Annex B

Analytical Annex

This annex provides detail of the model and assumptions that were used in the analysis presented in Chapter 7.

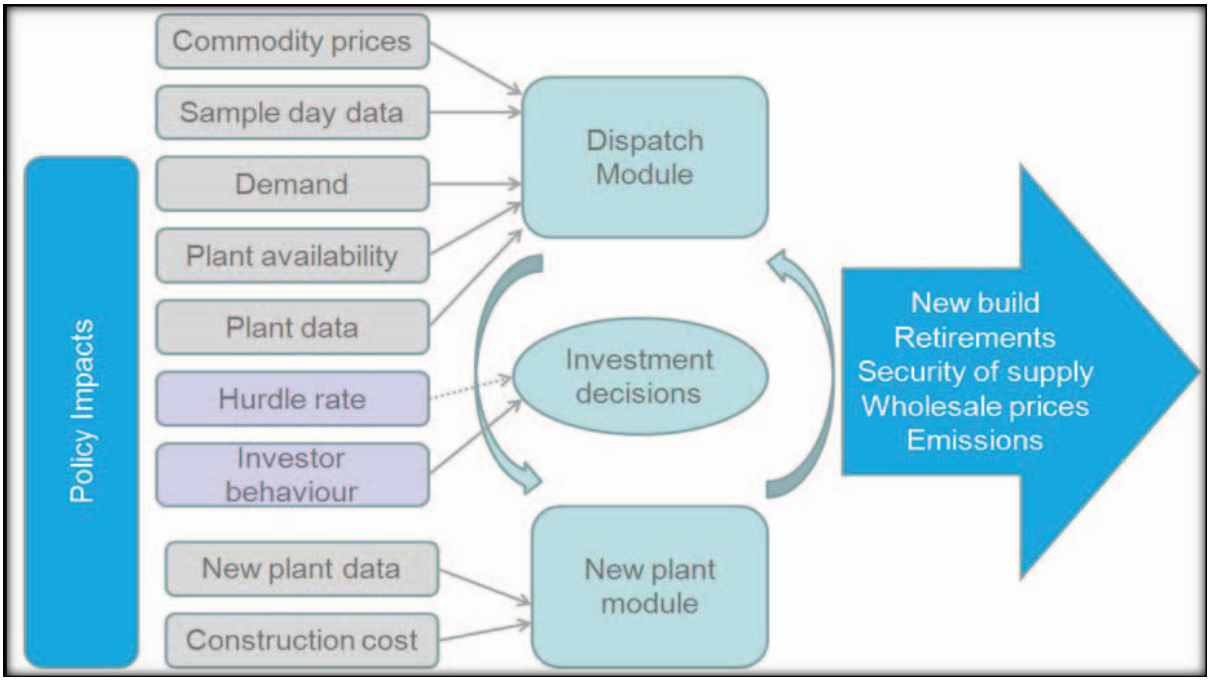
1. DECC Dynamic Dispatch Model

1.1 The Dynamic Dispatch Model (DDM) is a comprehensive, fully-integrated power market model covering the GB power market over the medium to long term. The model enables analysis of electricity dispatch from GB power generators and investment decisions in generating capacity from 2010 through to 2050. It considers electricity demand and supply on a half-hourly basis for sample days. Investment decisions are based on projected revenue and cashflows allowing for policy impacts and changes in the generation mix. The full lifecycle of power generation plant is modelled, from planning through to decommissioning, and also allows for risk and uncertainty involved in investment decisions. The DDM enables analysis comparing the impact of different policy decisions on generation, capacity, costs, prices, security of supply and carbon emissions, and also outputs comprehensive and consistent Cost-Benefit Analysis results.

Overview

1.2 The DDM is an electricity supply model, which allows the impact of policies on the investment and dispatch decisions to be analysed. Figure 1 illustrates the structure of the model.

Figure 1: Structure of the Dynamic Dispatch Model (DDM)



1.3 The purpose of the model is to allow DECC to compare the impact of different policy decisions on capacity, costs, prices, security of supply and carbon emissions in the GB power generation market.

Dispatch Decisions

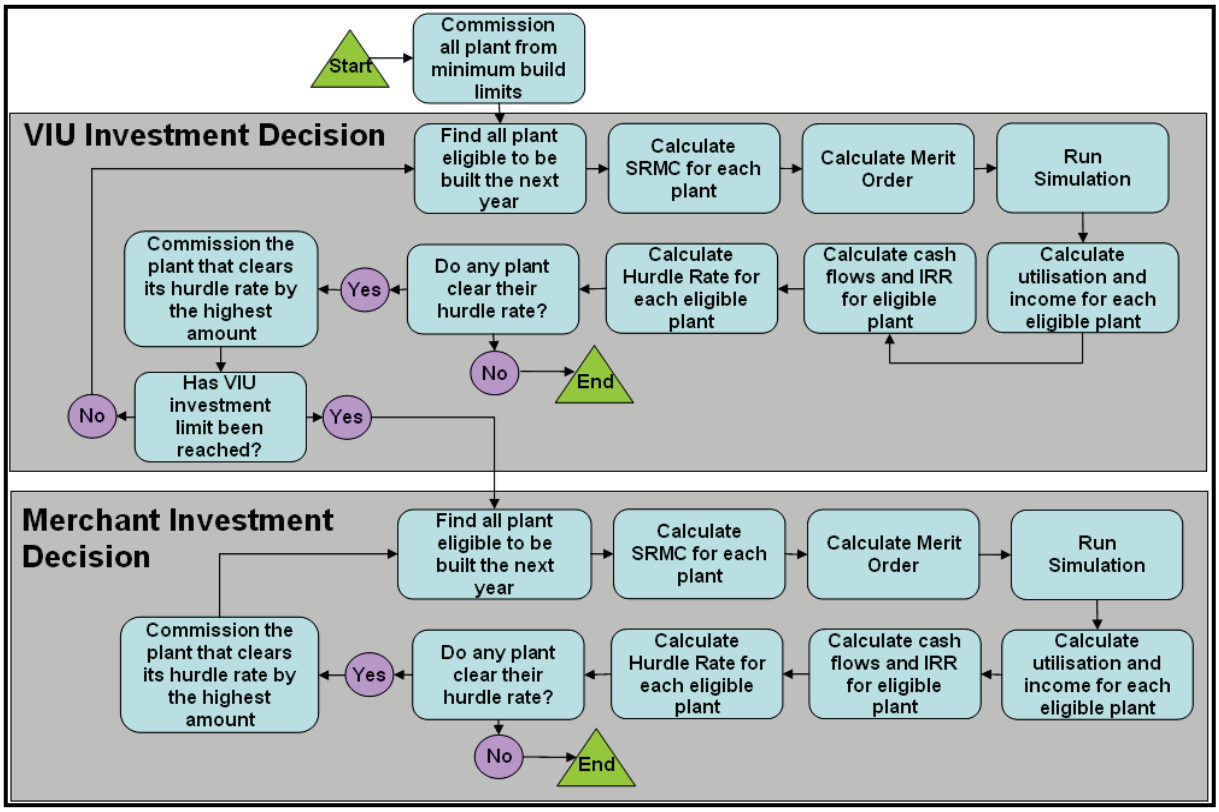
1.4 Economic, climate, policy, generation and demand assumptions are external inputs to the model. The model runs on sample days, including demand load curves for both business and non-business days, including seasonal impacts and are variable by assumptions on domestic and non-domestic sectors and smart meter usage. Also, there are 3 levels of wind load factor data applied to the sample days to reflect the intermittency of on- and offshore wind. The generation data includes outage rates, efficiencies and emissions, and also planned outages and probabilities of unplanned outages.

1.5 The Short Run Marginal Cost (SRMC) for each plant is calculated which enables the calculation of the generation merit order. Demand for each day is then calculated taking wind profiles into account and interconnector flows, pumped storage, autogeneration and wind generation. Once the required reserve is calculated the system SRMC is calculated by matching the demand against the merit order and taking the SRMC of the marginal plant to meet demand. The wholesale price is equal to the system marginal price plus the mark up. The mark up is derived from historic data and reflects the increase of system marginal price above marginal costs at times of reduced capacity margins. Plant income and utilisation are calculated and carbon emissions, unserved energy, and policy costs are reported.

Investment Decisions

1.6 The model requires input assumptions of the costs and characteristics of all generation types, and has the capability to consider any number of technologies. In investment decision making the model considers an example plant of each technology and estimates revenue and costs in order to calculate an IRR. This is then compared to a user specified technology specific hurdle rate and the plant that clears the hurdle rate by the most is commissioned. This is then repeated allowing for the impact of plants built in previous iterations until no plant achieves the required return or another limit is reached. The model is also able to consider investment decisions of both Vertically Integrated Utilities (VIUs) and merchant investors, see Figure 2. Limitations can be entered into the model such as minimum and maximum build rates per technology, per year, and cumulative limits.

Figure 2. Investment decisions in the DDM



Policy Tools

1.7 The model is able to consider many different policy instruments, including potential new policies as well as existing ones. Policies are implemented by making adjustments to plant cashflows which either encourage or discourage technology types from being built in future and impact on their dispatch decisions. The policy modelling has been designed flexibly and policies can be applied to all technologies or specific ones, only new plants or include existing plants and be varied over time and duration. Policies can be financed through Government spending/taxation or charged to consumers.

Outputs

1.8 The model can be run in both deterministic and stochastic modes – this enables analysis to be carried out with different levels of randomness, allowing for more realistic treatment of uncertainty to be incorporated into the model outputs and better understanding of investment behaviour. The model outputs many metrics on the electricity market and individual plant that enables the policy impacts to be interpreted. Using these outputs a Cost Benefit Analysis is carried out on the model run including a distributional analysis.

1.9 The DDM therefore enables analysis to be carried out on policy impacts in different future scenarios, allowing DECC to consider and compare the estimated impacts of different potential policies on the electricity market.

Peer Review

1.10 The model was peer reviewed by external independent academics to ensure the model is fit for the purpose of policy development. Professors David Newbery and Daniel Ralph of the University of Cambridge undertook a peer review to ensure the model met DECC's specification and delivered robust results. The DDM was deemed an impressive model with attractive features and good transparency. For the Peer Review report see 'Assessment of LCP's Dynamic Dispatch Model for DECC'.[1]

[1] http://www.decc.gov.uk/assets/decc/11/about-us/economics-social-research/5427-ddm-peer-review.pdf

2. Input assumptions

Fossil fuel price assumptions

2.1. DECC's fossil fuel price assumptions are used in the DDM as set out in Table 1, to 2030. Details can be found at: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/ff_prices/ff_prices.aspx

Table 1: DECC fossil fuel price assumptions, 2012

	Oil			Gas			Coal		
	$/bbl			p/therm			$/tonne		
2012 prices	Low	Central	High	Low	Central	High	Low	Central	High
2011	115	115	115	58	58	58	124	124	124
2012	105	115	125	54	63	72	97	102	107
2013	103	116	128	51	70	87	94	110	121
2014	102	117	131	49	76	89	92	116	134
2015	**100**	**118**	**134**	**47**	**77**	**91**	**89**	**117**	**139**
2016	99	119	137	45	78	93	86	117	144
2017	97	120	140	43	75	95	84	118	149
2018	96	121	144	41	72	98	81	119	154
2019	95	122	147	41	72	100	79	119	159
2020	**93**	**124**	**151**	**41**	**72**	**102**	**76**	**120**	**164**
2021	92	125	154	41	72	103	76	120	167
2022	90	126	158	41	72	103	76	120	171
2023	89	127	162	41	72	103	76	120	174
2024	88	128	165	41	72	103	76	120	177
2025	**86**	**129**	**169**	**41**	**72**	**103**	**76**	**120**	**181**
2026	85	130	173	41	72	103	76	120	182
2027	84	131	177	41	72	103	76	120	184

2028	83	133	181	41	72	103	76	120	186
2029	81	134	186	41	72	103	76	120	187
2030	**80**	**135**	**190**	**41**	**72**	**103**	**76**	**120**	**189**

Carbon Prices

2.2 The DDM uses DECC's projected carbon price for the traded sector as well as the appraisal values of carbon, as set out below.

Projected EU-ETS carbon price for the traded sector, 2012 £/tonne of CO_2e

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Central	6	6	6	6	7	7	8	8	9	9	9	10	10	10	11	11	11	12	12

DECC appraisal values for greenhouse gas emissions impacts in the traded sector, 2012 £/tonne of CO_2e

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Central	6	6	6	6	7	7	8	8	9	15	22	29	35	42	49	56	62	69	76

2.3 In addition to this the Carbon Price Floor is included in the model following the trajectory set out in the government's response to the consultation on the Carbon Price Floor:

2.4 http://www.hm-treasury.gov.uk/d/carbon_price_floor_consultation_govt_response.pdf

Carbon Price Floor, 2012 £/tonne of CO_2e

2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
10	14	20	24	26	28	30	32	37	41	45	50	54	58	63	67	71	76

Technology Assumptions

2.5 Cost and technical data for new plant is taken from the 2012 PB Power study (for non-renewable technologies) and the Renewables Obligation Banding Review for renewable technologies. Details can be found at: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/gen_costs/gen_costs.aspx