



Department
of Energy &
Climate Change

Electricity Generation Costs (December 2013)

[19th December 2013]

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Introduction

Electricity generation costs are a fundamental part of energy market analysis, and a good understanding of these costs is important when analysing and designing policy.

DECC regularly updates estimates of the costs and technical specifications for different generation technologies used in its analysis. Cost data is broken down into detailed expenditure per MW capacity or MWh generation for the full lifetime¹ of a plant including planning costs, construction costs, operating costs and eventual decommissioning costs.

These detailed data are used by DECC to calculate a 'levelised cost' for each technology. A 'levelised cost' is the average cost over the lifetime of the plant per MWh of electricity generated. They reflect the cost of building, operating and decommissioning a generic plant for each technology. Potential revenue streams are not considered².

There a number of reasons why strike prices for the Feed-in Tariff with Contracts for Difference (CfD) being introduced as part of Electricity Market Reform will be different to the estimates of levelised costs in this report. While the cost assumptions, summarised in this report, form an input to the calculation of strike prices, levelised costs are not the same as strike prices. Other inputs to strike prices include CfD contract terms, including length and risk allocation as well as revenue assumptions. For further details, please see 'Limitations of Levelised Costs' below.

This report is structured as follows:

- 1) The first section details the methodology, data and assumptions used to generate the levelised cost estimates. This section also includes a discussion of some of the limitations of these estimates.
- 2) The second section presents selected 'levelised cost' estimates generated using DECC's Levelised Cost Model and a standardised 10% hurdle rate for investors.
- 3) The final section discusses how cost information is used in DECC electricity market modelling, illustrating some of the cost estimates at technology specific hurdle rates, and further uncertainties.
- 4) The report has several annexes showing more detail about the levelised cost calculation, additional estimates for technologies not included in the main report and details of some further scenarios and sensitivities considered.

It is important to note there is a large amount of uncertainty when estimating current and future costs of electricity generation. This report has attempted to capture some of this uncertainty by portraying ranges. However, not all sensitivities and sources of uncertainty are captured. All estimates are in 2012 real prices.

¹ Including pre-development, construction, operation and de-commissioning periods

² With the exception of heat revenues for CHP technologies

How Levelised Costs are calculated

Definition of 'Levelised Costs of Electricity Generation'

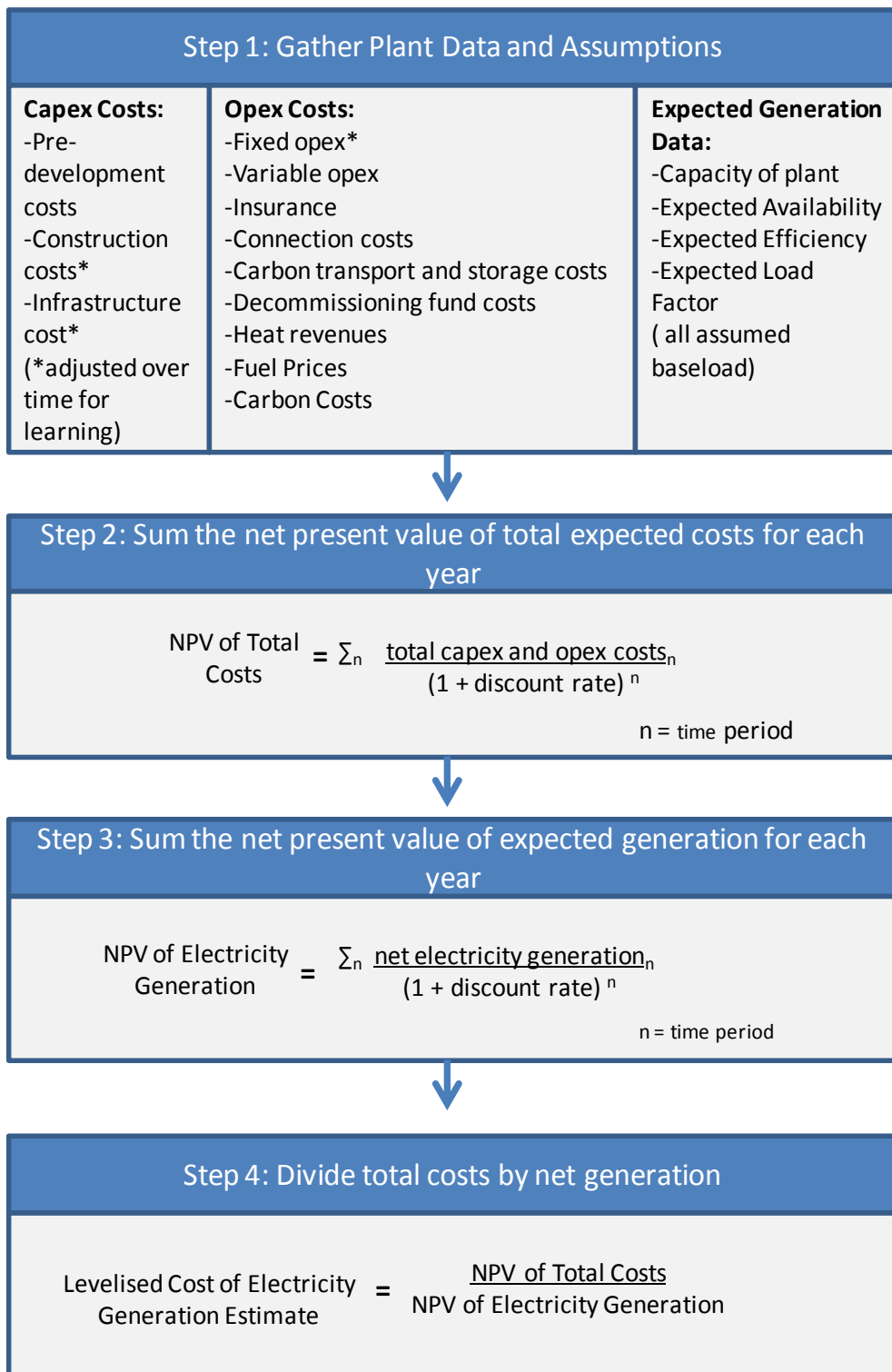
The Levelised Cost of Electricity Generation is the discounted lifetime cost of ownership and use of a generation asset, converted into an equivalent unit of cost of generation in £/MWh.

The levelised cost of a particular generation technology is the ratio of the total costs of a generic plant (including both capital and operating costs), to the total amount of electricity expected to be generated over the plant's lifetime. Both are expressed in net present value terms. This means that future costs and outputs are discounted, when compared to costs and outputs today.

This is sometimes called a life cycle cost, which emphasises the "cradle to grave" aspect of the definition. The levelised cost estimates do not consider revenue streams available to generators (e.g. from sale of electricity or revenues from other sources), with the exception of heat revenues for CHP plant which are included so that the estimates reflect the cost of electricity generation only.

As the definition of levelised costs relates only to those costs accruing to the owner/operator of the generation asset, it does not cover wider costs that may in part fall to others, such as the full cost of system balancing and network investment, or air quality impacts.

The figure on the next page demonstrates at a high level how Levelised Costs are calculated.



For further information on how levelised costs are calculated and DECC's Levelised Cost Model please refer to section 4.2 Mott MacDonald (2010)³.

³ http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/gen_costs/gen_costs.aspx

Data Sources and Assumptions

Data Sources

The following data sources and assumptions were used to calculate the levelised costs estimates presented in this report. Table 1 shows the data source for each technology. Annex 3 provides further explanation on the data used to inform renewable electricity generation cost estimates.

The full list of capital costs and operating costs used in DECC electricity market modelling is shown at Annex 3. This Annex also lists hurdle rate and effective tax rate assumptions.

Non – Renewable Technologies:

Fuel and decommissioning costs, carbon prices and hurdle rates were derived by DECC as described below under Further Assumptions. The rest of the underlying data on non-renewable technologies were provided by Parsons Brinckerhoff (PB). The underlying data and assumptions can be found in the PB (2013) “Update of Non-Renewable Technologies”, except for CCGT low and high sensitivities (also used for OCGT in Annex 2) which are based upon the forthcoming report PB (forthcoming) “Coal and Gas Technology Assumptions”⁴.

Renewable Technologies:

Nine data sources for various renewable technologies were used and/or considered by DECC. These are:

1. Government Response to the Banding Review (GRBR) - data and evidence underpinning the ‘Government response to the consultation on proposals for the levels of banded support under the Renewables Obligation for the period 2013-17 and the Renewables Obligation Order 2012’ for renewable technologies⁵.
2. Large scale ground mounted solar PV data (>5MW)⁶ - data and evidence on the costs and performance of large-scale solar PV underpinning ‘Government response to further consultations on solar PV support, biomass affordability and retaining the minimum calorific value requirement in the RO’⁷

⁴ Unless referenced specifically, all documentation can be found on the ‘Energy generation cost projections’ page of the DECC website: <https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/energy-generation-cost-projections>

⁵ <http://www.decc.gov.uk/assets/decc/11/consultation/ro-banding/5936-renewables-obligation-consultation-the-government.pdf>. This is referred to as the ‘Government Response to the Banding Review (GRBR)’ throughout this report. Please note that the data has been inflated from 2010 to 2012 prices and heat revenues have been updated to reflect DECC’s 2013 fuel and carbon prices when compared to those published as part of the Government Response to Banding Review.

⁶ The December Delivery plan analysis for Large scale solar PV is based on the cost and performance assumptions for large-scale ground mounted solar PV developed as part of the consultation on RO support rates for solar PV. These assumptions can be viewed at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66516/7328-renewables-obligation-banding-review-for-the-perio.pdf.

⁷ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66516/7328-renewables-obligation-banding-review-for-the-perio.pdf

3. Small-scale Feed in Tarff (FiTs) data (PV, wind, hydro and AD below 5MW): Data and evidence from Parsons Brinckerhoff (PB) (2012) published as part of the government response to Phase 2A and 2B comprehensive review of feed in tariffs⁸⁹.
4. Onshore Wind Call for Evidence - Data received in response to DECC's Onshore Wind Call for Evidence and published in June 2013¹⁰
5. National Grid (NG) Call for Evidence - Data received as part of National Grid's Call for Evidence¹¹ (2013)
6. PB 2013 - a DECC commissioned report from Parsons Brinckerhoff (2013) on renewable technology costs¹².
7. TNEI 2013 Offshore Wind Generation Cost Variations Review¹³
8. The Crown Estate Offshore wind cost reduction pathways study, including the associated PwC Project Finance work stream ¹⁴¹⁵.
9. Offshore Wind Cost Reduction Task Force (CRTF) Report June 2012¹⁶.

Table 1 identifies the data sources used for each technology. A high-level description of the process undertaken and rationale for the data used for renewable technologies is included in Annex 3.

⁸ <http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/renewable-energy/5381-solar-pv-cost-update.pdf>.

⁹ <http://www.decc.gov.uk/assets/decc/Consultations/fits-review/5900-update-of-nonpv-data-for-feed-in-tariff-.pdf>

¹⁰ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/205423/onshore_wind_call_for_evidence_response.pdf

¹¹ Unless referenced specifically, all documentation can be found on the 'Energy generation cost projections' page of the DECC website: <https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/energy-generation-cost-projections>

¹² Unless referenced specifically, all documentation can be found on the 'Energy generation cost projections' page of the DECC website: <https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/energy-generation-cost-projections>

¹³ Unless referenced specifically, all documentation can be found on the 'Energy generation cost projections' page of the DECC website: <https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/energy-generation-cost-projections>

¹⁴ <http://www.thecrownestate.co.uk/media/305094/Offshore%20wind%20cost%20reduction%20pathways%20study.pdf>. This is referred to as the 'Crown Estate Study' throughout this report.

¹⁵ <http://www.thecrownestate.co.uk/media/305102/PwC%20OWCRP%20project%20finance%20work%20stream.pdf>

¹⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66776/5584-offshore-wind-cost-reduction-task-force-report.pdf. This is referred to as the 'Offshore Wind CRTF report' throughout this report.

Table 1: Data Sources for Individual Technologies

Non-Renewables Technologies:	Data Source
CCGT with/without CHP	PB 2013 & PB forthcoming
OCGT	PB 2013 & PB forthcoming
Coal Plant with 300MW of CCS	PB 2013
Gas and Coal with CCS	PB 2013
Nuclear	PB 2013
Renewable Technologies:	Data Source
Onshore Wind	Onshore Wind Call for Evidence
Offshore Wind	GRBR, Crown Estate Study, Offshore Wind CRTF report
Biomass Conversion	GRBR
Dedicated biomass with/without CHP	GRBR
Cofiring conventional/Cofiring enhanced	GRBR
Co-firing standard CHP	GRBR
Hydropower	GRBR
Wave	NG Call for Evidence
Tidal Stream – shallow	GRBR (load factor updated in line with evidence from the NG Call for Evidence)
Tidal Stream – deep	GRBR
Tidal Range	GRBR
AD power with/without CHP	GRBR
ACT CHP	GRBR
Energy from Waste w/without CHP	GRBR
Landfill gas	GRBR
Sewage gas	GRBR
ACT advanced	GRBR
ACT standard	GRBR
Bioliqids with/without CHP	GRBR
Geothermal with/without CHP	GRBR
Large scale solar PV (>5MW) ¹⁷	Large scale solar PV data
AD 0-5MW	FiTs data
Onshore wind under 5MW	FiTs data
Solar PV under 5MW	FiTs data
Hydro under 5MW	FiTs data
Biomass with CCS	PB 2013

¹⁷ Large scale ground mounted solar PV

Further Assumptions

The following assumptions have also been used:

- Fuel and Carbon Prices: DECC's 2013 projected fossil fuel prices and Carbon Price Support¹⁸
- Technology Specific Hurdle Rates: Where used, technology specific hurdle rates are the same as those used in DECC's Dynamic Dispatch Model and have been updated to reflect those used in the EMR December Delivery Plan (December 2013). These are presented in Annex 3.

The cost assumptions presented in this report are those used in National Grid's modelling for the December Delivery Plan.

Future Cost Projections

There is significant uncertainty about how the costs of technologies will evolve over time.

In general, estimates of the capital and operating costs of different electricity generating technologies in the future are driven by expectations and assumptions of technology specific learning rates and by global and UK deployment levels.

The data sources referenced above provide detailed information about learning and deployment scenarios used in our analysis. IEA¹⁹ projections are the main source for global deployment and learning rates for most technologies. However, for ACT, wave, tidal stream and renewable technologies under 5MW learning rates are driven by scenarios of technical potential for UK deployment²⁰. We have also adjusted the assumed learning rate for offshore wind following the consultation on the July Electricity Market Reform Delivery Plan.

All estimates presented are for established plants - called Nth of a Kind (NOAK), unless stated otherwise. The exceptions are estimates for Carbon Capture and Storage CCS and Nuclear, which are shown on both a First of a Kind ('FOAK') and Nth of a Kind ('NOAK') basis. For these technologies with no commercial experience in the UK, FOAK was defined as the first plant within the UK, not including demonstration projects. For these technologies, FOAK costs assume experience has been gained from international and demonstration projects^{21,22}.

¹⁸ Please note that the Carbon Price Floor does not apply in Northern Ireland.

¹⁹ Estimates for renewable technologies are based on IEA Bluemap (see ARUP 2011 for details), and non-renewable technologies are IEA Energy Technology Perspectives (2012). Future deployment scenarios are not based on year-on-year data and therefore there is uncertainty about how costs will evolve overtime. This approach is intended to capture trends in cost reduction rather than precise year-on-year changes.

²⁰ Please see Arup 2011 and PB 2012 for FiTs for more details.

²¹ All estimates for Carbon Capture and Storage (CCS) presented in this document are intended to illustrate the cost of CCS for a commercial plant. In practice CCS would have to be successfully demonstrated first. We have not included estimates for the costs for initial CCS demonstration projects.

²² The period in which the cost moves from FOAK to NOAK is entirely dependent on the assumed learning rate and the assumed build rate. For nuclear we have assumed a move to NOAK for plants starting development in 2018 onwards. In practice this may occur later than we have assumed. The movement between FOAK and NOAK for CCS is even more uncertain and as such we have only used FOAK estimates in this report.

All levelised costs for wave and tidal stream technologies in this report illustrate the costs of commercial projects commissioning from the early 2020s onwards. Where technology-specific hurdle rates are used in this report, these are the hurdle rates for commercial projects.

Load factors

Levelised costs are sensitive to assumptions on load factor. For non-renewable technologies, with the exception of OCGTs, plants are assumed to operate at baseload with high load factors. OCGTs are assumed to operate as peaking plants (operating at times of higher system stress). The load factors for wind, wave and tidal stream technologies reflect that they operate as intermittent electricity generation technologies. Assumed load factors for key technologies are listed in Annex 3.

Financing and Hurdle Rates

The levelised cost measure does not explicitly include the financing costs attached to new generating stations²³. In most cases, this report includes estimates using a standard 10% discount rate across all technologies, in line with the 'tradition' used in reports produced by other organisations. This allows estimates to be viewed as neutral in financing and risk terms when comparison is made across technologies.

In practice, financing costs of individual projects will vary depending on a range of factors, including financing type, project developer, conditions in financial markets, maturity of technology, and risk and political factors. We have included some levelised cost estimates using technology specific hurdle rates in the section 'DECC Electricity Market Modelling'. Further details on the technology-specific hurdle rates used can be found in Annex 3.

Changes from July 2013 published estimates

There have been several changes in data and assumptions to selected technologies when comparing against previously published estimates²⁴. These are summarised below:

- Data: The source data has been updated for CCGT technologies. Data sources are listed in Table 1.
- Hurdle Rates: where technology specific hurdle rates have been used, these have been updated to match those used in the December Delivery Plan analysis. Further details can be found in Annex 3.
- Inflation Factors: Adjustments have been made to update figures to mid-2012 prices and for latest forecasts of inflation where required.
- Learning profiles have been updated for **offshore wind** to match the cost reduction profiles in the December Delivery Plan analysis.

²³ While financing costs are included implicitly through the choice of discount rate used to produce the levelised cost this is an approximation.

²⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223940/DECC_Electricity_Generation_Costs_for_publication_-_24_07_13.pdf

For further information about changes to the modelling assumptions for the EMR December Delivery Plan 2013 please see Annex H Modelling Assumptions of the December Delivery Plan documentation²⁵. Please note Annex 3 also contains further information about cost data and assumptions for all technologies.

Limitations of ‘Levelised Costs’

Levelised Costs are uncertain

Levelised cost estimates are highly sensitive to the underlying data and assumptions including those on capital costs, fuel and carbon costs, operating costs, operating profile, load factor and discount rates. Within this different technologies are sensitive to different input assumptions. Future levelised cost estimates are significantly driven by assumptions of global and UK deployment and assumed learning rates.

This report captures some of these uncertainties through ranges presented around key estimates. A range of costs is presented for capex and fuel, depending on the estimates. However, not all uncertainties are captured in these ranges and estimates should be viewed in this context. It is often more appropriate to consider a range of costs rather than point estimates.

It should also be noted that levelised costs are generic, rather than site specific. For instance land costs are not included in our estimation and although use of system charges are included, they are calculated on an average basis.

Levelised Costs are not Strike Prices

The levelised cost estimates in this report are not the sole determinant of strike prices and therefore do not provide an indication of potential future strike prices for a particular technology or plant under the Feed-in Tariff with Contracts for Difference (CfD) being introduced as part of Electricity Market Reform.

A CfD stabilises revenues for a particular generating station at a fixed price level known as the ‘strike price’ over a specified term. Generation costs data, summarised here in the form of levelised costs, are one input into setting strike prices. Other inputs may include:

- Revenue assumptions (such as wholesale market revenues post CfD and ancillary revenues from the system operator);
- Other costs not included in DECC’s definition of levelised cost (such as land costs);
- CfD contract terms including length and risk allocation;
- Financing costs (reflected in the levelised costs calculated at technology-specific hurdle rates but not in those calculated at 10% discount rate); and

²⁵ <https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan>

- Wider policy considerations, such as ensuring continuing security of supply, decarbonising electricity generation and maintaining affordability.

The generation costs data used here will, in some cases, be different from that used as part of the strike price setting process. This is particularly where project-specific cost discovery processes are undertaken. These reflect a site-specific, highly granular assessment of costs, whereas the estimates here are more high-level and generic.

For all these reasons, the levelised costs presented here may be quite different from the strike prices that are set for CfDs.

Timing

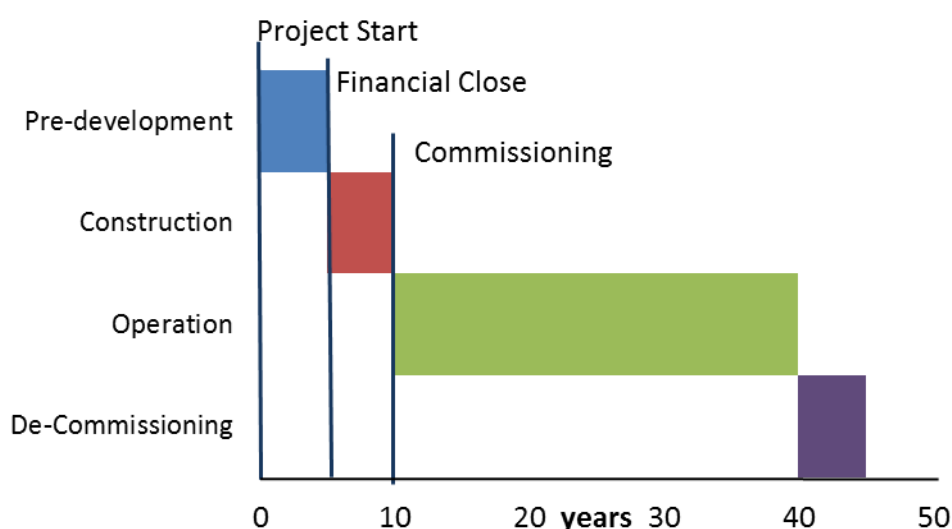
When looking at levelised cost estimates it is important to consider how they have been reported in terms of project timing and what sensitivities (if any) are included. These are discussed in more detail below.

Levelised cost estimates can be reported for different milestones associated with a project including 'Project Start', 'Financial Close' and 'Commissioning'. These are illustrated in Chart 1 below for an illustrative technology which has a 5 year pre-development period and a 5 year construction period.

For instance, if the levelised cost of this technology was £50/MWh for a project starting in 2012, this would be the same as saying £50/MWh for a project reaching financial close in 2017, or £50/MWh for a project commissioning in 2022. This is illustrated in Chart 1 below.

Pre-development and construction timings will vary by technology and therefore estimates reported for 'project start' or 'financial close'²⁶ for different technologies may not be commissioning in the same year as each other. Central estimates for pre-development and construction timings are presented for key technologies in Annex 3.

Chart 1: Illustrative Timings



²⁶ Financial close can also be known as the point of main Financial Investment Decision or FID.

Sensitivities

Levelised cost estimates are highly sensitive to the underlying data and assumptions used including those on capital costs, fuel prices, carbon costs, operating costs, load factor and discount rates. Within this different technologies are sensitive to different input assumptions. As such it is often more appropriate to consider a range of cost estimates rather than point estimates.

In order to illustrate some of these sensitivities, ranges of estimates have been shown. The key sensitivities explored are:

High and Low capital costs (including pre-development)

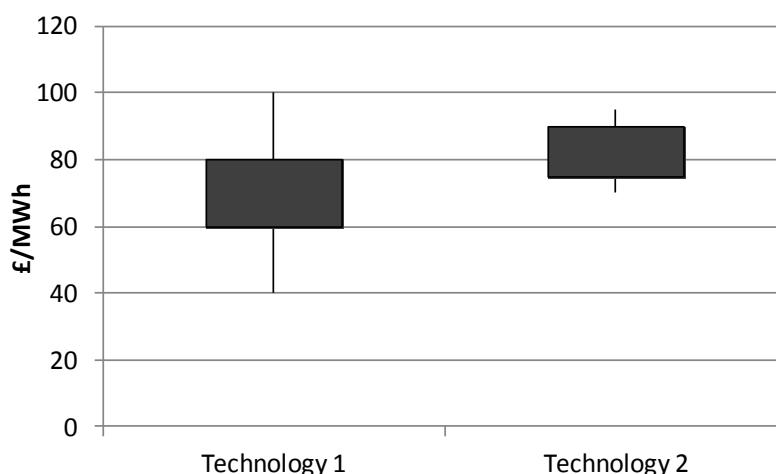
Unless otherwise specified, all 'high' and 'low' estimates in this report incorporate 'high' and 'low' capital costs including 'high' and 'low' pre-development costs.

It should also be noted that the ranges across different capital cost estimates for technologies have different interpretations between the renewable and non-renewable technologies. For renewable technologies, the ranges include substantial variability across potential sites, i.e. the range of levelised costs represents a supply curve of potential projects at different costs within the technology in a given year. For non-renewable technologies, in the main body of this report the capital cost range represents uncertainty around capital and siting costs for any given project. However Annex 2 does look at a wider range of variability for CCGT and OCGT technologies including variations in operating cost and plant efficiency as well as capital and pre-development cost variation.

High and Low fuel and capital costs

For some technologies (e.g. CCGT, CCS, biomass and waste technologies), fuel costs are a major driver of the levelised cost. In order to demonstrate this some sensitivities which explore uncertainty over both fuel costs and capex costs are provided. These are shown in charts like Chart 2 below. In these cases the thick blocks represent 'high/low' sensitivities around capex (including pre-development) costs and the thin lines represent 'high/low' sensitivities around fuel prices on top of the uncertainty around capex (including pre-development) costs.

Chart 2: Illustrative Sensitivities



Generation Cost Estimates at a 10% discount rate

This section summarises the analysis of the levelised cost of electricity generation at a 10% discount rate.

Comparing levelised cost estimates across technologies at a 10% discount rate allows estimates to be viewed as neutral in terms of financing and risk. This approach is in line with the ‘tradition’ used in reports produced by other organisations. As noted above, these estimates do not reflect differentials in financing costs between technologies. Where flexible technologies such as CCGTs operate at lower load factors, their levelised costs will be higher than those presented here.

This section focuses primarily on the main technologies likely to be deployed in the UK over the next decade and a half²⁷. A full set of estimates for those renewable and CCS technologies not covered in the main report can be found in Annex 1.

Levelised cost estimates for all cases have been calculated using the DECC Levelised Cost Model. The following ‘cases’ are considered in this section of the report:

Case No.		
1	Projects Starting in 2013	All at 10% discount rate. Technologies are mixture of FOAK and NOAK
2	Projects Starting in 2019	
3	Projects Commissioning in 2014, 2016, 2020, 2025, 2030	

Case 1: Projects starting in 2013, FOAK/ NOAK, 10% discount rate²⁸

Case 1 shows the levelised costs for projects starting pre-development in 2013. A 10% discount rate has been applied. Chart 3 shows the breakdown of central cost estimates, while Chart 4 shows the sensitivities of these estimates to capital costs²⁹, and to capital and fuel costs. As noted above, the range of capital costs for renewable technologies represents site/project variability, whereas the range of capital costs for non-renewable technologies represents uncertainty for any given site/project.

The ranges for renewable technologies generally show a large range of variability across different sites/projects, whilst the ranges for non-renewable technologies show there is a large amount of uncertainty over these costs for any given project, without necessarily illustrating all the uncertainty as discussed in preceding sections. However Annex 2 does look at a wider

²⁷ Please note for carbon capture and storage we have illustrated three of the types of fossil fuel plant and the three main types of capture process in the main report rather than illustrate which types we expect most deployment to come from.

²⁸ Please note these estimates should be viewed in the context of the sensitivities and uncertainties highlighted in the text of this report.

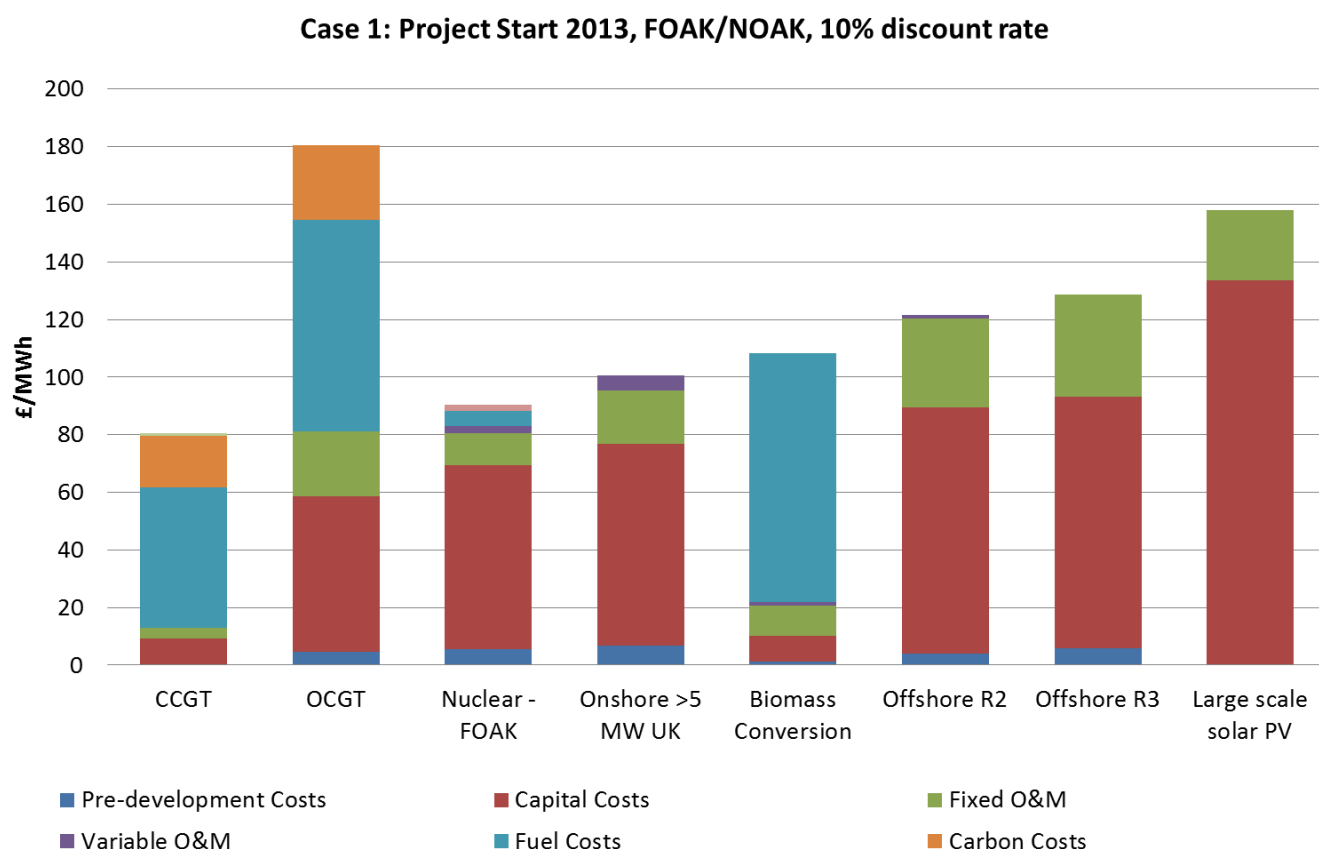
²⁹ Including pre-development costs

range of variability for CCGT and OCGT technologies including variations in operating cost and plant efficiency as well as capital and pre-development cost variation.

It should also be noted that all the estimates for non-renewable technologies reflect generic cost data from PB (2013) & PB (forthcoming) and do not reflect site-specific considerations which may become apparent through detailed cost discovery process for strike-price setting. The estimates at a 10% discount rate also do not reflect financing costs. Furthermore, as explained above, these levelised costs are not the sole determinant of strike prices and therefore should not be seen as a guide to potential future strike prices.

The figures used in these charts can be found in Tables 2 and 3. The load factor assumptions used to calculate these levelised cost assumptions are summarised in Annex 3³⁰.

Chart 3: Levelised Cost Estimates for Projects Starting in 2013, 10% discount rate³¹



³⁰ OCGT levelised costs have been calculated at a low load factor to reflect the fact that it tends to operate as a peaking plant. This low load factor results in a higher levelised cost for OCGT.

³¹ This chart has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles, please see page 12 for more details.

Chart 4: Levelised Cost Estimates for Projects Starting in 2013, 10% discount rate, sensitivities^{32 33}

Case 1: Project Start 2013, FOAK/NOAK, 10% discount rate

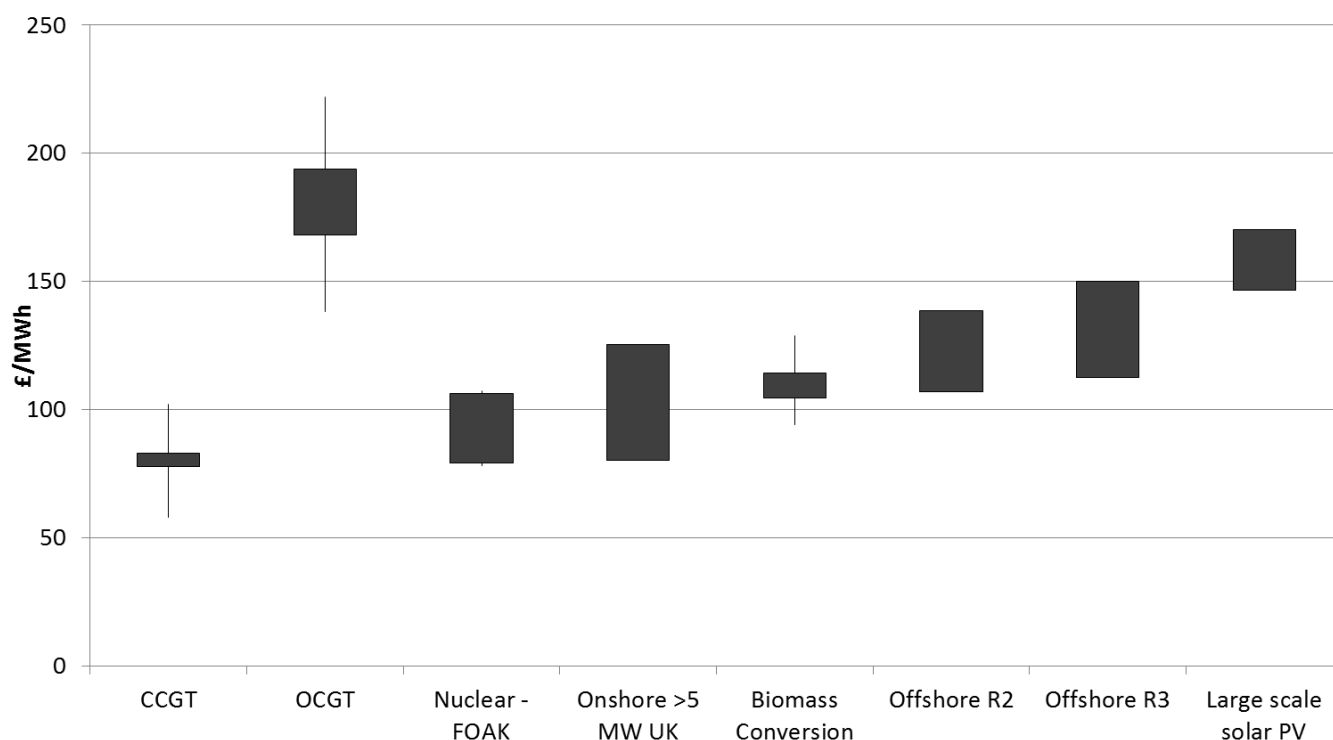


Table 2: Levelised Cost Estimates for Projects Starting in 2013, 10% discount rate, £/MWh³⁴

	CCGT	OCGT	Nuclear - FOAK	Onshore >5 MW UK	Biomass Conversion	Offshore R2	Offshore R3	Large scale solar PV
Pre-development Costs	0	5	6	7	1	4	6	0
Capital Costs	9	54	64	70	9	85	87	134
Fixed O&M	4	23	11	18	10	31	36	24
Variable O&M	0	0	3	5	1	1	0	0
Fuel Costs	49	73	5	0	86	0	0	0
Carbon Costs	18	26	0	0	0	0	0	0
CO2 Capture and Storage Costs	0	0	0	0	0	0	0	0
Decommissioning and Waste Function	0	0	2	0	0	0	0	0
Total Levelised Costs	80	181	90	101	108	122	129	158

³² See the 'Sensitivities' section above for an explanation of this chart

³³ This chart has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

³⁴ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles, please see page 12 for more details.

Table 3: Levelised Cost Estimates for Projects Starting in 2013, 10% discount rate, sensitivities (£/MWh)³⁵

	CCGT	OCGT	Nuclear - FOAK	Onshore >5 MW UK	Biomass Conversion	Offshore R2	Offshore R3	Large scale solar PV
Central	80	181	90	101	108	122	129	158
High capex	83	194	106	125	114	139	150	170
High capex, high fuel	102	222	107	n/a	129	n/a	n/a	n/a
Low capex, low fuel	58	138	78	n/a	94	n/a	n/a	n/a
Low capex	78	168	79	80	105	107	113	146

Case 2: Projects starting in 2019, FOAK/ NOAK, 10% discount rate³⁶

Case 2 shows the levelised costs for projects starting pre-development in 2019. A 10% discount rate has been applied. Chart 5 shows the breakdown of central cost estimates, while Chart 6 shows the sensitivities of these estimates to capital costs³⁷, and to capital and fuel costs.

As noted above, the range of capital costs for renewable technologies include substantial site/project variability, whereas the range of capital costs for non-renewable technologies represents cost uncertainty for any given site/project.

The ranges for renewable technologies generally show a large range of variability across different sites/projects, whilst the ranges for non-renewable technologies show there is a large amount of uncertainty over these costs for any given project, without necessarily illustrating all the uncertainty as discussed in preceding sections. However Annex 2 does look at a wider range of variability for CCGT and OCGT technologies including variations in operating cost and plant efficiency as well as capital and pre-development cost variation.

It should also be noted that all the estimates for non-renewable technologies reflect generic cost data from PB (2013) & PB (forthcoming) and do not reflect site-specific considerations which may become apparent through detailed cost discovery process for strike-price setting. The estimates at a 10% discount rate also do not reflect financing costs. Furthermore, as explained above, these levelised costs should not be seen as a guide to potential strike prices.

The figures used in these charts can be found in Tables 4 and 5. The load factor assumptions used to calculate these levelised cost assumptions are summarised in Annex 3³⁸.

³⁵ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

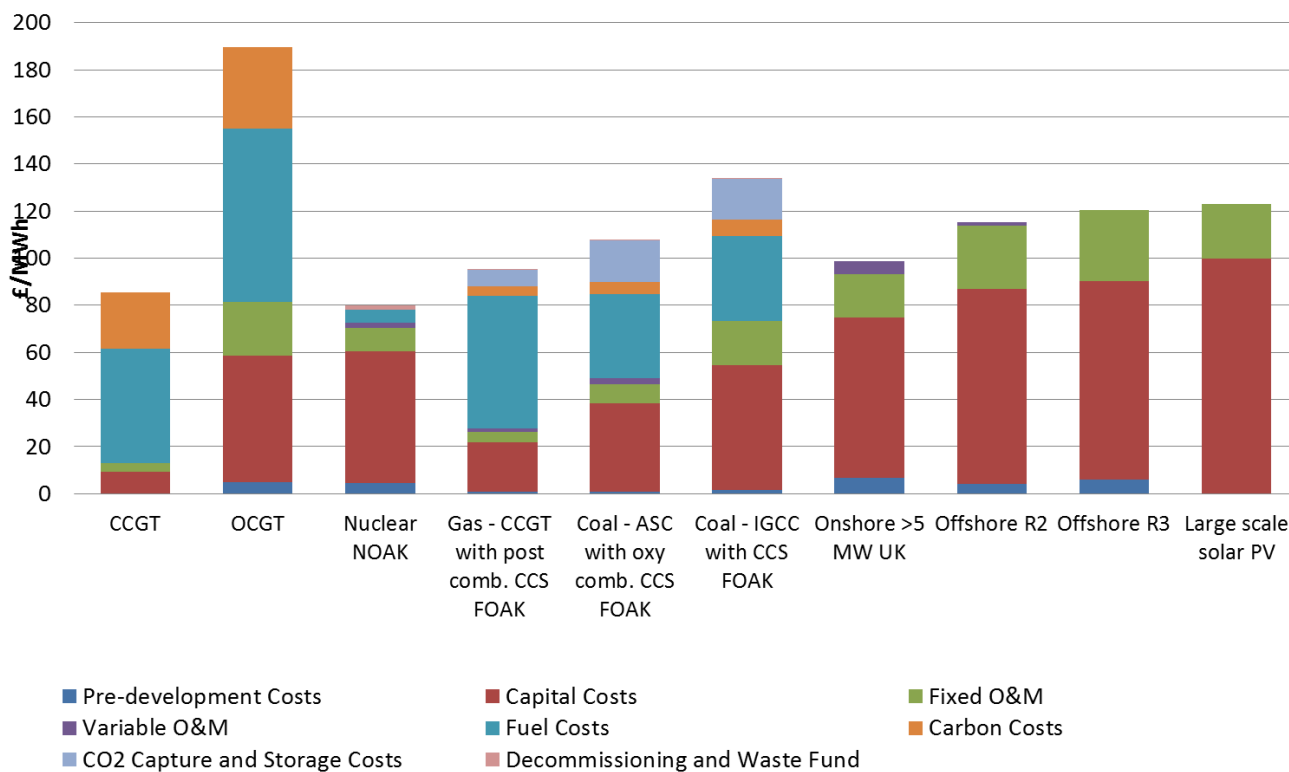
³⁶ Please note these estimates should be viewed in the context of the sensitivities and uncertainties highlighted in the text of this report.

³⁷ Including pre-development costs

³⁸ OCGT levelised costs have been calculated at a low load factor to reflect the fact that it tends to operate as a peaking plant. This low load factor results in a higher levelised cost for OCGT.

Chart 5: Levelised Cost Estimates for Projects Starting in 2019, 10% discount rate³⁹

Case 2: Project Start 2019, FOAK/NOAK, 10% discount rate



³⁹ This chart has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles, please see page 12 for more details.

Chart 6: Levelised Cost Estimates for Projects Starting in 2019, 10% discount rate, sensitivities^{40,41}

Case 2: Project Start 2019, FOAK/NOAK, 10% discount rate

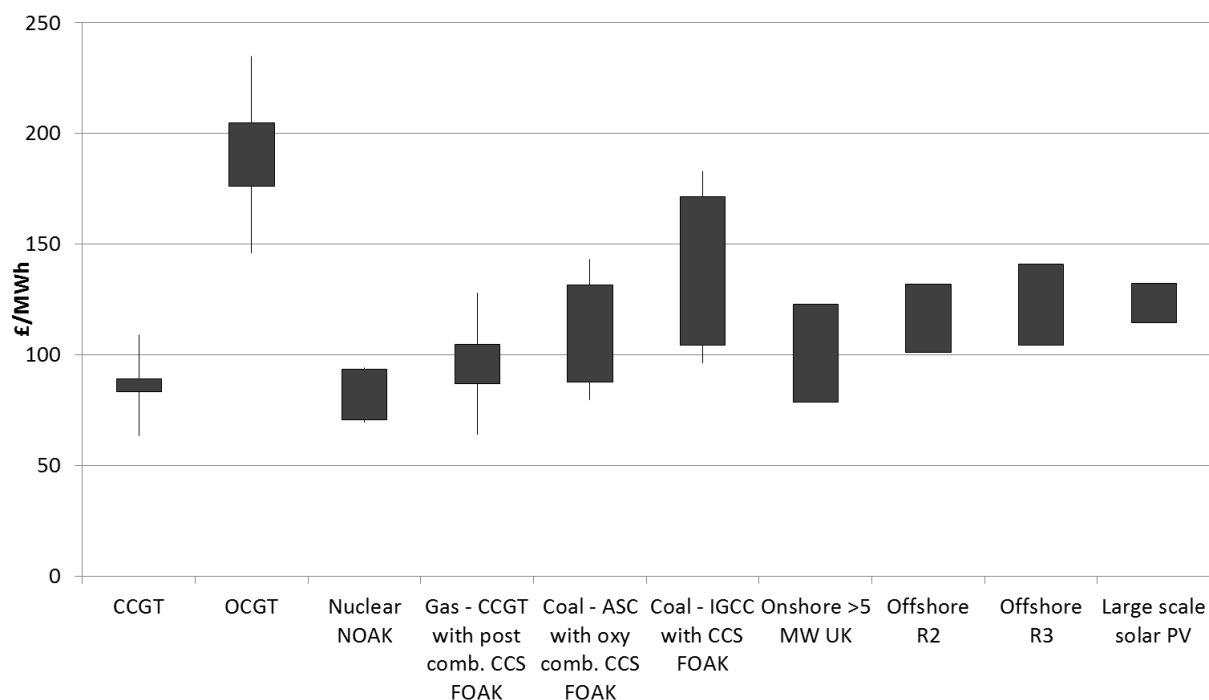


Table 4: Levelised Cost Estimates for Projects Starting in 2019, 10% discount rate, £/MWh⁴²

	CCGT	OCGT	Nuclear NOAK	Gas - CCGT with post comb. CCS FOAK	Coal - ASC with oxy comb. CCS FOAK	Coal - IGCC with CCS FOAK	Onshore >5 MW UK	Offshore R2	Offshore R3	Large scale solar PV
Pre-development Costs	0	5	5	1	1	1	7	4	6	0
Capital Costs	9	54	56	21	37	53	68	83	84	100
Fixed O&M	4	23	10	4	8	19	19	27	30	23
Variable O&M	0	0	3	2	2	0	5	1	0	0
Fuel Costs	49	74	5	56	36	36	0	0	0	0
Carbon Costs	24	35	0	4	5	7	0	0	0	0
CO2 Capture and Storage C	0	0	0	7	18	17	0	0	0	0
Decommissioning and Was	0	0	2	0	0	0	0	0	0	0
Total Levelised Costs	85	190	80	95	107	134	99	115	120	123

⁴⁰ See 'sensitivities' for explanation of chart

⁴¹ This chart has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

⁴² This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles, please see page 12 for more details.

Table 5: Levelised Cost Estimates for Projects Starting in 2019, 10% discount rate, sensitivities (£/MWh)⁴³

	CCGT	OCGT	Nuclear NOAK	Gas - CCGT with post comb. CCS FOAK	Coal - ASC with oxy comb. CCS FOAK	Coal - IGCC with CCS FOAK	Onshore >5 MW UK	Offshore R2	Offshore R3	Large scale solar PV
Central	85	190	80	95	107	134	99	115	120	123
High capex	89	205	93	105	132	172	123	132	141	132
High capex, high fuel	109	235	94	128	143	183	n/a	n/a	n/a	n/a
Low capex, low fuel	63	146	70	64	80	96	n/a	n/a	n/a	n/a
Low capex	83	176	71	87	88	104	79	101	104	115

Case 3: Commissioning in 2014, 2016, 2020, 2025, 2030, FOAK/ NOAK, 10% discount rate⁴⁴

In order to allow the comparison of the costs across different energy technologies commissioning, or starting operation, in the same year Case 3 illustrates the levelised costs for projects commissioning in 2014, 2016, 2020, 2025 and 2030. A 10% discount rate has been applied. ‘High’ and ‘Low’ estimates represent sensitivities around capex costs only.

As noted above, the range of capital costs for renewable technologies represents site/project variability, whereas the range of capital costs for non-renewable technologies represents uncertainty for any given site/project. The estimates at a 10% discount rate also do not reflect financing costs. Furthermore, as explained above, these levelised costs are not the sole determinant of strike prices and therefore should not be seen as a guide to potential future strike prices.

The ranges for renewable technologies generally show a large range of variability across different sites/projects, whilst the ranges for non-renewable technologies show there is a large amount of uncertainty over these costs for any given project, without necessarily illustrating all the uncertainty as discussed in preceding sections.

It should also be noted that all the estimates for non-renewable technologies reflect generic cost data from PB (2013) & PB (forthcoming) and do not reflect site-specific considerations which may become apparent through detailed cost discovery process for strike-price setting.

⁴³ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

⁴⁴ Please note these estimates should be viewed in the context of the sensitivities and uncertainties highlighted in the text of this report.

Table 6: Levelised Cost Estimates for Projects Commissioning in 2014, 2016, 2020, 2025 and 2030, 10% discount rate, £/MWh, highs and lows reflect high and low capital cost estimates⁴⁵

		2014	2016	2020	2025	2030
CCGT	High	78	81	85	90	92
	Central	75	77	82	86	88
	Low	73	76	80	84	86
OCGT	High	187	192	200	208	212
	Central	175	179	185	192	195
	Low	163	167	172	178	180
Nuclear FOAK/NOAK	High			108	106	94
	Central			93	90	80
	Low			83	78	70
CCGT with post comb. CCS - FOAK	High				105	105
	Central				95	95
	Low				88	87
Coal - ASC with oxy comb. CCS - FOAK	High				133	132
	Central				109	108
	Low				89	88
Coal - IGCC with CCS - FOAK	High				173	172
	Central				135	133
	Low				106	104
Onshore >5MW UK	High	129	128	123	121	118
	Central	104	103	100	99	97
	Low	83	82	84	84	84
Onshore >5MW E&W	High	140	138	133	130	127
	Central	112	111	108	106	104
	Low	89	88	91	91	91
Biomass conversion	High	115	114			
	Central	108	108			
	Low	105	105			
Offshore Round 2	High	166	153	140	133	130
	Central	146	135	122	116	114
	Low	129	119	108	102	99
Offshore Round 3	High	184	171	153	147	136
	Central	159	148	132	125	116
	Low	141	131	116	109	101
Large scale solar PV	High	170	154	132	112	96
	Central	158	144	123	105	90
	Low	146	133	115	98	84

⁴⁵ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

DECC Electricity Market Modelling, Levelised Costs and Uncertainty

The estimates outlined in the above sections are intended to provide a high-level view on the costs of different generating technologies.

In practice, DECC's electricity market modelling, including modelling for the Updated Energy & Emissions Projections and DECC's Dynamic Dispatch Model (DDM), does not use 'levelised cost estimates' per se. Instead it models private investment decisions, at the financial close for a project, using the same Capex and Opex assumptions incorporated in the levelised cost estimates reported above; assumptions on investors' foresight over fossil fuel, carbon and wholesale electricity prices; and the financial incentives from policies e.g. the RO or CfDs.

In order to model the investment decision, the internal rate of return of a potential plant is compared to a technology specific hurdle rate. The technology specific hurdle rates reflect different financing costs for different technologies and the estimated impact of policy interventions (e.g. Electricity Market Reform) on these costs.

This section shows illustrative levelised cost estimates using technology-specific 'hurdle' rates⁴⁶, in line with those used in DECC electricity market modelling⁴⁷.

These estimates at technology-specific hurdle rates reflect differentials in financing costs between technologies. Where flexible technologies such as CCGT operate at lower load factors, their levelised costs will be higher than those presented here.

Case 4: Commissioning in 2014, 2016, 2020, 2025, 2030, FOAK/ NOAK, technology specific hurdle rates⁴⁸

As noted above, the range of capital costs for renewable technologies represents site/project variability, whereas the range of capital costs for non-renewable technologies represents uncertainty for any given site/project.

The ranges for renewable technologies generally show a large range of variability across different sites/projects, whilst the ranges for non-renewable technologies show there is a large amount of uncertainty over these costs for any given project, without necessarily illustrating all the uncertainty as discussed in preceding sections.

⁴⁶ Please note that hurdle rates are themselves uncertain and likely to vary between projects and financing structures/providers.

⁴⁷ Table showing the hurdle rates used can be found in Annex 3. Please note that while we have aligned this methodology as far as possible with the Dynamic Dispatch Model (DDM) modelling there are some differences including that heat revenues for CHP technologies are modelled endogenously in the DDM but we have applied an exogenous profile.

⁴⁸ Please note these estimates should be viewed in the context of the sensitivities and uncertainties highlighted in the text of this report.

Furthermore, as explained above, these levelised costs are not the sole determinant of strike prices and therefore should not be seen as a guide to potential future strike prices. It should be noted that all the estimates for non-renewable technologies reflect generic cost data from PB (2013) & PB (forthcoming) and do not reflect site-specific considerations which may become apparent through detailed cost discovery process for strike-price setting.

Table 7: Levelised Cost Estimates for Projects Commissioning in 2014, 2016, 2020, 2025 and 2030, technology specific hurdle rates, £/MWh, highs and lows reflect high and low capital cost estimates⁴⁹

		2014	2016	2020	2025	2030
CCGT	High	76	79	83	88	89
	Central	74	77	81	84	86
	Low	73	75	79	83	85
OCGT	High	175	179	186	194	197
	Central	165	169	175	181	184
	Low	155	159	164	170	172
Nuclear FOAK/NOAK	High			102	101	89
	Central			89	86	77
	Low			79	75	67
CCGT with post comb. CCS - FOAK	High				118	118
	Central				105	104
	Low				94	93
Coal - ASC with oxy comb. CCS - FOAK	High				159	157
	Central				125	123
	Low				97	95
Coal - IGCC with CCS - FOAK	High				209	206
	Central				156	154
	Low				116	114
Onshore >5MW UK	High	115	104	100	98	96
	Central	93	85	81	80	79
	Low	75	69	66	65	64
Onshore >5MW E&W	High	124	112	107	106	104
	Central	100	91	88	86	85
	Low	81	74	71	70	69
Biomass conversion	High	116	115			
	Central	109	109			
	Low	106	105			
Offshore Round 2	High	168	151	135	129	126
	Central	148	133	119	113	110
	Low	131	117	105	99	96
Offshore Round 3	High	189	172	152	145	135
	Central	163	149	131	124	115
	Low	144	131	115	108	100

⁴⁹ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles, an updated range for CCGT costs and updates to technology specific hurdle rates to match those used in the December Delivery Plan analysis, please see page 12 for more details.

		2014	2016	2020	2025	2030
Large scale solar PV	High	131	111	94	81	71
	Central	122	104	89	76	67
	Low	114	97	83	72	63

Further key uncertainties accounted for in DECC's electricity market modelling

Load factors

For non-renewable technologies, with the exception of OCGT, plants are assumed to operate at baseload with high load factors. OCGT is assumed to operate as a peaking plant. The load factors for some renewable technologies reflect that they operate as intermittent electricity generation technologies. Load factors for key technologies are listed in Annex 3

It should be noted that in DECC's electricity market modelling, it is not only OCGT but also other flexible technologies such as CCGT which may operate at lower load factors than baseload. Where this is the case, the levelised costs will be higher than those presented above.

Carbon price

The carbon price assumed in the levelised costs presented is at the level of the Carbon Price Floor, which is assumed to stay flat in real terms beyond 2030 at £76/t in 2012 prices.

An alternative carbon price scenario, considered in DECC's electricity market modelling, assumes that up to 2030 the Carbon Price Floor gives the level of the carbon price, but that after 2030 a global carbon market emerges under the auspices of a global deal on climate change action, leading to a rising global traded carbon market price after 2030 as cheaper abatement options are used up.⁵⁰ Use of this second carbon price scenario would increase levelised costs for fossil fuel technologies.

⁵⁰ The carbon price values for this scenario are sourced from modelling by DECC using the GLOCAF model. They are also used as the Government's carbon price values for policy appraisal purposes. See the appraisal guidance for further details at: <https://www.gov.uk/government/policies/using-evidence-and-analysis-to-inform-energy-and-climate-change-policies/supporting-pages/policy-appraisal>.

Annex 1: Additional Estimates for Renewable and CCS Technologies

Case 1: Projects starting in 2013, NOAK, 10% discount rate⁵¹

Table 8: Central Levelised Cost Estimates for Projects Starting in 2013, 10% discount rate, £/MWh⁵²

	CCGT	OCGT	Nuclear - FOAK	Onshore >5 MW UK	Biomass Conversion	Offshore R2	Offshore R3	Large scale solar PV
Pre-development Costs	0	5	6	7	1	4	6	0
Capital Costs	9	54	64	70	9	85	87	134
Fixed O&M	4	23	11	18	10	31	36	24
Variable O&M	0	0	3	5	1	1	0	0
Fuel Costs	49	73	5	0	86	0	0	0
Carbon Costs	18	26	0	0	0	0	0	0
CO2 Capture and Storage Costs	0	0	0	0	0	0	0	0
Decommissioning and Waste Fund	0	0	2	0	0	0	0	0
Total Levelised Costs	80	181	90	101	108	122	129	158

	EfW CHP	EfW	Geo-thermal CHP	Landfill	Sewage Gas	Geo-thermal	AD CHP	Cofiring Conventional	AD
Pre-development Costs	0	0	3	4	0	3	3	0	3
Capital Costs	95	75	71	57	105	66	66	5	63
Fixed O&M	36	30	14	13	28	14	58	5	50
Variable O&M	30	24	10	9	0	11	21	1	31
Fuel Costs	-121	-100	0	0	0	0	-41	84	-41
Carbon Costs	0	0	0	0	0	0	0	0	0
CO2 Capture and Storage Costs	0	0	0	0	0	0	0	0	0
Decommissioning and Waste Fund	0	0	0	0	0	0	0	0	0
Heat Revenues	-13	0	-52	0	0	0	-14	0	0
Total Levelised Costs	26	29	47	84	134	93	94	95	106

	Dedicated biomass >50MW	Dedicated biomass 5-50MW	Hydropower 5-16MW	ACT standard	ACT CHP	ACT advanced	Biomass CHP	Bioliqids CHP	Bioliqids
Pre-development Costs	1	2	2	7	2	8	0	5	5
Capital Costs	37	52	112	83	100	103	63	21	20
Fixed O&M	14	16	14	58	66	58	24	22	22
Variable O&M	4	5	6	24	24	13	9	6	6
Fuel Costs	65	41	0	-27	-31	-23	119	270	270
Carbon Costs	0	0	0	0	0	0	0	0	0
CO2 Capture and Storage Costs	0	0	0	0	0	0	0	0	0
Decommissioning and Waste Fund	0	0	0	0	0	0	0	0	0
Heat Revenues	0	0	0	0	-15	0	-33	-14	0
Total Levelised Costs	122	116	134	144	145	158	182	310	323

⁵¹ Please note these estimates should be viewed in the context of the sensitivities and uncertainties highlighted in the text of this report.

⁵² This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles, please see page 12 for more details.

	Co-firing Standard CHP	Hydro large storage	Solar<4kW	Onshore <15kW	Onshore 1MW<5MW	AD < 250kW	AD > 500kW	Hydropower <15kW	Hydropower 100kW- 1000kW
Pre-development Costs	0	2	0	0	0	0	0	0	0
Capital Costs	62	92	253	414	107	134	75	341	162
Fixed O&M	32	8	28	49	14	176	102	36	34
Variable O&M	2	6	0	0	0	0	0	0	0
Fuel Costs	63	0	0	0	0	0	-54	0	0
Carbon Costs	0	0	0	0	0	0	0	0	0
CO2 Capture and Storage Costs	0	0	0	0	0	0	0	0	0
Decommissioning and Waste Fund	0	0	0	0	0	0	0	0	0
Heat Revenues	-52	0	0	0	0	0	0	0	0
Total Levelised Costs	108	108	282	463	121	310	123	377	196

Table 9: Levelised Cost Estimates for Projects Starting in 2013, 10% discount rate, £/MWh, highs and lows reflect high and low capital and fuel cost estimates⁵³

	CCGT	OCGT	Nuclear - FOAK	Onshore >5 MW UK	Biomass Conversion	Offshore R2	Offshore R3	Large scale solar PV
Central	80	181	90	101	108	122	129	158
High capex	83	194	106	125	114	139	150	170
High capex, high fuel	102	222	107	n/a	129	n/a	n/a	n/a
Low capex, low fuel	58	138	78	n/a	94	n/a	n/a	n/a
Low capex	78	168	79	80	105	107	113	146

	EfW CHP	EfW	Geothermal CHP	Landfill	Sewage Gas	Geo- thermal	AD CHP	Cofiring Convention al	AD
Central	26	29	47	84	134	93	94	95	106
High capex	37	34	79	124	201	125	149	96	165
High capex, high fuel	56	48	n/a	n/a	n/a	n/a	179	110	198
Low capex	15	23	10	52	95	58	54	91	68
Low capex, low fuel	-3	9	n/a	n/a	n/a	n/a	-37	81	-32

	Dedicated biomass >50MW	Dedicated biomass 5- 50MW	Hydropower 5- 16MW	ACT standard	ACT CHP	ACT advanced	Biomass CHP	Bioliqids CHP	Bioliqids
Central	122	116	134	144	145	158	182	310	323
High capex	154	138	149	223	226	171	200	364	375
High capex, high fuel	164	160	n/a	243	250	188	218	379	390
Low capex	115	100	80	71	61	128	163	297	310
Low capex, low fuel	106	81	n/a	57	45	116	146	211	224

⁵³ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

	Co-firing Standard CHP	Hydro large storage	Solar <4kW	Onshore <15kW	Onshore 1MW<5MW	AD < 250kW	AD > 500kW	Hydropower <15kW	Hydropower 100kW- 1000kW
Central	108	108	282	463	121	310	123	377	196
High capex	n/a	n/a	381	507	138	360	151	813	397
High capex, high fuel	n/a	n/a	n/a	n/a	n/a	n/a	183	n/a	n/a
Low capex	n/a	n/a	205	429	99	265	98	187	106
Low capex, low fuel	n/a	n/a	n/a	n/a	n/a	n/a	2	n/a	n/a

Case 2: Projects starting in 2019, NOAK, 10% discount rate⁵⁴

Table 10: Central Levelised Cost Estimates for Projects Starting in 2019, 10% discount rate, £/MWh⁵⁵

	CCGT	OCGT	Nuclear NOAK	Gas - CCGT with post comb. CCS FOAK	Coal - ASC with oxy comb. CCS FOAK	Coal - IGCC with CCS FOAK	Onshore >5 MW UK	Offshore R2	Offshore R3	Large scale solar PV
Pre-development Costs	0	5	5	1	1	1	7	4	6	0
Capital Costs	9	54	56	21	37	53	68	83	84	100
Fixed O&M	4	23	10	4	8	19	19	27	30	23
Variable O&M	0	0	3	2	2	0	5	1	0	0
Fuel Costs	49	74	5	56	36	36	0	0	0	0
Carbon Costs	24	35	0	4	5	7	0	0	0	0
CO2 Capture and Storage C	0	0	0	7	18	17	0	0	0	0
Decommissioning and Was	0	0	2	0	0	0	0	0	0	0
Total Levelised Costs	85	190	80	95	107	134	99	115	120	123

	Gas - CCGT retro post comb. CCS FOAK	Gas - CCGT with pre comb. CCS FOAK	CCGT with oxy comb. CCS FOAK	ASC FGD with 300MW CCS FOAK	ASC with post comb. CCS FOAK	Coal - ASC with ammonia FOAK	ASC ret post comb. CCS FOAK	Coal - IGCC with 300MW CCS FOAK	Coal - IGCC with retro CCS FOAK	Biomass CCS FOAK
Pre-development Costs	1	1	1	1	1	1	1	1	1	0
Capital Costs	15	24	24	31	44	42	27	49	27	63
Fixed O&M	4	5	13	7	10	10	10	16	19	12
Variable O&M	2	1	1	1	2	0	2	0	0	4
Fuel Costs	56	69	71	29	36	40	37	32	38	89
Carbon Costs	4	4	3	47	8	10	8	42	10	0
CO2 Capture and Storage C	7	9	9	3	17	18	17	6	18	0
Decommissioning and Was	0	0	0	0	0	0	0	0	0	0
Total Levelised Costs	88	113	122	119	118	121	102	146	112	168

⁵⁴ Please note these estimates should be viewed in the context of the sensitivities and uncertainties highlighted in the text of this report.

⁵⁵ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles, please see page 12 for more details.

	EfW CHP	EfW	Geo-thermal CHP	Landfill	Sewage Gas	Geothermal	AD CHP	Cofiring conventional	AD
Pre-development Costs	0	0	3	4	0	3	3	0	3
Capital Costs	93	73	70	57	102	64	63	5	60
Fixed O&M	36	30	14	14	28	14	59	5	50
Variable O&M	30	24	10	9	0	11	21	1	31
Fuel Costs	-121	-100	0	0	0	0	0	84	0
Carbon Costs	0	0	0	0	0	0	0	0	0
CO2 Capture and Storage Costs	0	0	0	0	0	0	0	0	0
Decommissioning and Waste	0	0	0	0	0	0	0	0	0
Heat Revenues	-13	0	-53	0	0	0	-14	0	0
Total Levelised Costs	25	28	45	83	130	92	132	94	145

	Dedicated biomass >50MW	Dedicated biomass 5-50MW	Hydro-power 5-16MW	ACT standard	ACT CHP	ACT advanced	Biomass CHP	Bioliqids CHP	Bioliqids
Pre-development Costs	1	2	2	7	2	8	0	5	5
Capital Costs	37	51	123	80	96	100	62	21	20
Fixed O&M	14	16	14	54	63	54	23	21	21
Variable O&M	4	5	6	22	22	12	9	5	5
Fuel Costs	65	41	0	-24	-28	-21	119	263	263
Carbon Costs	0	0	0	0	0	0	0	0	0
CO2 Capture and Storage Costs	0	0	0	0	0	0	0	0	0
Decommissioning and Waste	0	0	0	0	0	0	0	0	0
Heat Revenues	0	0	0	0	-15	0	-33	-14	0
Total Levelised Costs	121	115	146	139	140	153	180	302	315

	Co-firing Standard CHP	Hydro_LargeSTORE	Solar<4kW	Onshore <15kW	Onshore 1MW<5MW	AD < 250kW	AD > 500kW	Hydropower <15kW	Hydropower 100kW-1000kW
Pre-development Costs	0	2	0	0	0	0	0	0	0
Capital Costs	62	104	197	414	107	134	75	341	162
Fixed O&M	32	9	28	49	13	176	102	36	34
Variable O&M	2	6	0	0	0	0	0	0	0
Fuel Costs	63	0	0	0	0	0	0	0	0
Carbon Costs	0	0	0	0	0	0	0	0	0
CO2 Capture and Storage Costs	0	0	0	0	0	0	0	0	0
Decommissioning and Waste	0	0	0	0	0	0	0	0	0
Heat Revenues	-53	0	0	0	0	0	0	0	0
Total Levelised Costs	107	120	224	463	120	310	177	377	196

Table 11: Levelised Cost Estimates for Projects Starting in 2019, 10% discount rate, highs and lows reflect high and low capital cost estimates, £/MWh⁵⁶

	CCGT	OCGT	Nuclear NOAK	Gas - CCGT with post comb. CCS FOAK	Coal - ASC with oxy comb. CCS FOAK	Coal - IGCC with CCS FOAK	Onshore >5 MW UK	Offshore R2	Offshore R3	Large scale solar PV
Central	85	190	80	95	107	134	99	115	120	123
High capex	89	205	93	105	132	172	123	132	141	132
High capex, high fuel	109	235	94	128	143	183	n/a	n/a	n/a	n/a
Low capex, low fuel	63	146	70	64	80	96	n/a	n/a	n/a	n/a
Low capex	83	176	71	87	88	104	79	101	104	115

	Gas - CCGT retro post comb. CCS FOAK	Gas - CCGT with pre comb. CCS FOAK	Gas - CCGT with oxy comb. CCS FOAK	Coal - ASC FGD with 300MW CCS FOAK	Coal - ASC with post comb. CCS FOAK	Coal - ASC with ammonia FOAK	Coal - ASC ret post comb. CCS FOAK	Coal - IGCC with 300MW CCS FOAK	Coal - IGCC with retro CCS FOAK	Biomass CCS FOAK
Central	88	113	122	119	118	121	102	146	112	168
High capex	95	127	139	125	137	142	114	181	130	206
High capex, high fuel	118	155	168	134	149	155	125	191	142	219
Low capex	83	102	109	115	104	106	93	119	97	157
Low capex, low fuel	60	74	79	108	96	97	85	112	89	144

	EfW CHP	EfW	Geothermal CHP	Landfill	Sewage Gas	Geo-thermal	AD CHP	Cofiring Conventional	AD
Central	25	28	45	83	130	92	132	94	145
High capex	36	32	76	123	195	122	185	96	201
High capex, high fuel	54	47	n/a	n/a	n/a	n/a	215	110	235
Low capex	14	23	8	52	93	58	94	91	108
Low capex, low fuel	-4	8	n/a	n/a	n/a	n/a	3	81	8

	Dedicated biomass >50MW	Dedicated biomass 5-50MW	Hydro-power 5-16MW	ACT standard	ACT CHP	ACT advanced	Biomass CHP	Bioliquids CHP	Bioliquids
Central	121	115	146	139	140	153	180	302	315
High capex	153	137	161	216	218	166	198	356	367
High capex, high fuel	162	158	n/a	237	242	183	216	372	383
Low capex	114	99	87	69	59	124	162	289	303
Low capex, low fuel	105	80	n/a	55	43	112	144	210	224

⁵⁶ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

	Co-firing Standard CHP	Hydro large storage	Solar <4kW	Onshore <15kW	Onshore 1MW<5M W	AD < 250kW	AD > 500kW	Hydropow er <15kW	Hydropow er 100kW- 1000kW
Central	107	120	224	463	120	310	177	377	196
High capex	n/a	n/a	354	535	145	371	212	860	419
High capex, high fuel	n/a	n/a	n/a	n/a	n/a	n/a	244	n/a	n/a
Low capex	n/a	n/a	160	424	98	263	151	185	105
Low capex, low fuel	n/a	n/a	n/a	n/a	n/a	n/a	55	n/a	n/a

Case 3: Commissioning in 2014, 2016, 2020, 2025, 2030, NOAK, 10% discount rate⁵⁷

Table 12: Levelised Cost Estimates for Projects Commissioning in 2014, 2016, 2020, 2025, 2030, 10% discount rate, £/MWh, highs and lows reflect high and low capital cost estimates⁵⁸

		2014	2016	2020	2025	2030
CCGT	High	78	81	85	90	92
	Central	75	77	82	86	88
	Low	73	76	80	84	86
CCGT CHP	High	83	83	90	96	99
	Central	81	81	87	93	96
	Low	79	79	85	91	94
OCGT	High	187	192	200	208	212
	Central	175	179	185	192	195
	Low	163	167	172	178	180
Nuclear - FOAK/NOAK	High			108	106	94
	Central			93	90	80
	Low			83	78	70
CCGT with post comb. CCS - FOAK	High				105	105
	Central				95	95
	Low				88	87
CCGT retro post comb. CCS - FOAK	High				95	95
	Central				89	88
	Low				83	83
CCGT with pre comb. CCS - FOAK	High				127	127
	Central				113	113
	Low				102	102
CCGT with oxy comb. CCS - FOAK	High				139	139
	Central				123	122
	Low				110	109

⁵⁷ Please note these estimates should be viewed in the context of the sensitivities and uncertainties highlighted in the text of this report.

⁵⁸ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

		2014	2016	2020	2025	2030
Coal - ASC FGD with 300MW CCS - FOAK	High				121	125
	Central				116	119
	Low				112	115
Coal - ASC with post comb. CCS - FOAK	High				138	137
	Central				120	118
	Low				105	104
Coal ASC with ammonia - FOAK	High				145	142
	Central				124	121
	Low				108	106
Coal - ASC ret post comb. CCS - FOAK	High				115	113
	Central				103	102
	Low				94	92
Coal - ASC with oxy comb. CCS - FOAK	High				133	132
	Central				109	108
	Low				89	88
Coal - IGCC with 300MW CCS - FOAK	High				177	181
	Central				143	146
	Low				117	119
Coal - IGCC with CCS - FOAK	High				173	172
	Central				135	133
	Low				106	104
Coal - IGCC with retro CCS - FOAK	High				131	130
	Central				112	111
	Low				98	97
Biomass with CCS	High				206	206
	Central				168	168
	Low				157	157
Dedicated biomass >50MW	High	157	156	153	152	151
	Central	123	123	122	121	120
	Low	117	116	116	116	116
Dedicated biomass 5-50MW	High	141	140	137	136	135
	Central	118	118	116	115	115
	Low	102	101	101	101	101
Onshore >5MW E&W	High	140	138	133	130	127
	Central	112	111	108	106	104
	Low	89	88	91	91	91
Onshore >5MW UK	High	129	128	123	121	118
	Central	104	103	100	99	97
	Low	83	82	84	84	84
Offshore Round 2	High	166	153	140	133	130
	Central	146	135	122	116	114
	Low	129	119	108	102	99
Offshore Round 3	High	184	171	153	147	136
	Central	159	148	132	125	116
	Low	141	131	116	109	101

		2014	2016	2020	2025	2030
Biomass conversion	High	115	114			
	Central	108	108			
	Low	105	105			
Large scale solar PV	High	170	154	132	112	96
	Central	158	144	123	105	90
	Low	146	133	115	98	84
EfW CHP	High	40	38	37	36	35
	Central	28	27	26	25	25
	Low	17	16	15	14	14
EfW	High	35	34	33	32	32
	Central	30	29	28	28	27
	Low	25	24	23	23	22
Geothermal CHP	High	109	93	79	76	73
	Central	69	57	47	45	43
	Low	21	15	9	8	7
Landfill	High	125	124	123	123	123
	Central	84	84	84	83	83
	Low	52	52	52	52	52
Sewage gas	High	203	201	196	194	192
	Central	135	134	131	130	128
	Low	96	95	93	92	92
Geothermal	High	150	137	124	122	120
	Central	111	102	93	92	90
	Low	67	63	58	58	57
AD CHP	High	135	161	186	184	183
	Central	80	106	132	131	131
	Low	40	66	94	94	93
Cofiring conventional	High	97	96	96	96	96
	Central	95	95	94	94	94
	Low	91	91	91	91	91
AD	High	151	177	202	200	199
	Central	92	118	145	144	144
	Low	54	81	108	108	108
Cofiring standard CHP	Central	108	107	107	107	107
Hydro large storage	Central	106	110	117	122	122
Hydropower 5-16MW	High	142	146	156	161	162
	Central	127	132	141	146	146
	Low	77	79	84	87	87
ACT standard	High	228	225	218	214	209
	Central	147	145	141	138	133
	Low	73	72	70	68	64
ACT CHP	High	233	228	221	216	210
	Central	149	146	141	138	133
	Low	63	62	60	58	54

		2014	2016	2020	2025	2030
ACT advanced	High	175	172	168	164	160
	Central	162	159	155	152	147
	Low	131	129	125	122	118
Biomass CHP	High	205	203	200	198	197
	Central	186	184	182	180	179
	Low	167	166	163	162	161
Bioliquids	High	378	373	367	366	365
	Central	325	321	316	314	314
	Low	313	308	303	302	301
Bioliquids CHP	High	367	362	357	355	353
	Central	312	308	303	301	299
	Low	299	295	290	288	287
Wave	High				259	201
	Central				246	191
	Low				215	167
Tidal stream shallow	High				207	185
	Central				190	171
	Low				155	140
Tidal stream deep	High				165	144
	Central				148	129
	Low				131	115
Tidal range	High				283	283
	Central				230	230
	Low				173	173
Solar<4kW	High	381	373	354	330	310
	Central	282	258	224	198	181
	Low	205	183	160	144	134
Onshore <15kW	High	507	517	535	560	586
	Central	463	463	463	463	463
	Low	429	429	424	414	405
Onshore 1MW<5MW	High	138	141	145	152	159
	Central	121	121	120	120	120
	Low	99	99	98	95	93
AD < 250kW	High	360	364	371	381	392
	Central	310	310	310	310	310
	Low	265	265	263	261	259
AD > 500kW	High	151	180	212	218	223
	Central	123	150	177	177	177
	Low	98	125	151	150	149
Hydropower <15kW	High	813	828	860	902	947
	Central	377	377	377	377	377
	Low	187	187	185	181	177
Hydropower 100kW-1000kW	High	397	404	419	439	459
	Central	196	196	196	196	196
	Low	106	106	105	103	101

		2014	2016	2020	2025	2030
Dedicated biomass >50MW(ecrops)	High	172	171	171	170	168
	Central	139	139	139	138	137
	Low	133	132	132	131	131
Dedicated biomass 5-50MW(ecrop)	High	194	193	193	192	191
	Central	172	171	171	170	170
	Low	155	155	155	155	154

Case 4: Commissioning in 2014, 2016, 2020, 2025, 2030, NOAK, tech specific hurdle rates⁵⁹

Table 13: Levelised Cost Estimates for Projects Commissioning in 2014, 2016, 2020, 2025, 2030, technology specific hurdle rate, £/MWh, highs and lows reflect high and low capital cost estimates⁶⁰

		2014	2016	2020	2025	2030
CCGT	High	76	79	83	88	89
	Central	74	77	81	84	86
	Low	73	75	79	83	85
CCGT CHP	High	85	85	91	97	100
	Central	83	83	89	95	97
	Low	82	82	88	93	96
OCGT	High	175	179	186	194	197
	Central	165	169	175	181	184
	Low	155	159	164	170	172
Nuclear - FOAK/NOAK	High			102	101	89
	Central			89	86	77
	Low			79	75	67
CCGT with post comb. CCS - FOAK	High				118	118
	Central				105	104
	Low				94	93
CCGT retro post comb. CCS - FOAK	High				103	102
	Central				94	93
	Low				87	86
CCGT with pre comb. CCS - FOAK	High				143	143
	Central				124	123
	Low				109	107
CCGT with oxy comb. CCS - FOAK	High				158	156
	Central				134	133
	Low				115	114
Coal - ASC FGD with 300MW CCS - FOAK	High				134	139
	Central				127	131
	Low				122	125

⁵⁹ Please note these estimates should be viewed in the context of the sensitivities and uncertainties highlighted in the text of this report

⁶⁰ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles, an updated range for CCGT costs and updates to technology specific hurdle rates to match those used in the December Delivery Plan analysis, please see page 12 for more details.

		2014	2016	2020	2025	2030
Coal - ASC with post comb. CCS - FOAK	High				162	161
	Central				137	135
	Low				117	115
Coal ASC with ammonia - FOAK	High				170	165
	Central				141	137
	Low				120	116
Coal - ASC ret post comb. CCS - FOAK	High				126	124
	Central				111	109
	Low				99	97
Coal - ASC with oxy comb. CCS - FOAK	High				159	157
	Central				125	123
	Low				97	95
Coal - IGCC with 300MW CCS - FOAK	High				207	213
	Central				161	165
	Low				125	128
Coal - IGCC with CCS - FOAK	High				209	206
	Central				156	154
	Low				116	114
Coal - IGCC with retro CCS - FOAK	High				144	142
	Central				120	119
	Low				102	101
Biomass with CCS	High				239	239
	Central				188	188
	Low				174	174
Dedicated biomass >50MW	High	173	169	165	164	163
	Central	132	130	128	127	127
	Low	124	122	120	119	119
Dedicated biomass 5-50MW	High	157	153	149	148	147
	Central	130	127	124	124	123
	Low	110	108	105	105	104
Onshore >5MW E&W	High	124	112	107	106	104
	Central	100	91	88	86	85
	Low	81	74	71	70	69
Onshore >5MW UK	High	115	104	100	98	96
	Central	93	85	81	80	79
	Low	75	69	66	65	64
Offshore Round 2	High	168	151	135	129	126
	Central	148	133	119	113	110
	Low	131	117	105	99	96
Offshore Round 3	High	189	172	152	145	135
	Central	163	149	131	124	115
	Low	144	131	115	108	100
Biomass conversion	High	116	115			
	Central	109	109			
	Low	106	105			

		2014	2016	2020	2025	2030
Large scale solar PV	High	131	111	94	81	71
	Central	122	104	89	76	67
	Low	114	97	83	72	63
EfW CHP	High	58	45	41	40	40
	Central	44	34	30	29	28
	Low	31	22	18	18	17
EfW	High	41	36	35	34	34
	Central	36	31	30	29	29
	Low	30	26	25	24	24
Geothermal CHP	High	311	277	236	229	222
	Central	205	181	152	147	141
	Low	82	68	53	50	47
Landfill	High	116	102	100	100	100
	Central	79	71	70	70	69
	Low	50	46	45	45	45
Sewage gas	High	195	166	159	157	156
	Central	130	112	108	107	106
	Low	93	81	79	78	78
Geothermal	High	337	296	263	258	252
	Central	238	210	187	183	179
	Low	130	116	104	103	100
AD CHP	High	141	170	197	195	194
	Central	82	112	141	140	139
	Low	36	66	97	97	97
Cofiring conventional	High	97	97	97	97	97
	Central	95	95	95	95	95
	Low	91	91	91	91	91
AD	High	164	191	219	217	216
	Central	96	125	154	153	152
	Low	52	82	112	112	112
Co-firing standard CHP	Central	118	117	116	116	116
Hydro large storage	Central	80	72	75	77	78
Hydropower 5-16MW	High	107	97	100	103	103
	Central	97	88	91	94	95
	Low	61	56	58	59	60
ACT standard	High	206	197	188	184	179
	Central	136	130	125	122	118
	Low	71	69	67	65	61
ACT CHP	High	224	220	210	205	199
	Central	144	142	135	132	127
	Low	63	61	59	57	53
ACT advanced	High	187	179	171	168	164
	Central	173	165	158	155	151
	Low	139	133	128	125	121

		2014	2016	2020	2025	2030
Biomass CHP	High	229	228	222	220	218
	Central	204	203	198	196	195
	Low	179	177	174	172	171
Bioliquids	High	388	383	377	375	374
	Central	329	324	319	317	317
	Low	314	310	305	304	303
Bioliquids CHP	High	382	377	371	369	367
	Central	317	313	307	305	304
	Low	301	297	292	290	289
Wave	High				287	223
	Central				272	211
	Low				237	185
Tidal stream shallow	High				258	230
	Central				235	210
	Low				189	169
Tidal stream deep	High				203	176
	Central				181	157
	Low				158	138
Tidal range	High				183	183
	Central				150	150
	Low				115	115
Solar<4kW	High	305	279	242	214	195
	Central	238	218	190	168	154
	Low	192	176	155	137	126
Onshore <15kW	High	400	400	400	400	400
	Central	369	369	369	369	369
	Low	343	343	343	343	343
Onshore 1MW<5MW	High	109	109	109	108	108
	Central	97	96	96	96	95
	Low	80	80	80	79	79
AD < 250kW	High	314	314	314	314	314
	Central	279	279	279	279	279
	Low	245	245	245	245	245
AD > 500kW	High	134	157	180	180	180
	Central	115	138	160	160	160
	Low	95	118	141	141	141
Hydropower <15kW	High	608	608	608	608	608
	Central	290	290	290	290	290
	Low	148	148	148	148	148
Hydropower 100kW-1000kW	High	301	301	301	301	301
	Central	154	154	154	154	154
	Low	87	87	87	87	87
Dedicated biomass >50MW(ecrops)	High	189	184	182	181	180
	Central	149	146	144	144	144
	Low	140	138	137	137	136

		2014	2016	2020	2025	2030
Dedicated biomass 5-50MW(ecrop)	High	212	207	204	204	203
	Central	185	181	179	179	178
	Low	165	162	161	161	160

Annex 2: CCGT and OCGT costs for EMR December Delivery Plan

Wider CCGT and OCGT range

The main report presents a range of CCGT levelised costs based on capital and fuel cost variation only, using central cost estimates based on PB (2013) and low and high capital cost estimates for CCGT from the PB (forthcoming) realistic low and high cost ranges.

December Delivery Plan modelling uses a wider range of CCGT costs, again based on the realistic low and high cost ranges in PB (forthcoming), but allowing for additional variation (including operating cost variation)⁶¹. Corresponding levelised cost ranges for CCGT are presented below, at illustrative load factors of 93%, 71% and 61% and technology specific hurdle rates.

		2014	2016	2020	2025	2030
CCGT (93% load factor)	High	78	81	85	89	91
	Central	74	77	81	85	86
	Low	73	76	80	84	85
CCGT (71% load factor)	High	83	86	90	94	95
	Central	77	80	84	88	90
	Low	76	79	83	87	88
CCGT (61% load factor)	High	86	89	93	97	99
	Central	80	82	86	90	92
	Low	78	81	85	89	91

December Delivery Plan modelling also uses a wider range of OCGT costs. The high and low OCGT costs used in the December Delivery Plan are based on the percentage cost variation identified for CCGT. Corresponding levelised cost ranges for OCGT are presented below, at illustrative load factors of 7% and 1% and technology specific hurdle rates.

⁶¹ These levelised cost calculations use the PB (forthcoming) realistic case variation for CCGT from low to high, except they exclude load factor, lifetime and efficiency variation.

		2014	2016	2020	2025	2030
OCGT (7% load factor)	High	192	195	202	207	210
	Central	167	171	177	183	185
	Low	161	165	171	177	179
OCGT (1% load factor)	High	769	773	779	785	787
	Central	594	598	604	610	613
	Low	555	558	564	570	573

Annex 3: Key Data and Assumptions

This annex presents key data and assumptions used to calculate the levelised costs in this report.

Hurdle Rates

The technology specific hurdle rates used for the Levelised Cost estimates presented in this report represent estimates of pre-tax real hurdle rates. The starting point for the renewable hurdle rate estimates are the post-tax nominal hurdle rates underlying the Renewables Obligation Banding Review Government Response (2012). The post-tax nominal rates are based on evidence from Arup (2011)⁶² and Oxera (2011).⁶³ These post-tax nominal rates are adjusted using the following assumptions:

- To convert post-tax nominal to pre-tax real hurdle rates, updated effective tax rate assumptions from work undertaken by KPMG (2013)⁶⁴ (further explained below) and a 2% inflation assumption consistent with the Government's inflation target have been applied.
- For technologies offered CfDs, estimated hurdle rate reductions for the first delivery plan period due to the introduction of CfDs are included, which draw on analysis by NERA (2013)⁶⁵. For more information see Annex H: Modelling Assumptions of the EMR December 2013 Delivery Plan documentation.

The resulting pre-tax real hurdle rates used are shown in Table 14 below.

⁶² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42843/3237-cons-ro-banding-arup-report.pdf

⁶³ <http://hmccc.s3.amazonaws.com/Renewables%20Review/Oxera%20low%20carbon%20discount%20rates%20180411.pdf>

⁶⁴ Electricity Market Reform: Review of effective tax rates for renewable technologies, KPMG, July 2013 [URL]

⁶⁵ This can be found as part of the December 2013 EMR Delivery Plan documentation here: <https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan>

Table 14: Technology specific hurdle rates for renewable technologies⁶⁶⁶⁷

	RO pre-tax real hurdle rates used for December Delivery Plan⁶⁸	Pre-tax real hurdle rates under CfDs⁶⁹
ACT advanced	11.2%	10.7%
ACT CHP	9.4%	9.5%
ACT standard	8.4%	7.9%
AD >5MW	12.0%	11.5%
AD CHP	13.0%	13.1%
Bioliquids	12.7%	
Bioliquids CHP	13.7%	
Biomass Conversion	11.6%	10.9%
Dedicated Biomass CHP	13.5%	13.6%
EfW	10.9%	
EfW CHP	11.9%	10.8%
Enhanced co-firing	11.6%	
Geothermal	22.5%	22.0%
Geothermal CHP	23.5%	23.8%

⁶⁶ Pre-tax real hurdle rates for CHP technologies are assumed to be 1 percentage point higher than the equivalent power only technology

⁶⁷ This table has been updated from the July 2013 Electricity Generation Costs report to reflect updates to technology specific hurdle rates to match those used in the December Delivery Plan analysis, please see page 12 for more details.

⁶⁸ These have also been adjusted for the latest Effective Tax Rate estimates.

⁶⁹ RO is assumed to be switched to CfD for commissioning 2016 onwards.

	RO pre-tax real hurdle rates used for December Delivery Plan⁷⁰	Pre-tax real hurdle rates under CfDs⁷¹
Hydropower	7.0%	5.8%
Landfill gas	8.4%	5.7%
Large dedicated biomass	12.5%	
Large scale solar PV	6.2%	5.3%
Offshore Wind	10.2%	9.7%
Offshore Wind R3 ⁷²	10.4%	10.1%
Onshore Wind	8.3%	7.1%
Sewage Gas	9.4%	7.5%
Small dedicated biomass	12.5%	
Standard co-firing	11.6%	
Standard co-firing CHP	12.6%	
Tidal range	7.0%	6.4%
Tidal stream (pre-commercial) ⁷³	8.0%	8.3%
Wave (pre-commercial) ⁷⁴	8.0%	8.3%

⁷⁰ These have also been adjusted for the latest Effective Tax Rate estimates.

⁷¹ RO is assumed to be switched to CfD for commissioning 2016 onwards.

⁷² Since July 2013, the Offshore Wind R3 hurdle rate under the RO has been revised from 12.0% to 10.4%. This is in line with the PwC financing annex to the Crown Estate's Cost Reduction Pathways work (2012) which showed that while there was evidence on the cost of capital differences for offshore R2 and R3, the differences between site types predicted in the PwC report were lower than the 1.8% difference DECC had assumed in the July Delivery Plan analysis. For a full description of the rationale for this change please see Annex H: Modelling Assumptions of the Final Delivery Plan documentation, <https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan>.

⁷³ Pre-tax real hurdle rates for commercial tidal stream are estimated to be 12.9% under CfDs.

If a technology is being offered a CfD in the final Delivery Plan the “Pre-tax real hurdle rates under CfDs” is used for the technology specific hurdle rate, otherwise the “RO pre-tax real hurdle rates used for draft Delivery Plan” figure is used.

Effective Tax Rates

We have updated assumptions on effective tax rates (ETRs) for renewable technologies to take into account the effect of capital allowances. This is based on advice from KPMG.⁷⁵ KPMG modelled project cash flows including the impact of capital allowance on corporation tax paid based on their recent experiences of such projects.

The KPMG report derived indicative ETRs for three electricity generating technologies: onshore wind, offshore wind and biomass conversions. The report then applied a high-level qualitative analysis for other renewable technologies to assess whether the ETR for offshore wind or converted biomass is an appropriate proxy. For technologies that do not show similar characteristics to either offshore wind or converted biomass the main rate of corporation tax rate from 2015-16 (20%)⁷⁶ is used as an estimate for the ETR.

The ETRs which have been used are shown in Table 15 below.

⁷⁴ Pre-tax real hurdle rates for commercial wave are estimated to be 11.0% under CfDs.

⁷⁵ Electricity Market Reform: Review of effective tax rates for renewable technologies, KPMG, July 2013.

⁷⁶ <http://www.hmrc.gov.uk/rates/corp.htm>

Table 15: Effective Tax Rates⁷⁷⁷⁸

	Estimated Effective tax rate⁷⁹
ACT advanced	12%
ACT CHP	12%
ACT standard	12%
AD >5MW	12%
AD CHP	12%
Bioliqids	21%
Bioliqids CHP	21%
Biomass Conversion*	21%
Dedicated biomass CHP	20%
Enhanced co-firing	21%
EfW	12%
EfW CHP	12%
Geothermal	20%
Geothermal CHP	20%
Hydropower	20%
Landfill gas	12%

⁷⁷ Standard and enhanced cofiring and cofiring CHP were not included in the KPMG report. These technologies have been linked to the Biomass Conversion ETR assumption.

⁷⁸ KPMG's analysis of the ETR for biomass conversions was based on a 15 year CfD contract length (compared to CfDs for biomass conversions ending in 2027 as now announced). We do not believe this difference has an impact on the biomass conversion strike prices proposed in the December Delivery Plan, given strike prices have been set in £5 increments. We tested the implication for the calculated biomass conversion RO-X equivalent strike price if biomass conversion hurdle rates were between 5 percentage points lower and 5 percentage points higher than the assumed hurdle rates for biomass conversions in Table 14. This variation in hurdle rates would capture a very substantial variation in the ETR for biomass conversions. The RO-X equivalent biomass conversion strike price remained at £105/MWh for each of 2014/15, 2015/16 and 2016/17.

⁷⁹ These are the "Strawman 2b" estimates from the KPMG which calculate the ETR with reference to the post tax WACC.

	Estimated Effective tax rate
Hydropower	20%
Landfill gas	12%
Large dedicated biomass	20%
Large scale solar PV	12%
Offshore Wind	12%
Offshore Wind R3	12%
Onshore Wind	11.4%
Sewage Gas	20%
Small dedicated biomass	20%
Standard co-firing	21%
Standard co-firing CHP	21%
Tidal range	20%
Tidal stream (deep and shallow)	20%
Wave	12%

For non-renewable technologies the post-tax nominal rates are based on evidence from Oxera (2011). To convert post-tax nominal to pre-tax real hurdle rates, a 2% inflation assumption and a 20% ETR assumption is used. For technologies offered CfDs, estimated hurdle rate reductions due to the introduction of CfDs are included, which draws on analysis by NERA (2013).

Table 16: Technology specific hurdle rates for non-renewable technologies⁸⁰

	Pre-tax real hurdle rate
CCGT	7.5%
OCGT	7.5%
CCGT CHP	7.5%
Coal – IGCC with 300MW CCS	13.5%
Coal ASC CCS*	13.5%
Coal IGCC CCS*	13.5%
Gas CCS*	13.8%
Nuclear	9.5%

*The pre-tax hurdle rates refers to the hurdle rate under CfDs

Load factors for selected technologies

The table below summarises the load factor assumptions used to calculate levelised costs for key technologies in this report. The sources for these assumptions are summarised in Table 1 Data sources for individual technologies.

Table 17 Load factor assumptions for selected technologies

Technology	Average lifetime load factor (net of plant availability)
CCGT	93%
OCGT	7%
Nuclear – FOAK	91%
Gas - CCGT with post comb. CCS – FOAK	93%
Coal - ASC with oxy comb. CCS – FOAK	93%

⁸⁰ Standard and enhanced cofiring and cofiring CHP were not included in the KPMG report. These technologies have been linked to the Biomass Conversion ETR assumption.

Technology	Average lifetime load factor (net of plant availability)
Coal - IGCC with CCS – FOAK	90%
Onshore >5 MW UK	28%
Offshore Round 2	38%
Offshore Round 3	39%
Large scale solar PV	11%
Biomass conversion	65%

Project timings for selected technologies

Table 19: Central pre-development and construction period assumptions for selected technologies

Technology	Pre-development period	Construction period	Operating Period
CCGT	2	3	25
OCGT	2	2	25
Nuclear - FOAK	5	6	60
Gas - CCGT with post combustion CCS – FOAK	5	5	25
Coal - ASC with oxy combustion CCS - FOAK	6	6	25
Coal - IGCC with CCS - FOAK	5	5	25
Onshore >5 MW UK	4	2	24
Offshore Round 2	5	3	23
Offshore Round 3	6	3	22
Large scale solar PV	0	1	25
Biomass conversion	2	1	22

Capital and operating cost assumptions

Table 20: Capital and operating cost assumptions for all technologies⁸¹

Gas - CCGT					OCGT				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High	25	25	25	Pre-development £/kW	High	30	30	30
	Medium	10	10	10		Medium	20	20	20
	Low	5	5	5		Low	20	20	20
Construction costs £/kW	High	700	700	700	Construction costs £/kW	High	300	300	300
	Medium	600	600	600		Medium	300	300	300
	Low	500	500	500		Low	200	200	200
Fixed O+M £/MW/yr	Medium	22000	22000	22000	Fixed O+M £/MW/yr	Medium	9900	9900	9900
Variable O+M £/MWh	Medium	0.1	0.1	0.1	Variable O+M £/MWh	Medium	0.1	0.1	0.1
Insurance £/MW/yr	Medium	1990	1990	1990	Insurance £/MW/yr	Medium	960	960	960
Connection and Use of System charges £/MW/yr	Medium	6840	6840	6840	Connection and Use of System charges £/MW/yr	Medium	3440	3440	3440
Gas - CCGT with post combustion CCS (FOAK)					Coal - IGCC with CCS (FOAK)				
		Commissioning					Commissioning		
		2025					2025		
Pre-development £/kW	High	45			Pre-development £/kW	High	60		
	Medium	30				Medium	50		
	Low	25				Low	45		
Construction costs £/kW	High	1500			Construction costs £/kW	High	3800		
	Medium	1300				Medium	3300		
	Low	1100				Low	2700		
Fixed O+M £/MW/yr	Medium	25000			Fixed O+M £/MW/yr	Medium	134800		
Variable O+M £/MWh	Medium	2			Variable O+M £/MWh	Medium	2		
Insurance £/MW/yr	Medium	4600			Insurance £/MW/yr	Medium	5100		
Connection and Use of System charges £/MW/yr	Medium	6800			Connection and Use of System charges £/MW/yr	Medium	8800		

⁸¹ This table has been updated from the July 2013 Electricity Generation Costs report to reflect changes to offshore wind learning profiles and an updated range for CCGT costs, please see page 12 for more details.

Coal - ASC with oxy combustion CCS - FOAK				Nuclear - FOAK				
Commissioning				Commissioning				
2025				2020				
Pre-development	High	45		Pre-development	High	470		
£/kW	Medium	25		£/kW	Medium	210		
	Low	20			Low	110		
Construction costs	High	2500		Construction costs	High	4600		
£/kW	Medium	2200		£/kW	Medium	4100		
	Low	2000			Low	3700		
Fixed O+M				Fixed O+M				
£/MW/yr	Medium	56900		£/MW/yr	Medium	72000		
Variable O+M				Variable O+M				
£/MWh	Medium	2		£/MWh	Medium	3		
Insurance				Insurance				
£/MW/yr	Medium	3400		£/MW/yr	Medium	10000		
Connection and Use of System charges				Connection and Use of System charges				
£/MW/yr	Medium	8800		£/MW/yr	Medium	7400		
CCGT CHP				Co-firing Standard CHP				
Commissioning				Commissioning				
2016 2017 2020				2016 2017 2020				
Pre-development	High	75	75	75	Pre-development	High		
£/kW	Medium	50	50	50	£/kW	Medium	<i>Included in Construction cos</i>	
	Low	30	30	30		Low		
Construction costs	High	700	700	700	Construction costs	High		
£/kW	Medium	600	600	600	£/kW	Medium	4300	4300
	Low	500	500	500		Low	4300	4300
Fixed O+M					Fixed O+M			
£/MW/yr	Medium	46300	46300	46300	£/MW/yr	Medium	260000	260000
Variable O+M					Variable O+M			
£/MWh	Medium	0.1	0.1	0.1	£/MWh	Medium	2	2
Insurance					Insurance			
£/MW/yr	Medium	2000	2000	2000	£/MW/yr	Medium	<i>Included in fixed O+M</i>	
Connection and Use of System charges					Connection and Use of System charges			
£/MW/yr	Medium	6700	6700	6700	£/MW/yr	Medium	<i>Included in fixed O+M</i>	

ACT Advanced					ACT standard				
Commissioning					Commissioning				
		2016	2017	2020			2016	2017	2020
Pre-development	High	1000	1000	1000	Pre-development	High	1005	1005	1005
£/kW	Medium	410	410	410	£/kW	Medium	360	360	360
	Low	170	170	170		Low	165	165	165
Construction costs	High	6900	6800	6600	Construction costs	High	10100	10000	9800
£/kW	Medium	6800	6700	6500	£/kW	Medium	5600	5500	5400
	Low	5100	5000	4900		Low	900	900	900
Fixed O+M					Fixed O+M				
£/MW/yr	Medium	414800	410900	399500	£/MW/yr	Medium	426000	422000	410000
Variable O+M					Variable O+M				
£/MWh	Medium	13	13	13	£/MWh	Medium	25	25	25
Insurance					Insurance				
£/MW/yr	Medium	21900	21700	21050	£/MW/yr	Medium	21890	21680	21070
Connection and Use of System charges					Connection and Use of System charges				
£/MW/yr	Medium	<i>Included in fixed O+M</i>			£/MW/yr	Medium	5570	5520	5360
Dedicated biomass >50MW					Dedicated biomass 5-50MW				
Commissioning					Commissioning				
		2016	2017	2020			2016	2017	2020
Pre-development	High	40	40	40	Pre-development	High	110	110	110
£/kW	Medium	30	30	30	£/kW	Medium	95	95	95
	Low	15	15	15		Low	40	40	40
Construction costs	High	4600	4600	4500	Construction costs	High	5100	5000	4900
£/kW	Medium	2500	2500	2400	£/kW	Medium	3600	3500	3500
	Low	2000	2100	2000		Low	2500	2500	2500
Fixed O+M					Fixed O+M				
£/MW/yr	Medium	96500	95900	94400	£/MW/yr	Medium	112000	111000	109000
Variable O+M					Variable O+M				
£/MWh	Medium	5	5	5	£/MWh	Medium	5	5	5
Insurance					Insurance				
£/MW/yr	Medium	14320	14240	14020	£/MW/yr	Medium	16600	16500	16200
Connection and Use of System charges					Connection and Use of System charges				
£/MW/yr	Medium	1380	1370	1350	£/MW/yr	Medium	1600	1600	1600

Onshore >5 MW					Offshore Round 2				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High	240	240	240	Pre-development £/kW	High	120	120	120
	Medium	100	100	100		Medium	70	70	70
	Low	30	30	30		Low	50	50	50
Construction costs £/kW	High	1800	1800	1700	Construction costs £/kW	High	2900	2800	2700
	Medium	1500	1500	1400		Medium	2500	2400	2300
	Low	1100	1100	1100		Low	2100	2000	1900
Fixed O+M £/MW/yr	Medium	37100	37100	37100	Fixed O+M £/MW/yr	Medium	62800	60400	54500
Variable O+M £/MWh	Medium	5	5	5	Variable O+M £/MWh	Medium	2	2	2
Insurance £/MW/yr	Medium	3000	3000	3010	Insurance £/MW/yr	Medium	11500	11100	10000
Connection and Use of System charges £/MW/yr	Medium	4500	4500	4510	Connection and Use of System charges £/MW/yr	Medium	45900	44200	39800
Offshore Round 3					Bioliquids				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High	150	150	150	Pre-development £/kW	High	1040	1040	1040
	Medium	105	105	105		Medium	180	180	180
	Low	50	50	50		Low	30	30	30
Construction costs £/kW	High	3100	3000	2900	Construction costs £/kW	High	1900	1900	1900
	Medium	2600	2500	2400		Medium	800	800	800
	Low	2200	2100	2000		Low	500	500	500
Fixed O+M £/MW/yr	Medium	70900	66900	57700	Fixed O+M £/MW/yr	Medium	120900	120600	120000
Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>			Variable O+M £/MWh	Medium	6	7	8
Insurance £/MW/yr	Medium	32800	31000	26700	Insurance £/MW/yr	Medium	4900	4900	4800
Connection and Use of System charges £/MW/yr	Medium	60600	57200	49300	Connection and Use of System charges £/MW/yr	Medium	12000	11900	11900

Bioliqids CHP					Cofiring Conventional				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development	High	1000	1000	1000	Pre-development	High	7	7	7
£/kW	Medium	180	180	180	£/kW	Medium	5	5	5
	Low	30	30	30		Low	2	2	2
Construction costs	High	2000	2000	2000	Construction costs	High	170	170	160
£/kW	Medium	800	800	800	£/kW	Medium	120	120	120
	Low	500	500	500		Low	40	40	40
Fixed O+M					Fixed O+M				
£/MW/yr	Medium	121000	120700	120200	£/MW/yr	Medium	10100	10100	10200
Variable O+M					Variable O+M				
£/MWh	Medium	6	7	8	£/MWh	Medium	1	2	3
Insurance					Insurance				
£/MW/yr	Medium	4900	4900	4800	£/MW/yr	Medium	900	900	900
Connection and Use of System charges					Connection and Use of System charges				
£/MW/yr	Medium	12000	12000	11900	£/MW/yr	Medium	9200	9200	9200
Cofiring Enhanced					Biomass conversion				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development	High	60	60	60	Pre-development	High	60	60	60
£/kW	Medium	60	60	60	£/kW	Medium	60	60	60
	Low	60	60	60		Low	60	60	60
Construction costs	High	700	700	700	Construction costs	High	700	700	700
£/kW	Medium	400	400	400	£/kW	Medium	400	400	400
	Low	300	300	300		Low	300	300	300
Fixed O+M					Fixed O+M				
£/MW/yr	Medium	40900	41000	41000	£/MW/yr	Medium	40900	41000	41000
Variable O+M					Variable O+M				
£/MWh	Medium	1	2	3	£/MWh	Medium	1	2	3
Insurance					Insurance				
£/MW/yr	Medium	1300	1300	1300	£/MW/yr	Medium	1300	1300	1300
Connection and Use of System charges					Connection and Use of System charges				
£/MW/yr	Medium	17500	17500	17500	£/MW/yr	Medium	17500	17500	17500

Wave			Tidal stream shallow		
Commissioning 2025			Commissioning 2025		
Pre-development £/kW	High	130	Pre-development £/kW	High	
	Medium	110		Medium	<i>Included in construction costs</i>
	Low	100		Low	
Construction costs £/kW	High	4700	Construction costs £/kW	High	3100
	Medium	4500		Medium	2700
	Low	3800		Low	2000
Fixed O+M £/MW/yr	Medium	97800	Fixed O+M £/MW/yr	Medium	143300
Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>	Variable O+M £/MWh	Medium	1
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>	Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>
Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>	Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>
Tidal stream deep			Tidal range		
Commissioning 2025			Commissioning 2025		
Pre-development £/kW	High		Pre-development £/kW	High	
	Medium	<i>Included in construction costs</i>		Medium	<i>Included in construction costs</i>
	Low			Low	
Construction costs £/kW	High	3600	Construction costs £/kW	High	3800
	Medium	3200		Medium	3000
	Low	2700		Low	2200
Fixed O+M £/MW/yr	Medium	114000	Fixed O+M £/MW/yr	Medium	38000
Variable O+M £/MWh	Medium	1	Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>	Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>
Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>	Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>

Hydropower 5-16MW					Hydro Large Storage				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High Medium Low	50	50	50	Pre-development £/kW	High Medium Low	55	55	55
Construction costs £/kW	High Medium Low	3100	3100	3300	Construction costs £/kW	High Medium Low	3400	3400	3600
Fixed O+M £/MW/yr	Medium	43500	43600	43700	Fixed O+M £/MW/yr	Medium	24800	24800	24900
Variable O+M £/MWh	Medium	10	11	12	Variable O+M £/MWh	Medium	6	7	8
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>			Insurance £/MW/yr	Medium	900	900	900
Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>			Connection and Use of System charges £/MW/yr	Medium	7300	7300	7400
Sewage Gas					Landfill				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High Medium Low	<i>Included in construction costs</i>			Pre-development £/kW	High Medium Low	210	210	210
Construction costs £/kW	High Medium Low	5900	5900	5800	Construction costs £/kW	High Medium Low	3400	3400	3300
Fixed O+M £/MW/yr	Medium	101000	101000	101000	Fixed O+M £/MW/yr	Medium	59600	59600	59700
Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>			Variable O+M £/MWh	Medium	10	11	12
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>			Insurance £/MW/yr	Medium	1300	1300	1300
Connection and Use of System charges £/MW/yr	Medium	8700	8700	8700	Connection and Use of System charges £/MW/yr	Medium	5100	5100	5100

Energy from Waste					Energy from Waste CHP				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High				Pre-development £/kW	High			
	Medium	<i>Included in construction costs</i>				Medium	<i>Included in construction costs</i>		
	Low					Low			
Construction costs £/kW	High	5200	5200	5100	Construction costs £/kW	High	6900	6900	6800
	Medium	4900	4900	4800		Medium	6200	6200	6100
	Low	4500	4500	4500		Low	5500	5500	5400
Fixed O+M £/MW/yr	Medium	222000	222000	222000	Fixed O+M £/MW/yr	Medium	269000	269200	269600
Variable O+M £/MWh	Medium	25	25	25	Variable O+M £/MWh	Medium	30	30	30
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>			Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>		
Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>			Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>		
Geothermal					Geothermal CHP				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High	300	300	300	Pre-development £/kW	High	240	240	240
	Medium	140	140	140		Medium	140	140	140
	Low	50	50	50		Low	50	50	50
Construction costs £/kW	High	6700	6300	5900	Construction costs £/kW	High	7300	6800	6400
	Medium	4600	4400	4100		Medium	5100	4800	4500
	Low	2300	2200	2000		Low	2600	2500	2300
Fixed O+M £/MW/yr	Medium	35800	35800	35800	Fixed O+M £/MW/yr	Medium	34200	34200	34200
Variable O+M £/MWh	Medium	10	10	10	Variable O+M £/MWh	Medium	10	11	12
Insurance £/MW/yr	Medium	71500	71500	71700	Insurance £/MW/yr	Medium	77100	77100	77200
Connection and Use of System charges £/MW/yr	Medium	2000	2000	2000	Connection and Use of System charges £/MW/yr	Medium	1900	1900	1900

Biomass CHP					AD				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development	High				Pre-development	High	580	580	580
£/kW	Medium	<i>Included in construction costs</i>			£/kW	Medium	180	180	180
	Low					Low	50	50	50
Construction costs	High	5000	5000	4900	Construction costs	High	7200	7200	7000
£/kW	Medium	3900	3800	3800	£/kW	Medium	4000	3900	3900
	Low	2700	2700	2700		Low	1700	1700	1700
Fixed O+M					Fixed O+M				
£/MW/yr	Medium	149900	149100	146700	£/MW/yr	Medium	301000	301000	301000
Variable O+M					Variable O+M				
£/MWh	Medium	10	11	12	£/MWh	Medium	30	30	30
Insurance					Insurance				
£/MW/yr	Medium	25400	25300	24900	£/MW/yr	Medium	58000	58100	58200
Connection and Use of System charges					Connection and Use of System charges				
£/MW/yr	Medium	1400	1400	1400	£/MW/yr	Medium	8700	8700	8700
AD CHP					ACT CHP				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development	High				Pre-development	High	90	90	90
£/kW	Medium	<i>Included in construction costs</i>			£/kW	Medium	90	90	90
	Low					Low	90	90	90
Construction costs	High	7200	7200	7000	Construction costs	High	10600	10500	10300
£/kW	Medium	4200	4200	4100	£/kW	Medium	5900	5800	5700
	Low	1800	1800	1800		Low	1000	1000	900
Fixed O+M					Fixed O+M				
£/MW/yr	Medium	364000	364000	365000	£/MW/yr	Medium	425800	421800	410000
Variable O+M					Variable O+M				
£/MWh	Medium	20	20	20	£/MWh	Medium	10	11	12
Insurance					Insurance				
£/MW/yr	Medium	58000	58100	58200	£/MW/yr	Medium	21900	21700	21100
Connection and Use of System charges					Connection and Use of System charges				
£/MW/yr	Medium	8700	8700	8700	£/MW/yr	Medium	5600	5500	5400

Large scale solar PV					Solar <4kW				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High				Pre-development £/kW	High			
	Medium	<i>Included in construction costs</i>				Medium	<i>Included in construction costs</i>		
	Low					Low			
Construction costs £/kW	High	1100	1100	900	Construction costs £/kW	High	2500	2400	2100
	Medium	1000	1000	900		Medium	1900	1800	1600
	Low	900	900	800		Low	1500	1400	1300
Fixed O+M £/MW/yr	Medium	22600	22400	21900	Fixed O+M £/MW/yr	Medium	23700	23600	23500
Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>			Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>		
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>			Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>		
Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>			Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>		
Onshore 1MW<5MW					Onshore <15kW				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High				Pre-development £/kW	High			
	Medium	<i>Included in construction costs</i>				Medium	<i>Included in construction costs</i>		
	Low					Low			
Construction costs £/kW	High	2300	2300	2300	Construction costs £/kW	High	6100	6100	6100
	Medium	2000	2000	2000		Medium	5500	5500	5500
	Low	1600	1600	1600		Low	5000	5000	5000
Fixed O+M £/MW/yr	Medium	29600	29400	29000	Fixed O+M £/MW/yr	Medium	73000	73000	73000
Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>			Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>		
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>			Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>		
Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>			Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>		

AD < 250kW					AD > 500kW				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High Medium Low	<i>Included in construction costs</i>			Pre-development £/kW	High Medium Low	<i>Included in construction costs</i>		
Construction costs £/kW	High Medium Low	8000 6000 4000	8000 6000 4000	8000 6000 4000	Construction costs £/kW	High Medium Low	6000 4500 3000	6000 4500 3000	6000 4500 3000
Fixed O+M £/MW/yr	Medium	924000	924000	924000	Fixed O+M £/MW/yr	Medium	714800	714800	714800
Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>			Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>		
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>			Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>		
Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>			Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>		
Hydropower 100kW-1000kW					Hydropower <15kW				
		Commissioning					Commissioning		
		2016	2017	2020			2016	2017	2020
Pre-development £/kW	High Medium Low	<i>Included in construction costs</i>			Pre-development £/kW	High Medium Low	<i>Included in construction costs</i>		
Construction costs £/kW	High Medium Low	10000 4500 2000	10000 4500 2000	10000 4500 2000	Construction costs £/kW	High Medium Low	21400 9500 4200	21400 9500 4200	21400 9500 4200
Fixed O+M £/MW/yr	Medium	104000	104000	104000	Fixed O+M £/MW/yr	Medium	110000	110000	110000
Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>			Variable O+M £/MWh	Medium	<i>Included in fixed O+M</i>		
Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>			Insurance £/MW/yr	Medium	<i>Included in fixed O+M</i>		
Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>			Connection and Use of System charges £/MW/yr	Medium	<i>Included in fixed O+M</i>		

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