UKERC Energy 2050 Scenario Data

UKERC's ambitious interdisciplinary report – *Energy 2050: Making the transition to a secure and low-carbon energy system* – launched on April 30th 2009, addresses two of the UK Government's toughest energy policy goals – ensuring supply resilience in meeting energy demands, while meeting its legal commitment to reduce CO_2 emissions by 80% by 2050. The full report and supporting documentation is at www.ukerc.ac.uk/support/tiki-index.php?page=Energy+2050+Overview The report synthesises the project findings; an extended account of the project and policy implications are being published in book form in 2010 (*Ekins P., Skea J. and Winskel M. (eds) (2010), Energy 2050: the transition to a secure low carbon energy system for the UK, Earthscan*).

The project relied heavily on the use of interlinked models. These including the energy systems UK MARKAL Elastic Demand model, as well as sectoral models in the electricity and gas sectors (CGEN, WASP) and end-use buildings and transport sectors (UKDCM, UKTCM).

This introduction gives a listing and overview of the major UK energy scenarios (2000-2050) as used in the project. UKERC's energy data centre (EDC) holds the tabulated scenario data for public use. Please reference this data source as: Strachan N., Anandarajah G., Hughes N., and Ekins P. (2010), *UKERC Energy 2050 energy systems scenario data*, UKERC Energy Data Centre, http://ukedc.rl.ac.uk/index.html

The table below lists the UKERC Energy 2050 scenarios, report chapters, scenario names (and alternate names from earlier reports) and an overview description of key features. Detailed information on these scenarios is given at www.ukerc.ac.uk/support/tiki-index.php?page=Energy+2050+Overview

Name	Scenario	Previous names	Description of Key Features
CORE SCENARIOS (Chapters 2, 3, 4, 5, 6, additional)			
REF	Reference	Base	Only policies as of 2008 Energy Bill; No CO_2 price
LC	Low carbon	CAM, LC Core 80%	26% CO_2 reduction by 2020 (CCC interim target equivalent), exponentially extrapolated to -80% by 2050 (118MtCO_2)
CARBON REDUCTION (Chapter 2)			
LC-40	Faint-heart	CFH	15% CO_2 reduction by 2020, extrapolated to -40% by 2050 (355MtCO_2)
LC-60	Low-carbon-60	CLC, LC Core 60%	26% CO_2 reduction by 2020, extrapolated to -60% by 2050 (237MtCO_2)
LC-90	Super ambition	CSAM	32% CO_2 reduction by 2020 (CCC intended target equivalent), extrapolated to -90% by 2050 (59MtCO_2)
LC-EA	Early action	CEA	32% CO_2 reduction by 2020 (CCC intended target equivalent), extrapolated to -80% by 2050 (118MtCO_2)
LC-LCP	Least-cost path	CCP	Same cumulative emissions as LC-EA (19.24GtCO_2), but a least-cost cumulative path
LC-SO	Socially optimal least-cost path	CCSP	Same cumulative emissions as LC-EA (19.24GtCO_2), with a least-cost cumulative path, and social discount rate (3.5%)
RESILIENT SCENARIOS (Chapter 3, additional)			
R	Resilient		Primary energy resilience – 40% market share per fuel; Electricity generation and capacity resilience – 40% maximum market share per technology class; Final energy resilience – 3.2% p.a. reduction from 2010

LCR	Low-Carbon Resilient		Combination of LC and R scenarios
ACCELERATED TECHNOLOGY DEVELOPMENT (Chapter 4)			
LC-Acctech	Accelerated technology		As LC (80% CO_2 reduction by 2050), with acceleration of all technologies as below
LC-Renew	Accelerated renewables		As LC (80% CO_2 reduction by 2050), with acceleration of renewable technologies as below
LC-60 Acctech	LC-60 accelerated technology		As LC-60 (60% CO_2 reduction by 2050), with acceleration of all technologies as below
LC-60 Renew	LC-60 accelerated renewables		As LC-60 (60% CO_2 reduction by 2050), with acceleration of renewable technologies as below
LC-60 Bio	LC-60 accelerated biomass		As LC-60, with exogenous technology narrative – selective bio energy chain improvements based around: Bioengineering (a doubling of average energy crop yield by 2050); Agro-machinery (increasing yield of energy crops); Gasification technology (reduced capital costs and improved availability); Ligno-cellulosic ethanol (reduced capital and O&M costs, and increased efficiency): Fast pyrolysis (bio-oil process and quality improvements for reduced capital and O&M costs)
LC-60 CCS	LC-60 accelerated carbon capture and storage		As LC-60, with exogenous technology narrative – reduced off-shore storage costs for depleted oil and gas fields and saline aquifers. Same CCS plant costs as model data already considered optimistic
LC-60 Nuclear	LC-60 accelerated nuclear		As LC-60, with exogenous technology narrative – moderately lower costs, higher load factors, improved efficiencies and earlier availabilities for Gen III, III+ and IV fission plant. Gen. III technology available from 2017 for an first-of-a-kind (FOAK) plant, with next-of-a-kind (NOAK) plants from 2020
LC-60 FC	LC-60 accelerated fuel cells		As LC-60, with exogenous technology narrative – hydrogen fuel cell cost reductions for bus and car modes; natural gas (SOFC-CHP, MCFC-CHP) and hydrogen (PEMFC -CHP) cost reductions for electricity generation
LC-60 Marine	LC-60 accelerated marine		As LC-60, with exogenous technology narrative – supported niche learning on marine energy giving capital costs for wave and tidal of around £1100/kW by 2015. After 2015, annual cost reductions from global learning rate of 10%
LC-60 PV	LC-60 accelerated photo-voltaics		As LC-60, with exogenous technology narrative – worldwide R&D efforts, policy support and market developments for advanced learning rates for 1st gen. crystalline silicon, 2nd gen. thin film module technologies and 3rd gen. organic PV, leading to capital cost range of (£600-£200)/kW by 2050
LC-60 Wind	LC-60 accelerated wind		As LC-60, with exogenous technology narrative – higher UK onshore wind capacity of 18GW; raised offshore wind learning rates (of 10%) equivalent to investment cost reduction rate of 3% p.a. to 2020, and 1% p.a. post 2020
ENVIRONMENTAL SENSITIVITIES (Chapter 5)			
LC-DREAD	DREAD		LC with narrative on unfamiliar technologies constrained – 10GW onshore wind, 80GW offshore wind, no tidal barrage, 30.4GW nuclear, 10.5GW CCS, total biomass resource only 37% of Ref scenario and restricted to transport only

LC-ECO	ECO		LC with narrative on technologies that impinge on ecosystem services constrained – 10GW onshore wind, 80GW offshore wind, no tidal barrage, 13.5TWh pa tidal stream, 37.5TWh pa wave. No open cast coal mines from 2010, total domestic bio-energy resource only 11% of Ref scenario and restricted to end-use heat and power only (no bio-transport), no imported bio-fuel, high fossil fuel prices
LC-NIMBY	NIMBY		LC with narrative on technologies with high local impact constrained – no nuclear, no CCS, no hydrogen
ENERGY LIFESTYLES (Chapter 6)			
LS-REF	Reference lifestyle	LS REF	An iterative linkage with the UK MARKAL and sectoral UKDCM and UKTCM model to model lifestyle drivers. Residential: internal demand temperature peaks at 20C in 2010, then stabilises at 17C in 2025, demolition rate remain at 17,000 pa, whilst new build stabilises at 120,000 pa, air conditioning remains negligible, hot-water use falls linearly by 1.25% annually from 2010 to 2050, electricity for lights and appliances stabilizes in 2014 and then decreases by 58% in 2050, full penetration of cavity wall insulation by 2020 and loft top-up by 2040, increased use of external solid wall insulation (35%) and cladding walls (37%), wall insulation delivers U-values of 0.25 and windows 0.8 (ie best practice), no new conventional heating systems post 2030, district CHP take-up between 10% and 25% by 2050, micro CHP take-up between 10% and 60% by 2050, heat pump take-up between 10% and 60% by 2050, micro biomass limited to 20%, solar thermal on 50% of dwellings by 2050, solar PV panels on 15% of dwellings by 2050, micro-wind turbines on 5% of dwellings by 2050 Transport: Mode shift of 74% reduction in distance travelled by car, 12% fall in HGVs , 184% increase in bus travel, shift to cycling and walking; specific load factors also increase relative to the reference case for cars (about 23%), LGV and HGV; drivers practice eco-driving with an average 8% improvement in fuel efficiency;, more favourable preferences (hurdle rates) and performance parameters (but keeping cost factors the same) for battery electric, hybrid electric and plug-in hybrid electric vehicles
LS-LC	Low-carbon lifestyle	LS LC	As LS-REF with 80% CO_2 reduction by 2050
GLOBAL SENSITIVITIES (additional for book)			
LC-HI	High fossil prices	CAM-HI	As LC, but with high fossil fuel price imports
LCR-HI	Resilient high fossil priced	LCR-HI	As LCR, but with high fossil fuel price imports
LC-CC	Central cost credits	CAM-CC	As LC, but with CCC central cost and availability of international emissions credits (from CCC)
LCR-CC	Resilient central cost credits	LCR-CC	As LCR, but with central cost and availability of international emissions credits (from CCC)
LC-HI-LC	High prices/cheap credits	CAM-HI-LC	As LC, but with high fossil fuel price imports, and low cost (central availability) of international emissions credits (from CCC). This represents a "best case" for the UK from international drivers
LCR-NB	Resilient/no credits/no biomass imports	LCR-NB	As LCR (resilience constraints, central fossil fuel prices, no emissions credits) and with no biomass imports). This represents a "worst case" for the UK from international drivers