	1.0E+04	1.0E+04	1.0E+04		1.30E+05	1.06E+05	4.00E+03	4.00E+03									standard	3.06E+06	2.49E+06	kWh of liquid fuel	per year																			
Large Articulated Truck (ICE)		vehicle	10	20	0	1.0E+04	1.0E+04	1.0E+04	1.0E+04	1.0E+04		1.75E+05	1.43E+05	4.00E+03	4.00E+03									standard	3.59E+06	2.93E+06	kWh of liquid fuel	per year																			
Medium Wheel Loader (ICE)		vehicle	10	25	0	1.0E+04	1.0E+04	1.0E+04	1.0E+04	1.0E+04		8.00E+04	6.55E+04	2.50E+03	2.50E+03									standard	1.36E+06	1.11E+06	kWh of liquid fuel	per year																			

Emissions Factors:

Fuel	Unit	CIF (t/kWh) Consumption	Emission	Notes
Aviation Fuel	kWh (th)		0.0002455	
Biofuel imports	kWh (th)		0.0001000	Corresponds to imports of 2nd generation biofuel. Assume Net GHG is 40% of fossil fuel equivalent (based on IEA data and ETI analysis)
UK Biomass	kWh (th)	0.0002920	0.0003318	Corresponds to Indigenously grown UK Biomass, including agri and forest residues
Biomass Imports	kWh (th)	0.0002678	0.0003318	Corresponds to imports of woody biomass
Coal	kWh (th)		0.0003101	
Diesel	kWh (th)		0.0002501	
Gas	kWh (th)		0.0001836	
Petrol	kWh (th)		0.0002400	
Liquid Fuel	kWh (th)		0.0002450	Corresponds to petrol and diesel. CO2 content and price taken as the average of petrol and diesel.
Nuclear	kWh (th)			
Wet Waste	kWh (th)			Corresponds to food waste and agri/sewage slurries
Dry Waste Resource	kWh (th)	0.0001674	0.0003435	Corresponds to municipal, commericial and industrial waste, excluding agri and forest residues. Assumed 45% biogenic content.

Conversion Factors:

Unit	kWh equiv.	Reference
btu	2.931E-04	DUKES Annex A
mmbtu	293	DUKES Annex A
therm	29.3	DUKES Annex A
toe	11630	DUKES Annex A
GJ	277.8	DUKES Annex A
Te Coal	7472	DUKES Annex A.1 (26.9 GJ/te for coal, all consumers wieghted average)
bbl Aviation fue	1452	DUKES Annex A (159 litres per barrel; 1405 litres per tonne for Aviation gasoline) & Annex A.1 (46.2 GJ/te for aviation turbine fuel)
bbl Diesel	1486	DUKES Annex A (159 litres per barrel; 1361 litres per tonne for motor spirit) & Annex A.1 (45.8 GJ/te for petroleum prducts weighted average)
bbl Petrol	1486	DUKES Annex A (159 litres per barrel; 1361 litres per tonne for motor spirit) & Annex A.1 (45.8 GJ/te for petroleum prducts weighted average)
litre biofuel	9.348	DUKES Annex A (1361 litres per tonne for motor spirit) & Annex A.1 (45.8 GJ/te for petroleum prducts weighted average)
kg U	1.08E+06	World Nuclear Association - 45,000 MWd/t burn-up of 3.5% enriched U in LWR
kg H2	39.39	US DOE (http://hydrogen.pnl.gov/cocoon/morf/hydrogen/site_specific/fuel_heating_calculator?canprint=false)
m^3 H2 (STP)	3.545	US DOE (http://hydrogen.pnl.gov/cocoon/morf/hydrogen/site_specific/fuel_heating_calculator?canprint=false)

Resource	Native Unit	Base Line 2010	Ref Case 2050	Scenario range 2050 Min	Scenario range 2050 Max	Ref Case 2050 taken as	ESME Unit	Base Line 2010	Ref Case 2050	Scenario range 2050 Min	Scenario range 2050 Max
Gas	p/therm	41	54	33	63	Mode	p/kWh	1.41	1.86	1.14	2.16
Coal	$/tonne	89	70	54	106	Mean	p/kWh	0.78	0.61	0.48	0.93
Nuclear	£/kg	1700	3700	3300	4600	Mean	p/kWh(th)	0.16	0.34	0.31	0.43
Liquid Fuel	$/bbl	77	70	48	105	Mean	p/kWh	4.62	4.20	2.89	6.30
Biofuel Imports	$/bbl	100	91	63	137	Mean	p/kWh	6.01	5.46	3.75	8.19
UK Biomass	£/GJ	5.2	5.2	3.5	8.7	Mean	p/kWh	1.87	1.87	1.26	3.13
Biomass Imports	£/GJ	5.4	6.3	5	10	Mean	p/kWh	1.94	2.27	1.80	3.60
Dry Waste Resource	£/tonne	-75	-75	-114	-19	Mean	p/kWh	-1.59	-1.59	-2.42	-0.41
Wet Waste	p/kWh	-1.0	-1.0	-1.9	0.0	Mean	p/kWh	-0.99	-0.99	-1.86	0.00

Energy Unit Conversions	kWh equiv.	Reference
btu	2.93E-04	DUKES Annex A
mmbtu	293.1	DUKES Annex A
therm	29.3	DUKES Annex A
toe	11630.0	DUKES Annex A
GJ	277.8	DUKES Annex A
Te Coal	7472.2	DUKES Annex A.1 (26.9 GJ/te for coal, all consumers wieghted average)
bbl Diesel	1486.4	DUKES Annex A (159 litres per barrel; 1361 litres per tonne for motor spirit) & Annex A.1 (45.8 GJ/te for petroleum prducts weighted average)
bbl Petrol	1486.4	DUKES Annex A (159 litres per barrel; 1361 litres per tonne for motor spirit) & Annex A.1 (45.8 GJ/te for petroleum prducts weighted average)
litre biofuel	9.3	DUKES Annex A (1361 litres per tonne for motor spirit) & Annex A.1 (45.8 GJ/te for petroleum prducts weighted average)
kg Uranium	1.08E+06	World Nuclear Association - 45,000 MWd/t burn-up of 3.5% enriched U in LWR
kg H2	39.4	US DOE (http://hydrogen.pnl.gov/cocoon/morf/hydrogen/site_specific/fuel_heating_calculator?canprint=false)
m^3 H2 (STP)	3.5	US DOE (http://hydrogen.pnl.gov/cocoon/morf/hydrogen/site_specific/fuel_heating_calculator?canprint=false)
Te RDF	4722.2	BVCM (17GJ/Te)
Volume Unit Conversions	**Bbls equiv.**	**Reference**
toe	7.33	BP Statistical Review of World Energy June 2009
litres	158.99	DUKES Annex A
Currency Unit Conversions	**p equiv.**	**Reference**
$	65.40	
Ratio of refined petroleum price to crude oil (ex t	1.36	BEIS "Typical retail prices of petroleum products and a crude oil price index"

Gas price variations by season and by import route:
All gas prices are 5% above annual average values in Winter and Peak seasons, 5% below annual average in Summer season
TTF and ZEB gas imports are 5% above reference values given in the table above, LNG gas imports are 12% above the reference values

Resource prices in Alternative Demand Cases:

"Great Stagnation" demand case	Resource prices at bottom of their ranges
"Sharing Economy" demand case	Resource prices at top of their ranges

Resource Quantity Values:	**Biofuel Imports (2010)**	**Biofuel Imports (2050)**	**UK Biomass (2010)**	**UK Biomass (2050)**	**Dry Waste (2010)**	**Dry Waste (2050)**	**Coal**	**Liquid Fuel**	**Gas**	**Hydro**	**Nuclear**	**Solar Resource**	**Tidal Range Resource**	**Tidal Stream Resource**	**Wave Resource**	**Wet Waste (2010)**	**Wet Waste (2050)**	**Wind (onshore) Resource**	**Wind (shallow offshore) Resource**	**Wind (deep offshore) Resource**
	kWh	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**
Off_Channel Islands														7.1E+09					1.5E+10	8.8E+08
Off_Dogger Bank																			4.7E+10	1.1E+10
Off_East Scotland																				5.6E+10
Off_Hebrides															4.1E+10				2.7E+10	3.3E+09
Off_Irish Sea																			1.9E+10	3.7E+10
Off_Lundy													1.7E+10		1.8E+10				1.3E+10	1.9E+10
Off_Norfolk																			3.8E+10	7.1E+10
Off_Pentland														3.8E+10	9.4E+08				1.2E+10	5.8E+09
Off_Shetlands														5.8E+07	1.5E+10				1.4E+10	1.4E+10
Off_Wales															2.5E+09				6.4E+09	
On_East	1.1E+09	4.6E+08	3.0E+09	1.9E+10	7.5E+09	6.0E+09	Unlimited	Unlimited	Unlimited		Unlimited	7.0E+10				1.3E+09	6.7E+08	4.0E+09		
On_East Midlands	8.3E+08	3.6E+08	2.6E+09	1.6E+10	5.8E+09	4.7E+09	Unlimited	Unlimited	Unlimited		Unlimited	5.5E+10				1.0E+09	5.2E+08	3.2E+09		
On_London	1.4E+09	6.2E+08			1.0E+10	8.3E+09	Unlimited	Unlimited	Unlimited		Unlimited	7.9E+10				1.9E+09	9.3E+08			
On_North East	4.9E+08	2.1E+08	1.9E+08	1.2E+09	3.4E+09	2.7E+09	Unlimited	Unlimited	Unlimited	3.8E+07	Unlimited	2.6E+10				6.1E+08	3.0E+08	1.8E+09		
On_North West	1.3E+09	5.6E+08	7.1E+08	4.4E+09	9.0E+09	7.2E+09	Unlimited	Unlimited	Unlimited		Unlimited	7.3E+10	7.0E+09			1.6E+09	8.1E+08	3.0E+09		
On_Northern Ireland	3.3E+08	1.4E+08	7.7E+08	4.7E+09	2.3E+09	1.9E+09	Unlimited	Unlimited	Unlimited		Unlimited	2.5E+10		2.1E+09		4.2E+08	2.1E+08	2.9E+09		
On_Scotland	9.7E+08	4.2E+08	4.3E+09	2.7E+10	6.8E+09	5.5E+09	Unlimited	Unlimited	Unlimited	9.0E+09	Unlimited	6.7E+10		2.8E+09		1.2E+09	6.1E+08	1.6E+10		
On_South East	1.6E+09	6.8E+08	1.6E+09	1.0E+10	1.1E+10	8.9E+09	Unlimited	Unlimited	Unlimited		Unlimited	1.0E+11		3.2E+08		2.0E+09	9.9E+08	3.9E+09		
On_South West	9.8E+08	4.2E+08	1.4E+09	8.5E+09	6.8E+09	5.5E+09	Unlimited	Unlimited	Unlimited		Unlimited	6.8E+10				1.2E+09	6.1E+08	4.9E+09		
On_Wales	5.6E+08	2.4E+08	1.1E+09	7.0E+09	3.9E+09	3.1E+09	Unlimited	Unlimited	Unlimited	7.6E+08	Unlimited	3.5E+10	1.8E+10	2.5E+09		7.0E+08	3.5E+08	4.3E+09		
On_West Midlands	1.0E+09	4.4E+08	1.6E+09	1.0E+10	7.1E+09	5.7E+09	Unlimited	Unlimited	Unlimited		Unlimited	5.9E+10				1.3E+09	6.4E+08	2.6E+09		
On_Yorkshire & Humber	9.8E+08	4.2E+08	1.5E+09	9.4E+09	6.8E+09	5.5E+09	Unlimited	Unlimited	Unlimited		Unlimited	5.6E+10				1.2E+09	6.1E+08	3.2E+09		
Storage_Humber																				
Storage_North Sea																				
Total	**1.2E+10**	**5.0E+09**	**1.9E+10**	**1.2E+11**	**8.1E+10**	**6.5E+10**				**9.8E+09**		**7.1E+11**	**4.2E+10**	**5.2E+10**	**7.8E+10**	**1.5E+10**	**7.3E+09**	**5.0E+10**	**1.9E+11**	**2.2E+11**

Resource Quantity Profiles:	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
UK Biomass	1.0	1.6	2.1	2.7	3.3	4.0	4.7	5.4	6.2
Biomass Imports	1.0	22.3	21.7	17.1	11.7	9.1	7.7	4.6	3.1
Dry Waste	1.0	0.98	0.95	0.92	0.89	0.87	0.85	0.83	0.80
Biofuel Imports	1.0	0.68	1.82	1.47	1.30	1.13	0.87	0.52	0.43
Wet Waste	1.0	0.92	0.83	0.83	0.83	0.75	0.67	0.58	0.50

Resource Quantity Distributions:

	Min	**Mode**	**Max**
UK Biomass	3.0	6.2	7.5
Biomass Imports	0.0	3.1	6.3

Resource Cost Distributions:

All resource costs have triangular distributions. Min and max are given on the Resource Prices worksheet

Demand pathway datasets for the UK ESME

Reference Case

			2010	2015	2020	2025	2030	2035	2040	2045	2050
High Density Dwellings		million dwellings	5.4	5.7	6.0	6.2	6.5	6.7	6.9	7.1	7.3
Mid Density Dwellings		million dwellings	14.4	15.2	15.9	16.6	17.2	17.8	18.3	18.8	19.4
Low Density Dwellings		million dwellings	6.7	7.1	7.5	7.8	8.1	8.3	8.6	8.8	9.1
Commercial Floorspace		million sq metres	549.2	584.0	617.7	645.1	684.9	725.1	790.7	834.5	856.7
Public Floorspace		million sq metres	254.7	318.1	335.9	338.8	339.9	340.7	341.1	341.5	341.9
Appliances		TWh	60.2	62.3	64.3	66.0	67.5	68.9	70.2	71.6	73.0
Cooking		TWh	8.9	9.3	9.7	9.9	10.2	10.3	10.5	10.7	10.9
Air Conditioning		TWh	0.9	1.2	1.7	2.2	3.2	4.2	6.0	7.8	11.2
Aviation Domestic Passenger		billion passenger km	15.7	17.4	19.8	22.1	24.4	26.5	29.4	33.1	36.4
Aviation International Passenger		billion passenger km	282.6	313.2	354.7	396.8	437.7	476.5	528.2	593.8	652.5
Rail Passenger Electric		billion passenger km	30.4	36.1	48.4	54.2	59.8	66.4	73.3	73.3	73.3
Rail Passenger Diesel		billion passenger km	21.8	25.5	23.0	26.0	28.5	31.1	34.7	34.7	34.7
Rail Freight		billion tonne km	19.1	20.6	24.3	26.5	28.4	30.1	30.1	30.1	30.1
Road Passenger C/D Segment		billion passenger km	399.8	400.9	425.6	451.7	462.7	470.2	490.0	509.8	529.6
Road Passenger A/B Segment		billion passenger km	255.6	256.3	272.1	288.8	295.8	300.6	313.3	325.9	338.6
Road Passenger Bus		billion passenger km	45.0	43.1	41.3	41.0	40.8	38.9	37.3	35.6	33.9
Road Freight Heavy Goods Vehicle		billion tonne km	133.0	128.7	133.7	138.7	143.7	149.1	154.0	160.0	165.8
Road Freight Light Goods Vehicle		billion tonne km	12.0	13.9	16.1	18.2	20.3	22.6	25.3	28.1	30.9
Maritime International Freight		billion tonne km	878.5	921.7	924.7	917.7	922.3	935.0	952.9	970.9	1003.5
Maritime Domestic Freight		billion tonne km	42.0	43.3	42.4	41.0	36.7	35.9	35.9	36.1	36.3
Road Freight Medium Goods Vehicle		billion tonne km	2.0	1.9	2.0	2.1	2.2	2.2	2.3	2.4	2.5
Off Road Agricultural Truck		Million Operating Hours	119.1	122.0	124.9	127.8	130.9	134.0	137.1	140.4	143.7
Off Road Wheeled excavators		Million Operating Hours	19.5	19.2	18.8	18.5	18.1	17.8	17.4	17.1	16.8
Off Road Crawler excavators		Million Operating Hours	18.1	17.8	17.4	17.1	16.8	16.5	16.1	15.8	15.5
Off Road Wheeled Loaders		Million Operating Hours	10.6	10.4	10.2	10.0	9.8	9.7	9.5	9.3	9.1
Off Road Articulated Trucks A		Million Operating Hours	11.6	11.4	11.2	11.0	10.8	10.6	10.4	10.2	10.0
Off Road Articulated Trucks B		Million Operating Hours	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.8
Iron, Steel and Non-Ferrous Metals	I1	energy demand relative to 2010	1.00	0.82	0.83	0.81	0.81	0.79	0.78	0.77	0.75
Chemicals	I2	energy demand relative to 2010	1.00	0.91	0.96	0.98	1.00	1.01	0.97	0.92	0.84
Metal Products	I3	energy demand relative to 2010	1.00	1.03	1.09	1.13	1.17	1.20	1.22	1.24	1.26
Food, Drinks and Tobacco	I4	energy demand relative to 2010	1.00	1.03	1.06	1.09	1.12	1.15	1.18	1.21	1.25
Paper, Printing and Publishing	I5	energy demand relative to 2010	1.00	0.96	0.99	1.00	1.02	1.03	1.04	1.04	1.04
Other Industry	I6	energy demand relative to 2010	1.00	1.00	1.02	1.03	1.04	1.04	1.02	1.00	0.96
Cement Industry	I7	energy demand relative to 2010	1.00	0.93	0.87	0.79	0.72	0.63	0.55	0.47	0.38
Refined Petroleum Products	I8	energy demand relative to 2010	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.75
Agriculture	I9	energy demand relative to 2010	1.00	1.01	1.02	1.02	1.03	1.04	1.04	1.05	1.05

Great Stagnation

			2010	2015	2020	2025	2030	2035	2040	2045	2050
High Density Dwellings		million dwellings	5.4	5.7	6.1	6.5	6.9	7.2	7.5	7.9	8.2
Mid Density Dwellings		million dwellings	14.4	15.2	15.1	15.0	14.9	14.8	14.8	14.7	14.6
Low Density Dwellings		million dwellings	6.7	7.1	7.0	6.9	6.8	6.7	6.6	6.5	6.4
Commercial Floorspace		million sq metres	549.2	555.3	578.3	598.5	615.6	629.1	638.4	643.1	642.5
Public Floorspace		million sq metres	254.7	259.6	264.4	269.3	274.1	278.9	283.8	288.6	293.4
Appliances		TWh	60.2	62.3	62.7	63.0	63.3	63.6	63.8	64.1	64.4
Cooking		TWh	8.9	9.3	8.9	8.6	8.4	8.2	8.0	7.8	7.6
Air Conditioning		TWh	0.9	1.2	1.3	1.5	1.8	2.0	2.5	3.0	4.0
Aviation Domestic Passenger		billion passenger km	15.7	17.4	17.4	18.5	19.7	21.0	22.4	23.8	25.4
Aviation International Passenger		billion passenger km	282.6	313.2	304.5	319.0	334.5	351.1	368.8	387.7	407.9
Rail Passenger Electric		billion passenger km	30.4	36.1	33.2	35.2	37.4	39.7	42.1	44.8	47.7
Rail Passenger Diesel		billion passenger km	21.8	25.5	22.2	22.2	22.3	22.4	22.4	22.5	22.5
Rail Freight		billion tonne km	19.1	18.7	18.6	18.2	17.6	16.9	15.8	14.6	13.1
Road Passenger C/D Segment		billion passenger km	399.8	400.9	391.8	386.6	381.0	375.0	368.6	361.7	354.4
Road Passenger A/B Segment		billion passenger km	255.6	256.3	250.5	247.2	243.6	239.7	235.7	231.3	226.6
Road Passenger Bus		billion passenger km	45.0	43.1	43.5	43.9	44.2	44.6	44.9	45.3	45.6
Road Freight Heavy Goods Vehicle		billion tonne km	133.0	133.3	133.8	134.2	134.4	134.8	135.1	135.6	136.1
Road Freight Light Goods Vehicle		billion tonne km	12.0	13.6	16.2	18.9	21.9	25.0	28.4	32.0	35.8
Maritime International Freight		billion tonne km	878.5	864.2	840.8	815.9	789.2	760.7	730.3	697.8	663.1
Maritime Domestic Freight		billion tonne km	42.0	39.5	35.5	31.2	26.6	21.7	16.4	10.8	4.8
Road Freight Medium Goods Vehicle		billion tonne km	2.0	2.1	2.2	2.4	2.5	2.7	2.9	3.1	3.3
Off Road Agricultural Truck		Million Operating Hours	119.1	120.3	122.0	123.8	125.8	128.0	130.3	132.8	135.5
Off Road Wheeled excavators		Million Operating Hours	19.5	18.8	17.8	17.2	16.5	15.8	15.3	14.9	14.5
Off Road Crawler excavators		Million Operating Hours	18.1	17.4	16.5	15.9	15.2	14.7	14.2	13.8	13.5
Off Road Wheeled Loaders		Million Operating Hours	10.6	10.2	9.7	9.3	8.9	8.6	8.3	8.1	7.9
Off Road Articulated Trucks A		Million Operating Hours	11.6	11.2	10.6	10.2	9.8	9.4	9.1	8.9	8.6
Off Road Articulated Trucks B		Million Operating Hours	5.5	5.3	5.1	4.9	4.7	4.5	4.4	4.2	4.1
Iron, Steel and Non-Ferrous Metals	I1	energy demand relative to 2010	1.00	0.94	0.90	0.85	0.77	0.68	0.57	0.45	0.32
Chemicals	I2	energy demand relative to 2010	1.00	0.98	0.98	0.97	0.97	0.95	0.94	0.92	0.90
Metal Products	I3	energy demand relative to 2010	1.00	1.01	1.03	1.06	1.09	1.11	1.14	1.17	1.20
Food, Drinks and Tobacco	I4	energy demand relative to 2010	1.00	1.00	1.01	1.02	1.03	1.04	1.05	1.07	1.08
Paper, Printing and Publishing	I5	energy demand relative to 2010	1.00	1.00	0.99	0.98	0.96	0.94	0.91	0.88	0.84
Other Industry	I6	energy demand relative to 2010	1.00	0.98	0.97	0.95	0.93	0.91	0.88	0.84	0.80
Cement Industry	I7	energy demand relative to 2010	1.00	0.91	0.82	0.73	0.64	0.55	0.47	0.39	0.32
Refined Petroleum Products	I8	energy demand relative to 2010	1.00	0.95	0.92	0.87	0.81	0.75	0.67	0.58	0.48
Agriculture	I9	energy demand relative to 2010	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Sharing Economy

			2010	2015	2020	2025	2030	2035	2040	2045	2050
High Density Dwellings		million dwellings	5.4	5.7	6.4	7.1	7.7	8.2	8.7	9.3	9.8
Mid Density Dwellings		million dwellings	14.4	15.2	15.6	16.0	16.3	16.6	16.9	17.2	17.6
Low Density Dwellings		million dwellings	6.7	7.1	7.2	7.3	7.4	7.5	7.6	7.6	7.7
Commercial Floorspace		million sq metres	549.2	555.3	635.2	701.0	762.8	818.5	865.5	900.7	920.0
Public Floorspace		million sq metres	254.7	259.6	272.9	286.8	302.6	320.6	341.2	364.7	391.5
Appliances		TWh	60.2	62.3	67.0	71.1	74.7	77.9	81.1	84.4	87.8
Cooking		TWh	8.9	9.3	9.4	9.5	9.6	9.7	9.7	9.8	9.8
Air Conditioning		TWh	0.9	1.2	1.8	2.3	3.5	4.5	6.6	8.5	12.4
Aviation Domestic Passenger		billion passenger km	15.7	17.4	19.4	21.5	23.9	26.6	29.6	33.2	37.2
Aviation International Passenger		billion passenger km	282.6	313.2	353.3	394.9	442.4	496.6	558.4	629.0	709.6
Rail Passenger Electric		billion passenger km	30.4	36.1	54.2	60.0	65.7	72.9	79.7	79.7	79.7
Rail Passenger Diesel		billion passenger km	21.8	25.5	25.8	28.8	31.4	34.2	37.7	37.7	37.7
Rail Freight		billion tonne km	19.1	18.7	18.8	18.9	19.1	19.3	19.5	19.7	20.0
Road Passenger C/D Segment		billion passenger km	399.8	400.9	405.9	410.9	416.0	421.0	426.0	431.0	436.0
Road Passenger A/B Segment		billion passenger km	255.6	256.3	259.5	262.7	265.9	269.1	272.4	275.6	278.8
Road Passenger Bus		billion passenger km	45.0	43.1	45.8	48.5	51.1	53.8	56.5	59.1	61.8
Road Freight Heavy Goods Vehicle		billion tonne km	133.0	137.8	144.8	152.4	160.0	168.5	176.9	187.2	197.4
Road Freight Light Goods Vehicle		billion tonne km	12.0	13.6	16.7	19.9	23.5	27.7	32.5	37.9	44.1
Maritime International Freight		billion tonne km	878.5	864.2	873.8	883.8	895.2	908.2	923.1	940.0	959.4
Maritime Domestic Freight		billion tonne km	42.0	39.5	29.0	24.6	21.3	18.5	16.0	13.7	11.7
Road Freight Medium Goods Vehicle		billion tonne km	2.0	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.6
Off Road Agricultural Truck		Million Operating Hours	119.1	120.3	124.2	128.4	133.1	138.6	144.8	152.0	160.2
Off Road Wheeled excavators		Million Operating Hours	19.5	18.8	18.1	17.7	17.2	16.9	16.8	16.7	16.7
Off Road Crawler excavators		Million Operating Hours	18.1	17.4	16.8	16.4	16.0	15.7	15.5	15.5	15.5
Off Road Wheeled Loaders		Million Operating Hours	10.6	10.2	9.8	9.6	9.4	9.2	9.1	9.1	9.1
Off Road Articulated Trucks A		Million Operating Hours	11.6	11.2	10.8	10.5	10.2	10.1	10.0	9.9	10.0
Off Road Articulated Trucks B		Million Operating Hours	5.5	5.3	5.1	5.0	4.9	4.8	4.7	4.7	4.7
Iron, Steel and Non-Ferrous Metals	I1	energy demand relative to 2010	1.00	0.94	0.68	0.56	0.48	0.40	0.34	0.29	0.24
Chemicals	I2	energy demand relative to 2010	1.00	0.98	0.99	0.98	0.96	0.94	0.91	0.86	0.80
Metal Products	I3	energy demand relative to 2010	1.00	1.01	1.00	0.99	0.99	0.98	0.98	0.98	0.98
Food, Drinks and Tobacco	I4	energy demand relative to 2010	1.00	1.00	1.01	1.01	1.02	1.03	1.04	1.06	1.08
Paper, Printing and Publishing	I5	energy demand relative to 2010	1.00	1.00	0.95	0.91	0.86	0.80	0.75	0.70	0.64
Other Industry	I6	energy demand relative to 2010	1.00	0.98	0.96	0.95	0.92	0.89	0.85	0.80	0.74
Cement Industry	I7	energy demand relative to 2010	1.00	0.91	0.82	0.73	0.63	0.54	0.46	0.37	0.29
Refined Petroleum Products	I8	energy demand relative to 2010	1.00	0.95	0.75	0.67	0.60	0.54	0.49	0.44	0.40
Agriculture	I9	energy demand relative to 2010	1.00	0.99	1.03	1.06	1.09	1.14	1.18	1.24	1.30

Glossary of terms used:

Capacity Unit	Unit defining the amount of the technology which is built or installed
Economic Life	Number of years over which investment costs are to be annualised
Technical Life	Number of years technology can operate once installed
Max annual build rate	Upper limit on amount which can be built/installed per year across whole UK
Capital cost	Cost of deploying the technology (per capacity unit). This should be based on cost estimates for nth of a kind. Costs should include, where relevant: EPC cost, infrastructure connection costs, pre-licensing costs, technical and design costs, licensing costs and public enquiry costs. Contingency costs should be included but would normally be minimal for nth of a kind deployment. Land purchase costs and financing charges, such as interest during construction, should be excluded.
Fixed O&M costs	Costs, eg operation and maintenance, which are incurred per year regardless of level of usage (per capacity unit). [NB do not include fuel costs]
Variable O&M costs	Costs, eg operation and maintenance costs, which are in proportion to the level of usage (per capacity unit). [NB do not include fuel costs, or balancing costs]
Peak Contribution Factor	Also known as capacity credit. The percentage of capacity that statistically contributes to meeting the peak electricity demand of the year at a 95% confidence level. Only relevant to technologies generating electricity or heat.
Flexibility Factor	The flexibility contribution factor in ESME represents the ability of an electricity generation technology either to contribute to meeting fluctuating electricity demand, or to place demands for flexibility on the system (associated with a negative factor). The factor represents the percentage of capacity by which output could be increased in one hour, or the percentage of capacity by which output could drop in one hour. Only relevant to technologies generating electricity.
Annual availability factor	The % average availability of a technology over a year. E.g. For a power station this is the maximum energy generated in one year divided by the energy which would have been generated if the plant had run at nameplate capacity for the entire year
Time period to define inputs & outputs	Choose "hour" or "year" for convenience in specifying the inputs and outputs
Input(s)	The input(s) consumed by 1 capacity unit of the technology in 1 time period. E.g. Fuels, resources, energy carriers, intermediate products, etc N.b. All fuels and energy carriers are defined on a HHV basis
Output(s)	The output(s) from 1 capacity unit of the technology in 1 time period. E.g. Energy carriers, intermediate products, end-use energy services etc. Do not include emissions (these are calculated automatically) Please scale the data so that the figure in this column for the primary output is unity: E.g. a kW of power plant should have an output of 1kWh of electricity, and a kW of boiler should have an output of 1kWh of space heat, etc... N.b. All fuels and energy carriers are defined on a HHV basis
B Segment Cars	Small cars
C/D Segment Cars	Medium and large cars

Timeslice definitions:

Summer	April-September
Winter	October-March
Morning	6am - 10am
Mid-Day	10am - 4pm
Early Evening	4pm - 7pm
Late Evening	7pm - 11pm
Overnight	11pm - 6am

Industry Sectors and Processes:

I1 Industry (Iron, Steel, Metals)
I2 Industry (Chemicals)
I3 Industry (Metal Products)
I4 Industry (Food, drinks, tobacco)
I5 Industry (Paper, printing, publishing)
I6 Industry (Other w/o Cement)
I7 Industry (Cement)
I8 Industry (Refining)
I9 Industry (Agriculture)

HTP - High Temperature Process
LTP - Low Temperature Process
Mot - Motors
SpH - Space Heat
DaS - Drying and Separation
Other
Sw = Switching (relative to baseline mix)

Gas products

Gas_Irl_Export	Exports of gas to Ireland
Gas_LNG_Import	Imports of gas as LNG
Gas_NCS_Import	Imports of gas from Norwegian Continental Shelf
Gas_TTF_Export	Exports of gas to the Netherlands
Gas_TTF_Import	Imports of gas from the Netherlands
Gas_UKCS_Import	Gas extracted from the UK Continental Shelf
Gas_Zeb_Export	Exports of gas to Belgium
Gas_Zeb_Import	Imports of gas from Belgium
GasLDN	Gas in the UK Local Distribution Networks
GasTS	Gas in the UK Transmission System

UK Retail Prices Index (RPIJ)

http://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/kvr9

Year	Annual Average RPI %	Year Multiplier
1999	1.2	1.012
2000	2.5	1.025
2001	1.5	1.015
2002	1.3	1.013
2003	2.6	1.026
2004	2.7	1.027
2005	2.5	1.025
2006	2.8	1.028
2007	3.9	1.039
2008	3.6	1.036
2009	-0.9	0.991
2010	4.0	1.040
2011	4.5	1.045
2012	2.6	1.026
2013	2.4	1.024
2014	1.7	1.017
2015	0.3	1.003

Currency Exchange Rates

Data sourced from HMRC website

http://www.hmrc.gov.uk/exrate/yearly_rates.htm

e.g. 'Average for the year to 31 March 2015' as 2014 rate

Year	Average € per £ for year	Average $ per £ for year
2002	1.59	1.50
2003	1.45	1.63
2004	1.47	1.83
2005	1.46	1.82
2006	1.47	1.84
2007	1.46	2.00
2008	1.26	1.85
2009	1.12	1.56
2010	1.17	1.55
2011	1.15	1.60
2012	1.23	1.58
2013	1.18	1.56
2014	1.24	1.65
2015	1.37	1.51

Release	Date	Technology	Change	Sheet
1.1	01/11/2010	Bus (Hybrid)	Efficiency reduced in line with new source	
1.1	01/11/2010	HGV (Hybrid)	Efficiency reduced in line with new source	
1.1	01/11/2010	Dwellings (all)	Technical Life increased to 200 years	
1.1	01/11/2010	Nuclear	Maximum build rate in 2020 reduced to smooth curve	
1.1	01/11/2010	Heat Pumps (Space Heat)	No longer available for thermally poor dwellings	
1.2	07/02/2011	Anaerobic Digestion Gas Plant	Added to give more detailed data about Anaerobic digestion of waste plants	
1.2	07/02/2011	Anaerobic Digestion CHP Plant	Added to give more detailed data about Anaerobic digestion of waste plants	
1.2	07/02/2011	Micro Solar thermal (south-facing)	Added to give more detailed data about micro solar thermal	
1.2	07/02/2011	Micro Solar thermal (non-south-facing)	Added to give more detailed data about micro solar thermal	
1.2	07/02/2011	Biodiesel, Biokerosine and Biopetrol production	Renamed and cost and efficiency data updated in line with new sources	
1.2	07/02/2011	Biopetrol production with CCS	Added as a new technology	
1.2	07/02/2011	Space Heating	Units changed to kW per HDD and appropriate data sourced	
1.2	07/02/2011	All HGV	Average vehicle journey distance increased and average freight mass reduced and efficiencies updated accordingly to align with TSGB	
1.2	07/02/2011	Emission factors	Biofuels rationalised into a single type of import, Biofuel imports	
1.2	18/02/2011	PC Coal	Efficiencies updated	
1.2	18/02/2011	PC Coal with CCS	Efficiencies updated	
1.2	18/02/2011	IGCC Coal	Efficiencies updated	
1.2	18/02/2011	IGCC Coal with CCS	Efficiencies updated	
1.2	18/02/2011	CCGT	Efficiencies updated	
1.2	18/02/2011	CCGT with CCS	Efficiencies updated	
1.2	18/02/2011	Biofuel Resource	Available resource updated for all (onshore) regions	
1.2	04/03/2011	PC Coal	Capex cost and efficiencies updated	
1.2	04/03/2011	PC Coal with CCS	Capex cost and efficiencies updated and CO2 capture rate increased	
1.2	04/03/2011	IGCC Coal	Capex cost and efficiencies updated	
1.2	04/03/2011	IGCC Coal with CCS	Capex cost and efficiencies updated and CO2 capture rate increased	
1.2	04/03/2011	CCGT	Capex cost and efficiencies updated	
1.2	04/03/2011	CCGT with CCS	Capex cost and efficiencies updated and CO2 capture rate increased	
1.2	04/03/2011	H2 Turbine	Capex cost and efficiencies updated	
1.2	04/03/2011	H2 Plant (Gasification with CCS)	Capex cost and efficiencies updated and CO2 capture rate increased	
1.2	04/03/2011	H2 Plant (SMR with CCS)	Capex cost and efficiencies updated and CO2 capture rate increased	
2.0	23/06/2011	Industry CCS	Additional options for CCS for industry added	
2.0	23/06/2011	Incineration of Waste	Name changed from "Energy from Waste"	
2.0	23/06/2011	Nuclear	2020 build rate updated	
2.0	23/06/2011	Electricity Distribution	Capex costs updated	
2.0	11/07/2011	Waste	Wet and dry waste added as separate IO options	
2.0	11/07/2011	H2 Plant (Biomass Gasification with CCS)	New technology added	
2.0	11/07/2011	H2 Plant (SMR with CCS)	Efficiencies updated	
2.0	11/07/2011	PC Coal	Distributions for Capex changed from Uniform to Triangular	
2.0	11/07/2011	CCGT	Distributions for Capex changed from Uniform to Triangular	
2.0	11/07/2011	Macro CHP	Distributions for Capex changed from Uniform to Triangular	
2.0	11/07/2011	Incineration of Waste	Distributions for Capex changed from Uniform to Triangular	
2.0	11/07/2011	Lighting (LED)	Distributions for Capex changed from Uniform to Triangular	
2.0	11/07/2011	All Car technologies	Reclassification creating segments based on vehicle size and removing urban and extra-urban operating modes	
2.0	11/07/2011	Car (CNG) - B Segment	New technology added	
2.0	11/07/2011	Car (CNG) - C/D Segment	New technology added	
2.0	11/07/2011	MGV (ICE)	New technology added	
2.0	11/07/2011	MGV (CNG)	New technology added	
2.0	11/07/2011	MGV (Hybrid)	New technology added	
2.0	11/07/2011	MGV (Hydrogen FCV)	New technology added	
2.0	11/07/2011	HGV (CNG)	New technology added	
2.0	11/07/2011	HGV (LNG)	New technology added	
2.0	11/07/2011	LGV (CNG)	New technology added	
2.0	11/07/2011	HGV (ICE)	Average vehicle journey distance reduced and average freight mass increased and efficiencies updated accordingly	
2.0	11/07/2011	HGV (Hydrogen FCV)	Average vehicle journey distance reduced and average freight mass increased and efficiencies updated accordingly	
2.0	11/07/2011	HGV (Hybrid)	Technology removed	
2.0	11/08/2011	Heat Pump (Air Source) (Space Heat)	Applicability updated	
2.0	11/08/2011	Air Capture of CO2	New technology added	
2.0	16/09/2011	Biogas Production with CCS	New technology added	
2.0	16/09/2011	Insulation Bundles for Buildings	Distributions for Capex added	
2.0	16/09/2011	All CNG vehicles	Capex costs updated to account for fuel distribution infrastructure costs, notes updated	
2.0	16/09/2011	All hydrogen vehicles	Capex costs updated to account for fuel distribution infrastructure costs, notes updated	
2.0	16/09/2011	HGV (LNG) vehicle	Capex costs updated to account for fuel distribution infrastructure costs, notes updated	
3.0	04/07/2012	N/A	New Resource prices worksheet added	Resource Prices
3.0	04/07/2012	Boilers, micro CHP, electric resistive heating, heat pumps, electric heating	Technology name changes	Conversion
3.0	04/07/2012	H2 Electrolysis Plant, H2 Plant (Gasification with CCS)	Technology name changes	Conversion
3.0	04/07/2012	SNG Plant (Biomass Gasification with CCS)	Technology name change and data updated	Conversion
3.0	04/07/2012	Boilers, electric resistive heating	Indicative scale updated, Capex cost updated for gas boilers accordingly	Conversion
3.0	04/07/2012	Anaerobic Digestion Gas Plant and CHP Plant and appliances	Lifetimes corrected	Conversion
3.0	04/07/2012	CCGT with CCS, Macro CHP	Technical life updated	Conversion
3.0	04/07/2012	IGCC Biomass with CCS	Capex, Fixed O&M, Variable O&M 2010 and 2050 updated when CO2 capture rate changed to 95%	Conversion
3.0	04/07/2012	All technologies with electricity output	Peak Contrib. Factor, Flexibility Factor and Annual Availability 2010 and 2050 updated	Conversion
3.0	04/07/2012	Oil boiler, gas boiler, biomass boiler, electric resistive heating, heat pumps, micro solar thermal (south facing)	Peak Contrib. Factor introduced and Annual availability factor 2010 and 2050 updated	Conversion
3.0	04/07/2012	Biomass and waste technologies	Notes updated	Conversion
3.0	04/07/2012	Oil and Gas Boiler - hot water	Input 1 2010 and 2050 updated	Conversion
3.0	04/07/2012	Heat Pumps (Ground Source)	Input 1 2010 and 2050 updated	Conversion
3.0	04/07/2012	Heat Pumps (Air Source)	Input 2 2010 and 2050 updated	Conversion
3.0	04/07/2012	Electric Vehicle Charging and 4 types of interconnector	New technologies added	Infrastructure
3.0	04/07/2012	Building Space Heat Storage and Building Hot Water Storage	New technologies added	Infrastructure
3.0	04/07/2012	Diurnal Storage technologies	Columns added relating to power rating of diurnal storage technologies. Indicative scales revised.	Infrastructure
3.0	04/07/2012	Electricity Transmission, CO2 and hydrogen transmission	Lifetimes corrected	Infrastructure
3.0	04/07/2012	Storage of Electricity	All data revised for separate modelling of storage power and volume	Infrastructure
3.0	04/07/2012	H2 Gas Transmission Pipeline	% loss factors corrected	Infrastructure
3.0	04/07/2012	Geological Storage of Hydrogen and CASE	Comment added	Infrastructure
3.0	04/07/2012	I?a, I?c, I??	CCS capture costs 2010 updated	Industry
3.0	04/07/2012	All industries	Fixed costs 2010 and 2050 updated, comments updated	Industry
3.0	04/07/2012	N/A	Columns updated for new timeslice definitions	Industry
3.0	04/07/2012	Floorspaces	Energy input time slice values both for light and electricity added	Buildings
3.0	04/07/2012	Dwellings	Energy input timeslice values for light added	Buildings
3.0	04/07/2012	All cars	Maximum annual build rate 2040 and 2050 removed	Transport
3.0	04/07/2012	Car (Hydrogen FCV) (B and C/D segment)	Investment costs 2050 updated and capex distribution updated	Transport
3.0	04/07/2012	Bus (CNG)	Investment costs 2010 and 2050 updated	Transport
3.0	04/07/2012	International Aviation	Investment costs 2050 corrected	Transport
3.1	03/01/2013	Micro Solar PV	Capex costs upated and fixed O&M costs introduced. Capex distribution min and max changed. Annual availability updated. Load factor varies by region, se	Conversion
3.1	03/01/2013	Micro Solar Thermal	Capex costs revised, notes updated	Conversion
3.1	03/01/2013	District Heating MD/HD	Capex costs changed, Capex distribution introduced	Conversion
3.1	03/01/2013	Electric Vehicle Charging	New costs and new limits on fraction of the parc for which each charging point type is available	Infrastructure
3.1	03/01/2013	Pumped Storage, Compressed Air Storage, Battery Storage of Electricity	Capex costs changed	Infrastructure
3.1	03/01/2013	Geological Storage of CO2	Cost structure changed: Capacity unit and economic life changed	Infrastructure
3.1	03/01/2013	Geological Storage of Hydrogen	Max build rates 2010 and 2050 introduced	Infrastructure
3.1	03/01/2013	Insulation	Capex costs updated. Capex distribution min and max changed, additional comments updated	Buildings
3.1	03/01/2013	Car (A/B Segment)	Weighted average of A/B segments replaces B segment. Costs and efficiencies updated. Average of diesel/petrol types adopted for liquid fuel. Capex distribu	Transport
3.1	03/01/2013	Car (C/D Segment)	Costs and efficiencies updated, average of diesel/petrol types adopted for liquid fuel, Capex distribution min and max changed	Transport
3.1	03/01/2013	MGV (ICE), MGV (Hybrid), HGV (ICE), LGV (ICE), LGV (Hybrid), LGV (PHEV), Bus (ICE), Bus (Hybrid)	Efficiency changed	Transport
3.1	03/01/2013	N/A	New product - Biomass Imports	Products
3.1	03/01/2013	Conversion CCS Technologies	Notes updated	Conversion
3.1	03/01/2013	Nuclear	2020 and 2030 max build rates changed. Notes updated	Conversion
3.1	03/01/2013	Offshore and Onshore Wind	Notes updated	Conversion
3.1	03/01/2013	Lighting	Economic life revised	Conversion
3.1	03/01/2013	Domestic Air Conditioning, Domestic Appliances	Names changed from "Air Conditioning" and "Appliances"	Conversion
3.1	03/01/2013	Interconnectors	Additional comments updated	Infrastructure
3.1	03/01/2013	Industry CCS Technologies	2010 max build rate set to 0	Industry
3.1	03/01/2013	LGV (Gas SI), LGV (Dual Fuel Port), LGV (Dual Fuel Direct)	New technologies added	Transport
3.1	03/01/2013	MGV (Gas SI), MGV (Dual Fuel Port),MGV (Dual Fuel Direct)	New technologies added	Transport
3.1	03/01/2013	HGV (Gas SI), HGV (Dual Fuel Port), HGV (Dual Fuel Direct)	New technologies added	Transport
3.1	03/01/2013	Bus (Gas SI), Bus (Dual Fuel Port), Bus (Dual Fuel Direct)	New technologies added	Transport
3.1	03/01/2013	Heat Pump (Large Scale Marine), Biomass Importing CO2 Credit	New technology added	Conversion
3.1	03/01/2013	Onshore Wind	Availability factor corrected	Conversion
3.1	03/01/2013	Various	Several name changes, unit changes and other minor corrections to align with data in ESME	N/A
3.2	03/06/2013	N/A	Revised demand cases	N/A
3.2	03/06/2013	N/A	Constraints for exponential uptake added	N/A
3.2	03/06/2013	Electricity transmission	Revised existing transmission capacities	N/A
3.2	03/06/2013	N/A	Revised CO2 targets	N/A
3.2	03/06/2013	All (except industry)	New 'construction period' parameter added to calculate interest during construction	N/A
3.2	03/06/2013	Converted Biomass Plant	New technology added (and available as retrofit option for PC Coal Plant)	Conversion
3.2	03/06/2013	PC Coal with CCS, CCGT, OCGT	Technical lives changed	Conversion
3.2	03/06/2013	Nuclear	Notes updated on availability factors	Conversion
3.2	03/06/2013	IGCC Coal	Notes updated	Conversion
3.2	03/06/2013	Technologies producing 'waste heat'	Product 'waste heat' renamed 'recoverable heat'	Conversion
3.2	03/06/2013	Geothermal Plants	Expanded into three separate technologies: HSA (Heat only), HSA (Heat & Electricity) and EGS (Heat and Electricity). Geothermal Heat also added as new re	Conversion
3.2	03/06/2013	Domestic Cooking (Electric) and Domestic Cooking (Gas)	Renamed, previously 'Cooking (Electric)' and 'Cooking (Gas)'	Conversion
3.2	03/06/2013	Large Scale Ground Mounted Solar PV	New technology added	Conversion
3.2	03/06/2013	Micro Solar PV	Correlated with Large Scale Ground Mounted Solar PV and vice versa	Conversion
3.2	03/06/2013	District Heating LD technologies	Eight new technologies added for the different thermal ratings	Conversion
3.2	03/06/2013	District Heating HD and District Heating MD technologies	New categories introduced for retrofix and retroplus in medium and poor thermal rating bands	Conversion
3.2	03/06/2013	Heat Offtake for District Heat Network	Renamed, previously 'Waste Heat Collection' and capital costs corrected	Conversion
3.2	03/06/2013	Oil boilers and Electric Resistive Heating	Notes updated. Minimum load factors and minimum build quantities employed in early years to ensure that existing stock continues to be used and is not re	Conversion
3.2	03/06/2013	District Heat Storage	New storage technology added	Infrastructure
3.2	03/06/2013	Pumped Storage of Electricity	Diurnal Storage Power to Volume constraint - max discharge time revised	Infrastructure
3.2	03/06/2013	All industry technologies	Capacity units renamed 'Sector Energy Demand relative to 2010'	Industry
3.2	03/06/2013	All industry technologies	Energy inputs and fixed costs revised in line with 2012 Dukes data on 2010	Industry
3.2	03/06/2013	Industry plus Hydrogen	Four new technologies added for I1, I2, I6 and I7 categories to represent hydrogen as a fuel switch in industry	Industry
3.2	03/06/2013	Industry process emissions	Four new dummy technologies added for I1, I2, I6 and I7 categories to represent CO2 process emissions	Industry
3.2	03/06/2013	Industry process emissions with CCS	Three new dummy technologies added for I1, I2 and I6 categories to represent CO2 process emissions	Industry
3.2	03/06/2013	Other CO2 emissions	Dummy technology added to produce CO2 emissions not covered elsewhere. Capacity unit in tonnes/year	Industry
3.2	03/06/2013	Industry technologies that are not process emissions	Additional comments updated, load factor varies by season and time of day. Also fixed costs scaled down by the annual loadfactor for every tech (ESME	Industry
3.2	03/06/2013	Retrofix and Retroplus technologies	Twelve new retrofit technologies replacing the insulation bundles in the previous version. Retrofix and retroplus correlated with each other	Buildings
3.2	03/06/2013	Floorspace (Commercial) and Floorspace (Public)	Light and electricity energy inputs recalibrated	Buildings
3.2	03/06/2013	All 'Dwelling' technologies	Light energy inputs recalibrated	Buildings
3.2	03/06/2013	Car, LGV, MGV and bus technologies	Notes updated on uptake constraints	Transport
3.2	03/06/2013	Maritime and Aviation	2010 and 2050 inputs recalibrated in line with 2010 emissions, existing efficiency increases and new demand figures	Transport
3.2	03/06/2013	Rail technologies	2010 and 2050 inputs recalibrated	Transport
3.2	03/06/2013	All passenger transport technologies	Average number of people per vehicle revised as part of demand case revisions	Transport
3.2	03/06/2013	All Car technologies	Average number of km per vehicle revised as part of demand case revisions	Transport
3.2	03/06/2013	MGV vehicles	All MGV vehicles removed as part of demand case revisions	Transport
3.2	03/06/2013	All transport technologies	Inputs now given as 'per km'	Transport
3.3	03/01/2014	N/A	New column added to distribution info section to give clarity on how the deterministic value is used in combination with the min and max to define a distrib	N/A
3.3	03/01/2014	PC Coal, IGCC Coal, CCGT (and corresponding CCS technologies), H2 Turbine, IGCC Biomass with CCS	Capex costs 2010 and 2050 revised	Conversion
3.3	03/01/2014	PC Coal and H2 Turbine	Fixed costs 2010 and 2050 revised	Conversion
3.3	03/01/2014	CCGT with CCS	Variable costs 2010 and 2050 revised	Conversion
3.3	03/01/2014	PC Coal with CCS, IGCC Coal with CCS, CCGT with CCS, H2 Turbine, IGCC Biomass with CCS	Inputs 2010 and 2050 revised	Conversion
3.3	03/01/2014	Onshore Wind, Micro Solar PV, Large Scale Ground-Mounted Solar PV	Notes updated to reflect change in short term momentum effects	Conversion
3.3	03/01/2014	Domestic Boilers, Micro CHP, Electric Resistive Heating, Domestic Heat Pumps, Micro Solar Thermal (south)	Time period to define I/O corrected	Conversion
3.3	03/01/2014	District Heating for Dwellings	Notes updated to show new constraint limiting max rate of growth	Conversion
3.3	03/01/2014	H2 Plant (Coal, Biomass and SMR) with CCS	Capex, fixed and variable costs 2010 and 2050 and inputs 2010 and 2050 revised	Conversion
3.3	03/01/2014	SNG Plant (Biomass Gasification with CCS)	Capex costs 2010 and 2050 revised, inputs 2010 and 2050 revised	Conversion
3.3	03/01/2014	Captured CO2 Transmission	Now split into offshore and onshore with no sizing assumptions. Economic and technical lives revised. Capex costs 2010 and 2050 revised	Infrastructure
3.3	03/01/2014	Geological Storage of CO2	Economic life revised. Capex costs 2010 and 2050 revised and now differ by storage node (see notes)	Infrastructure
3.3	03/01/2014	Geological Storage of Hydrogen	Capex costs 2010 and 2050, % loss factors and notes revised. H2 storage now diurnal	Infrastructure
3.3	03/01/2014	Building Space Heat Storage and Building Hot Water Storage	Notes revised (more details given on the "per house" limits - no change to underlying data)	Infrastructure
3.3	03/01/2014	N/A	Column headings for energy inputs corrected	Industry
3.3	03/01/2014	Dwellings	Technical life adjusted to give a retirement that matches to observed demolition rate (~0.07% per annum)	Buildings
3.3	03/01/2014	Retroplus	Capex costs 2010 and 2050 corrected due to a typo in the previous version of this sheet. No change to the data in this update	Buildings
3.3	03/01/2014	Cars and LGVs	Cost distributions added for LGVs (similar basis to cars) and correlated to corresponding car type	Transport
3.3	03/01/2014	HGVs	Indicative scale corrected. Average km per vehicle per year, average tonnes freight per vehicle and number of tonne-km per vehicle per year corrected	Transport
3.3	03/01/2014	HGVs, LGVs and Buses	Notes updated (correction of % pa maximum growth rate - typo in previous sheet)	Transport
3.3	03/01/2014	HGV (Gas SI)	Input 2050 updated	Transport
3.3	03/01/2014	LGVs	All LGV data updated using the same source to make it consistent (previous LGV data came from different sources). Max build rates added for some	Transport
3.3	03/01/2014	LGV (Dual Fuel Port), LGV (Dual Fuel Direct)	Two technologies removed	Transport
3.3	03/01/2014	LGV (Hydrogen ICE)	New technology added	Transport
3.3	03/01/2014	Bus (Gas SI)	2050 input updated	Transport
3.3	03/01/2014	Bus (Hydrogen FCV)	2010 capex cost and inputs (2010 and 2050) updated	Transport
3.4	30/06/2014	All hydrogen vehicles	Electricity added as an input at 4.3% of hydrogen consumption, required for compression of the H2	Transport
3.4	30/06/2014	Hydrogen cars	Costs updated to reflect fresh calculation of the tank size required to deliver range	Transport
3.4	30/06/2014	All LGV technologies	Full revision of the data in this sector. Data brought into line with the car data by using the same source (ETI light vehicles database), and new technologies a	Transport
3.4	30/06/2014	Biomass Macro CHP	New technology added	Conversion
3.4	30/06/2014	Gas Macro CHP	Technology renamed (previously called "Macro CHP") to avoid confusion with Biomass Macro CHP	Conversion
3.4	30/06/2014	Nuclear	Notes updated to reflect revised maximum build quantity, and to clarify scope of the VOM costs	Conversion
3.4	30/06/2014	H2 Turbines	Capex and fixed costs updated	Conversion
3.4	30/06/2014	Geological stororage of hydrogen	Capex updated. Note on fixed costs updated	Infrastructure
3.4	30/06/2014	All electricity storage technoloiges	Ful revision of the data for these technologies, and addition of several new battery technologies	Infrastructure
3.4	30/06/2014	I6 Industry and I6g Industry	Minor corrections to the energy inputs	Industry
3.4	30/06/2014	All Dwelling technologoes	Comments updated to include explanation of the abbreviations used in the technology names	Buildings
3.4	30/06/2014	N/A	New worksheet added with data on historic inflation and currency exchange rates	Financial Data
3.4	11/07/2014	N/A	UK Biomass resource updated	Resource Limits
3.5	19/01/2015	All gas and hydrogen road vehicles	The per-vehicle costs for refuelling infrastructure, included in vehicle capex in previous versions, have been removed and now treated as distinct technologie	Transport
3.5	19/01/2015	Natural gas vehicle refuelling and Hydrogen gas vehicle refuelling	New technologies which represent the per-vehicle costs for refuelling infrastructure, included in vehicle capex in previous versions. The per-vehicle costs ar	Infrastructure
3.5	19/01/2015	Aviation (domestic) & Aviation (international)	Technical life and efficiency updated	Transport
4.0	30/07/2015	Nuclear (Legacy, Gen III, Gen IV and SMR)	New technologies to replace previous single "Nuclear"	Conversion
4.0	30/07/2015	Offshore Wind (fixed and floating)	New technologies to replace previous single "Offshore Wind"	Conversion
4.0	30/07/2015	Dry waste carbon accounting & Biomass Production (UK)	New dummy technologies	Conversion
4.0	30/07/2015	All industry technologies	Full revision of the data in this sector	Industry
4.0	30/07/2015	All natural gas road vehicles	Added an electricity input to represent energy for compression during fuelling	Transport
4.0	30/07/2015	HGV & MGV	Full revision of the previous HGV sector, disaggregated into two weight categories	Transport
4.0	30/07/2015	Buses	Full revision of the data for buses	Transport
4.0	30/07/2015	Maritime (Dual Fuel International) & Maritime (Dual Fuel Domestic)	New technologies added	Transport
4.0	30/07/2015	Agricultural Vehicle (ICE), Wheeled Excavator (ICE), Crawler Excavator (ICE), Medium Articulated Truck (ICE), Large Articulated Truck (ICE) & Medium W	New technologies added for the new off-road vehicle categories	Transport
4.0	30/07/2015	N/A	Wind resource disaggregated into three categories and the offshore values revised	Resource Limits
4.0	30/07/2015	N/A	Typo corrected on the emission factor for imported biofuels.	Products
4.0	30/07/2015	N/A	"UK Biomass" adopted as name for the resource previously called "Biomass"	Products
4.1	03/05/2016	IGCC Coal with CCS	updated in line with DC dataset	Conversion
4.1	03/05/2016	CCGT with CCS	updated in line with DC dataset	Conversion
4.1	03/05/2016	Waste Gasification	New technology, data from DC	Conversion
4.1	03/05/2016	Waste Gasification with CCS	New technology, data from DC	Conversion
4.1	03/05/2016	Onshore Wind	Build rate for 2015 increased to allow for historical deployment	Conversion
4.1	03/05/2016	Tidal Stream	updated in line with DC dataset	Conversion
4.1	03/05/2016	Wave Power	updated in line with DC dataset	Conversion
4.1	03/05/2016	Biomass Boiler - Space Heat	max capacity limited to oil boiler 2010 capacity, availability factor updated to prevent over-generation	Conversion
4.1	03/05/2016	Biomass Boiler - Hot Water	max capacity limited to oil boiler 2010 capacity	Conversion
4.1	03/05/2016	Heat Pump (Air Source) (Space Heat)	updated in line with DC dataset, exponential uptake and 2015 max build introduced	Conversion
4.1	03/05/2016	Heat Pump (Air Source, hot water)	updated in line with DC dataset, exponential uptake and 2015 max build introduced	Conversion
4.1	03/05/2016	Heat Pump (Ground Source, space heat)	exponential uptake and 2015 max build introduced	Conversion
4.1	03/05/2016	Heat Pump (Ground Source, hot water)	exponential uptake and 2015 max build introduced	Conversion
4.1	03/05/2016	Solar Thermal (Domestic south facing)	Name changed from "Micro Solar thermal (south facing)"	Conversion
4.1	03/05/2016	Solar Thermal (Domestic non south facing)	Name changed from "Micro Solar thermal (non south facing)"	Conversion
4.1	03/05/2016	Solar PV (Domestic)	Name changed from "Micro Solar PV", costs, load factors, build rates updated in line with ETI's Solar PV review	Conversion
4.1	03/05/2016	Solar PV (Farm)	Name changed from Large Scale Ground Mounted Solar PV" costs, load factors, build rates updated in line with ETI's Solar PV review	Conversion
4.1	03/05/2016	District Heating (for Dwellings)	group constraint to limit uptake pre-2015	Conversion
4.1	03/05/2016	Heat Offtake for District Heat Network	build rate constraint to prevent immediate mass deployment	Conversion
4.1	03/05/2016	H2 Plant (Biomass Gasification with CCS)	build rates update to align with H2 Plant (Coal Gasification with CCS)	Conversion
4.1	03/05/2016	H2 Plant (SMR with CCS)	build rates update to align with H2 Plant (Coal Gasification with CCS)	Conversion
4.1	03/05/2016	Biopetrol Production with CCS	build rates update to align with H2 Plant (Coal Gasification with CCS)	Conversion
4.1	03/05/2016	SNG Plant (Biomass Gasification with CCS)	build rates update to align with H2 Plant (Coal Gasification with CCS)	Conversion
4.1	03/05/2016	Pumped Heat Storage of Electricity	New technology, data from DC	Infrastructure
4.1	03/05/2016	Hydrogen storage - shallow salt cavern	disaggregated from single Hydrogen Storage	Infrastructure
4.1	03/05/2016	Hydrogen storage - medium salt cavern	disaggregated from single Hydrogen Storage	Infrastructure
4.1	03/05/2016	Hydrogen storage - deep salt cavern	disaggregated from single Hydrogen Storage	Infrastructure
4.1	03/05/2016	Retrofix and Retroplus technologies	introduction of group exponential uptake constraint, to ensure starting stock of 100,000 retrofits, then 20% pa growth	Buildings
4.1	03/05/2016	HGV (Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	HGV (Gas SI Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	HGV (Dual Fuel Direct Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	MGV (Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	MGV (Gas SI Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	MGV (Dual Fuel Direct Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	Bus (Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	Bus (Gas SI Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	Bus (Dual Fuel Direct Flywheel Hybrid)	New technology, data from DC	Transport
4.1	03/05/2016	Dry Waste Resource	Prices updated with data from Bioenergy programme	Resource Prices
4.1	03/05/2016	Dry Waste	Quantities update with data from Bioenergy programme	Resource Limits
4.1	03/05/2016	Solar	Resource quantity doubled as previous value was arbitrarily limiting	Resource Limits
4.1	03/05/2016	Wet Waste	Quantities update with data from Bioenergy programme	Resource Limits
4.1	03/05/2016	All CCS technologies	build rates, efficiencies, capture rates, capex, fixed cost all shifted 5 ears to the right as per 5 year CCS delay	Conversion
4.1	03/05/2016	Industry I7 HTP Low Carbon Cement CCS	name changed to include CCS suffix	Industry
4.1	03/05/2016	Industry (various)	definitions provided in glossary for sectors and processes	Glossary
4.2	22/12/2016	CCGT, CCGT with CCS	Output of recovereable heat reduced	Conversion
4.2	22/12/2016	IGCC Biomass, H2 Plant (Biomass Gasification), H2 Plant (SMR), SNG Plant (Biomass Gasification)	New technologies added	Conversion
4.2	22/12/2016	Anaerobic Digestion Gas Plant, Anaerobic Digestion CHP Plant	Costs updated	Conversion
4.2	22/12/2016	Onshore Wind, Offshore Wind (fixed), Solar PV (Domestic), Solar PV (Farm), Biomass Boiler - space heat	Minimum build in 2015 updated	Conversion
4.2	22/12/2016	Gasification plants	Monte Carlo cost distributions and correlations updated	Conversion
4.2	22/12/2016	Oil boilers and Gas boilers	Minimum load factors added	Conversion
4.2	22/12/2016	H2 plants (gasification and electrolysis) and SNG plants	Revision of cost and efficiency assumptions	Conversion
4.2	22/12/2016	Tidal Stream	Capital cost revised	Conversion
4.2	22/12/2016	Electricity Distribution Network	Loss factors revised	Infrastructure
4.2	22/12/2016	Captured CO2 transmission (offshore) and storage	Costs revised	Infrastructure
4.2	22/12/2016	Car (PHEV)	Technology replaces 3 variants of PHEV with different electric ranges	Transport
4.2	22/12/2016	Cars	Max build rates removed (superseded by exp growth constraints), costs revised	Transport
4.2	22/12/2016	Car ICE, Car Hybrid, Car PHEV, Car Battery	Efficiencies revised	Transport
4.2	22/12/2016	UK Biomass, Biomass Imports, Dry Waste	Carbon intensity factors revised	Products
4.2	22/12/2016	Offshore Wind, Wave, Tidal Stream, Tidal Range	Offshore renewable resources revised, new node "Off_Wales" added	Resource Limits
4.3	21/08/2017	All electricity generation technologies and all electricity storage technologies	Revised peak contribution factors	Conversion, Infrastructure
4.3	21/08/2017	SNG Plant (Power to SNG)	New technology added	Conversion
4.3	21/08/2017	Gas Distribution Network, Gas NCS Entry Point, Gas UKCS Entry Point, Interconnector BBL (Gas), Interconnector IUK (Gas), Interconnector Moffat (Gas), LNG Regasification Terminal, Gas Long Range Storage, Gas Medium Range Storage, Gas Short Range Storage, Gas T Linepack, Gas Transmission	New technbologies added as part of new representation of the UK gas network	Infrastructure
4.3	21/08/2017	n/a	Resource prices for all fossil fuels and bioenergy resources updated	Resource Prices
4.3	21/08/2017	n/a	Resource limits for UK Biomass, Biofuel Imports and Biomass Imports revised	Resource Limits, Conversion
4.3	21/08/2017	Biomass Fired Generation with CCS	New technology added	Conversion
4.3	21/08/2017	Biomass Fired Generation, IGCC Biomass, IGCC Biomass with CCS, H2 Plant (Biomass Gasification), H2 Plant (Biomass Gasification with CCS), SNG Plant (Biomass Gasification), SNG Plant (Biomass Gasification with CCS)	Bioenergy conversion technoolgy costs updated	Conversion