Department for
Business, Energy
& Industrial Strategy

EVALUATION OF THE CONTRACTS FOR DIFFERENCE SCHEME

[Phase 1: Allocation Rounds 1 & 2]

Annexes

June 2019

Contents

Annex A: Methodology

Evaluation Aims and Objectives

The evaluation aims to assess the extent to which the Contracts for Difference (CfD) Scheme is meeting its intended objectives, and to identify how and why any intended and unintended outcomes are being realised for different technologies and developers. The evaluation will provide an evidence base that can inform the ongoing design and development of the Scheme and related low carbon generation schemes, as well as providing a better understanding of participation and operating costs and investment risks to improve BEIS modelling of renewable generation technologies. The evaluation fed into the statutory five-year review of the Electricity Market Reform (EMR) Programme, which the CfD formed part.

In doing so, the evaluation will answer five High-level-Questions:

1. To what extent, how and why is the CfD Scheme contributing to its intended objectives, and do its outcomes, both intended and unintended, differ for different groups (project developers, investors, technology types)?

2. Are the design parameters of the CfD Scheme and auction allocations appropriate for achieving the intended objectives?

3. Is the CfD Scheme being delivered as intended?

4. Does the CfD scheme present good value for money?

5. What are the implications of the findings for the future contribution of renewable technology to the Electricity Market?

The ITT set out a series of sub-questions under each of the five High-Level Questions. These are listed, alongside a description of each will be addressed through various strands of data collection, in Annex G: Evaluation Questions.

Theoretical Approach to the Evaluation

Addressing these questions requires a mix of impact, process and economic evaluation. The evaluation is theory-based. This started with developing a detailed Theory of Change (See Annex C) for the CfD Scheme to set out (pre-fieldwork) understanding of the flow of cause and effect between how **inputs** and **activities** (e.g. Government regulations, Budget Allocation and actions by Delivery Bodies to administer the Scheme) lead to their expected **outputs** (such as number of new contracts signed to deliver renewable projects), **outcomes** (increased renewable electricity generation) and longer-term **impacts** (such as more cost-effective clean electricity supply and reduced carbon emissions).

Adopting principles of a realist approach, the overall programme Theory of Change (ToC) was refined to explore not only what outcomes and impacts are expected to be achieved, but to understand the causal pathways of *how* they were achieved, and how this may be driven by differences in **contexts**. This was key to assessing the extent to which the Scheme is on track to deliver upon its objectives, and if not, *why* not.

Realist evaluation is concerned with unravelling the "inner mechanisms" at work in different contexts. As described by Barbara Befani (2016[1]), this entails refining the ToC into one or more Context-Mechanism-Outcome (CMO) configurations, where **Contexts** are made of resources, opportunities and constraints available to the beneficiaries; **Mechanisms** are choices, reasoning or decisions that individuals take based on the resources available in their context; and **Outcomes** are the product of individuals' behaviour and choices. Annex C refines the overall programme's Theory of Change (ToC) into a series of Context Mechanism Outcome (CMO) configurations.

Addressing some of the Evaluation Questions in this mixed methods study did not require a realist approach. For example, addressing the question; "*Have CfDs which were allocated via auction rounds reduced the impact of renewable deployment on consumer bills relative to the Renewables Obligation*?" was based primarily on **economic analysis** and statistical modelling techniques to estimate the overall costs and benefits of the Scheme compared to a modelled counterfactual scenario of continued RO support. This method for assessing overall aggregate impacts of the Scheme may be considered more "positivist" than "realist" but is fit for purpose in terms of addressing the question.

In addition, some of the more exploratory **process evaluation** questions did not require development of pre-defined theories, or CMOs, in advance of fieldwork and then testing. For example, when exploring; "*What improvements can be made to the developer journey through the CfD application and delivery process*?" respondents were asked open ended questions to discuss their experiences of the application process to share their unprompted views on what aspects worked well, or not so well, and why. Here the analysis of findings was based around a 'bottom-up' approach to coding and grouping the range of themes emerging and then exploring how these varied by context (rather than a top-down assessment of whether the findings confirm or refute a pre-defined CMO configuration about the application process). This approach to addressing such questions may be considered more "constructivist" than realist (See table 8 below).

A realist approach added value in addressing the High-Level Questions around the extent to which the Scheme is meeting its objectives, why and in which contexts. For example, in assessing whether the Scheme lowered risks for investors and reduced costs of capital, we developed pre-fieldwork CMO theories to consider which aspects of the Scheme are more attractive than the RO for investors (e.g. price stabilisation), how these may affect

[1] Choosing Appropriate Evaluation Methods: A Tool for Assessment and Selection, October 2016. Bond.

investment decisions and how this might vary by context (e.g. what stage a project is at in its development). Interviews with developers were used to test the extent to which these CMO theories held true and provided insights into other types of context that affected developer's decisions, which had not previously been captured in the pre-fieldwork CMOs.

The mixed methods used in the evaluation therefore adopted elements of constructivist, positivist and realist approaches to address each evaluation in the most fit for purpose way. Table 8 below provides a brief overview of these three approaches.

	Constructivism	Positivism	Realist
Philosophical underpinning	The real world is constructed, since our observations are shaped and filtered through human senses. It is not possible to know for certain what the nature of reality is	The real world is independent from the researcher, from which we can directly observe and derive "facts"'	Acknowledges that all enquiry and observation are shaped and filtered through the human senses, therefore, no such thing as 'final' truth. Nonetheless it is possible to work towards a closer understanding of the nature of reality
Research Methods	Qualitative	Quantitative	Mixed
Types of questioning	Open-ended questions, analysis of narrative, text and/or image data	Closed questions, pre-determined approaches, numeric data	Both, open and closed questions and both qualitative and quantitative data analysis
Research Practices	Studies the context or setting of participants Constructs meaning from the experience of participants Involves researcher in collaborating with participants Validates the accuracy of findings	Observes and then measures information numerically Tests or verifies theories or explanations Employs statistical procedures to assess overall outcomes	Develops a rationale for mixing methods Assumes that nothing works everywhere or for everyone, and that **context** makes a difference to programme outcomes Tests or verifies pre-defined theories and then refines these in response to emerging findings

Table 1. Theoretical approaches evaluation. Adapted from Realist Impact Evaluation, an Introduction. Methods Lab.Gill Westhorp 2014

Overall Approach to Developing and Testing the Theory of Change

Contribution Analysis (See John Mayne 2012[2]) is an approach designed to reduce uncertainty about the contribution an intervention is making to **observed results** over and above other influencing factors. Our methods of economic analysis for estimating future (unobservable) impacts are not an example of Contribution Analysis. However, our step-by-step process for developing, testing and refining the Scheme's Theory of Change of how it will lead to intended outcomes was broadly informed by Mayne's (2012) six steps Framework to test and develop a theory of change. As summarised below:

1. **Setting out the cause-effect problem to be addressed**: This step involves identifying the key outcomes and impacts that the programmes intend to improve or change, with a clear rationale. The 'attribution problem' we address is the extent to which intended outcomes, such as reduced cost of capital for investing in renewable energy projects, can be attributed to the Scheme, or would have happened anyway.

2. **Develop a Theory of Change (ToC)**: The CfD Evaluation Feasibility Study led by UCL (2017) provided an initial draft programme level Theory of Change and Policy Map for the Scheme (see Annex C).

3. **Populating the Theory of Change with existing data and evidence**: This step involved gathering existing evidence about the theory of change, with further consideration of the underlying assumptions, risks and other external influencing factors. Evidence from the three Scoping Stage work strands was used to further develop and refine the draft ToC developed by UCL (see Annex C) and break this down into a series of CMOs.

4. **Assemble and assess the intervention logic**: This step develops the use of new research to assess the intervention logic in reality. For example, the primary research interviews with CfD contracted project developers. The findings will help develop potential alternative explanations for the gross outcomes observed and identify weaknesses in the intervention logic i.e. where causal links are not supported by evidence. In this study, this stage provided a first assessment of the draft CMOs and highlighted areas where they need further refinement.

5. **Seek out additional evidence:** Following the Phase 1 round of primary research and analysis we will undertake a review of the intervention logic, to develop a refined ToC and CMOs based upon our new understanding of the key contextual factors which influence outcomes. This will also identify any new sources of evidence or that may be needed to strengthen the ToC in future research (following evaluation of Allocation Round 3 in 2020).

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[2] *Contribution Analysis: Coming of Age*? Evaluation 2012 18: 270. Sage

6. **Revise and strengthen our understanding of the intervention logic**: As new evidence becomes available the claims made by the theory can be tested and refined in an iterative process. A Syntheses Phase in 2020 will triangulate results across all strands of the evaluation, to revisit the Scheme's initial ToC and CMOs and assess whether the programme has worked as expected to achieve its anticipated outcomes and intended objectives. This will also provide an assessment of how differences in context for scheme participants effect outcomes and why.

Developing Context Mechanism Outcome configurations (CMOs)

To scope out how CMOs may be applied to refine the ToC for CfD Scheme, a workshop was held in July 2018 with BEIS CfD policy and analyst leads to discuss the contexts which may influence differences in how scheme participants respond to the Scheme design. This brainstormed questions such as:

- How might differences in context affect how developers respond to the Scheme? For example, by differences in the developer's previous experience, the financial structure of the project, or by different types of technologies and scale/capacity of generation unit?

- How might different types of financial investor respond differently to the Scheme and why?

The starting point was to first create a prioritised list of outcomes that are within scope for the evaluation. To do so, outcomes were categorised under three high level objectives for the Scheme, as follows:

1. Give investors the confidence they need to invest, attracting greater investment at a lower cost of capital and from a wider pool of sources.

2. Decarbonise electricity supply at least cost - minimise risk of overcompensation and ensure value for money for consumers.

3. Make the Scheme attractive to broader range of clean energy developers (securing investment both in proven technologies, as well as less mature technologies).

The purpose of the workshop was to develop an initial long-list of contexts and mechanisms which may influence achievement of outcomes. At this stage they were tabulated, without making attempts to define causal links between each.

Following a review of findings emerging from our scoping stage outputs, plus key informant interviews, this list of CMOs was refined, alongside descriptions of sub-group theories around the contextual factors that may lead to programme participants responding to the Scheme's design in different ways. Flow chart diagrams illustrating these causal linkages can be found at Annex C.

The CMOs have been developed under the three broad categories of Scheme objectives that were agreed at the workshop. This provides a clear line of sight between the context level theories of change that the evaluation will explore and how these relate to assessing whether, how and why the Scheme is delivering upon its priority objectives.

As discussed in the section on CMOs below, the development, testing and refinement of CMOs is an iterative process. The first iteration of pre-analysis stage draft CMOs were intended to be fairly high-level overview of the key influencing factors that may affect outcomes rather than a fully scoped-out and exhaustive list of all relevant contexts. The findings from this Phase 1 stage of the evaluation provided new evidence to suggest that other contextual factors which were not explicitly stated in the draft CMOs were important in influencing how different groups of developers responded to the scheme, leading to difference in outcomes. For example, whether the developer had participated in AR1 as well as AR2, whether they are part of a large multi-national development firm with an international portfolio of renewable development projects, and whether they developed more than one type of technology. Development work in advance of Phase 2 fieldwork will take account of these findings to revise the CMOs and overall programme theories of change.

Phase 1 Data Collection and Analysis

Primary research interviews with scheme participants and wider stakeholders formed a central component of new data collection for the evaluation. This will be used to test and refine the draft theories of change and CMOs, as well as provide evidence to address several of the wider evaluation questions that are not explicitly linked to testing CMOs. This includes face-to-face and semi-structured qualitative telephone interviews, plus a quantitative online survey, covering each stakeholder group specified in the ITT.

Phase 1 of the evaluation carried out research with the groups of stakeholders outlined in the table below:

Stakeholder Group	Primary method for engagement
Developers of projects with CfDs	Interviews, Survey
Non-CfD parties (e.g. those with the potential to obtain CfD but didn't, for reasons such as failure at auction or not engaging with the scheme at all)	Interviews
Investors in projects with CfDs	Interviews, Survey

Stakeholder Group	Primary method for engagement
Developers of near-market technologies (those at technology-readiness level 7)	Interviews (sub-group of interviews with developers with and without a CfD).
UK based academic experts	Peer-Review
Statutory bodies responsible for CfD delivery (LCCC, National Grid, BEIS, Ofgem and BEIS policy officials).	Scoping stage interviews

Table 2. Stakeholder groups covered in research

In addition to primary research interviews, we have also made use of a range of secondary data sources, including:

- **Programme administrative data** on outcomes arising from CfD Allocation Rounds 1 and 2. Including the CfD Register[3] and other administrative records held by LCCC on progress with the development of generation units, the proportion that are meeting Milestone Delivery Dates, Target Commissioning Window, their forecast capacity, strike prices and the value of subsidy payments.

- **The Renewable Energy Planning Database[4]** – to gather information on the wider profile of generation units under development in the UK. This was used to identify projects which received planning permission and may, in theory, be eligible for a CfD but do not have one (as a sample group of potential unsuccessful applicants).

- **Bloomberg Terminal data** – to gather information on the financial structure of generation units, their total cost, the profile of investors and any information on asset level financial transactions that may be used to gather evidence on costs of capital (for example, an amount loaned to a project and its interest rate).

  The Bloomberg Terminal is a computer software system provided by the financial data vendor Bloomberg L.P[5]. Through purchasing a license, this provides users

[3] Current and historical CFD Register data. Low Carbon Contracts Company. Available at: https://www.lowcarboncontracts.uk/download-current-and-historical-cfd-register-data

[4] Renewable Energy Planning Database quarterly extract. BEIS. Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

[5] Bloomberg Terminal. See: https://www.bloomberg.com/professional/solution/bloomberg-terminal/

with access to real-time global financial market data, such as stock market trends, investment deals across a range of industries and company level financial information. This was used to assess the profile of the parent companies of equity owners of CfD and RO renewable projects (at the time of financial close of the project). Bloomberg datasets are largely compiled from datasets of various other publicly disclosed company accounts and trade deals. For some projects, equity ownership is not disclosed, therefore, the full profile of ownership is not known.

- **Online published information on project background** – prior to interviewing representatives of each CfD development unit, we carried out a brief online search to gather background information about each project's development, such as; who the parent company / lead developer is, their level of experience in developing similar projects in the UK and internationally, whether ownership has changed hands, the length of time the project has been under development, any known barriers to development (e.g. a public campaign against a solar park). This will be used to develop brief pen portraits of each generation unit in advance of interviewing in order to understand any relevant contextual factors and likely issues to investigate.

The project was arranged around delivering a series of Work Packages (WP), as briefly summarised below. This began with a series of three Scoping Phase Strands (CfD Scheme Composition Analysis, a Rapid Evidence Assessment of existing literature and a report with results of Analysis of Renewable Energy Investment trends (based primarily on Bloomberg Terminal data), as outlined below:

WP 1.2.1. CfD Scheme Composition Analysis - This work package provided an initial analysis to date of the levels of electricity generation that CfD contracted projects are forecast to deliver. This provided an initial assessment of the sub questions of HLQ1 around a) *What capacity is on track to be delivered within agreed milestones, and how much has been invested in it? And b) To what extent has CfD contributed to meeting the 2020 renewables targe*t?

Firstly, this assessed the volume of electricity generation capacity that has been delivered (based on the CfD register) compared to that under the RO (RO Certificates register), highlighting any capacity that is behind agreed milestones, has been terminated or has chosen not to sign the contract. Secondly, modelling outputs of each technology provided a breakdown of what this means in terms of expected renewable generation by 2020 and 2030, broken down into RO and CfD auction capacity. This showed the overall contribution of CfDs to the 2020 and 2030 renewables targets, and the likelihood of the targets being met.

WP 1.2.2 Analysis of renewable energy investment trends – Through analysis of existing secondary data sources (primarily the Bloomberg Terminal[6]) this strand provided an analysis of trends in renewable investment over time, since 2004-2018 to assess whether different types of firms have begun investing more/less in different technologies since the CfD Scheme was introduced. It includes breakdowns of the characteristics of institutions providing financial investment in CfD projects and non-CfD renewable projects (with Renewables Obligation Certificates) of comparable type and scale.

WP 1.4 Rapid Evidence Assessment (REA) - The REA was used to consolidate existing evidence on the extent to which the CfD is delivering against its objectives, or ways in which processes for delivery may be improved. This strand reviewed international literature to give examples of how the design of renewable energy auctions has influenced the type of outcomes obtained. The REA addressed the following two research questions:

- *What does existing evidence tell us about how renewable energy auction design affects intended outcomes, around: encouraging investment in and increasing supply of renewable electricity, lowering technology and support costs?*
- *What implications do wider international trends in renewable energy investment and technology cost have on the continued use of auctions in the future?*

These Scoping Stage reports have been provided as separate Appendices.

Following this desk-based review of existing evidence, we then began Phase 1 fieldwork interviews with groups of key stakeholders, as outlined below.

WP2.1. Interviews with CfD Delivery Bodies – Prior to mainstage fieldwork with renewable project developers, an initial round of face-to-face interviews was carried out with CfD Scheme policy leads and representatives of delivery partner organisations. This built our understanding of the Scheme's design, it's intended policy objectives and the details involved in processes for delivering the Scheme, including the roles of different delivery bodies. This stage was used to refine our Theories of Change before testing whether these align with the views of scheme participants and outcomes arising. Eight key informant interviews were carried out in total, covering representatives of; CfD policy and analyst leads in BEIS, LCCC, Ofgem and the National Grid.

WP2.2. expert academic peer review and advice –. A draft survey questionnaire and analysis plan for estimating change in hurdle rates was sent for expert peer review in September 2018. Professor Derek Bunn and Professor Ania Zalewska (who provided peer review for the previous NERA 2015 study to estimate hurdle rates for DECC) provided comments and the questionnaire was amended accordingly (as detailed in separate

[6] The Bloomberg Terminal is a computer software system provided by the financial data vendor Bloomberg L.P. that enables analysis of real-time financial market data.

papers). The overall evaluation approach was also peer reviewed by Professor Barbara Befani and Charles Michaelis. This second peer review had a particular focus on the realist elements of the evaluation such as the approach to developing and testing CMOs.

WP2.3. Interviews with Round 1 and 2 project developers – We aimed to carry out semi-structured telephone interviews with representatives of all 34 developer organisations who were successfully awarded the 38 contracts in Allocation Rounds one and two (AR1 and AR2). These in-depth interviews lasted between 45 and 90 minutes, with an average of around 1 hour. The topic guide can be found in Annex D. Due to some non-response, we achieved interviews with developers of 23 of the CfD projects. Some developer firms held contracts for more than one CfD generation unit. In addition, some contracted 'projects' were phased over time, splitting them into 3 individual generation units (common for large Offshore Wind projects). In these cases, interviews were used to gather information on more than project and generation unit per interview. Hence, the interviews had a total coverage of 31 individual CfD generations units.

In advance of the interviews, the recruitment emails provided a description of the aims of the evaluation in terms of assessing the extent to which the CfD scheme is meeting its objectives and a summary of what the key objectives are. This was a starting point in prompting respondents to consider whether the scheme's theory of change is being delivered as intended. The recruitment emails also provided an overview of what topics would be covered in the interview. Including their experience of the CfD application process, the financial structure of the project and extent to which implementation of the generation unit is on track). Experience and insight on these topics are often held by people with different roles e.g. Financial Officer or overall Project Manager so we clarified in advance of interviews that we would like to speak to more than one person if required to give views on these issues. The interviews often included more than one knowledgeable person from the developer's firm or consortium in order to cover as much of their experience of participation in the scheme as possible.

As outlined in Table 9 below, the profile of those interviewed reflected a good spread of different types of CfD participants, in terms of types of technology, stage of project development, AR1 and AR2. It also included interviews with developers which had been successful at auction but refused their contracts (due to the strike price offered) or had their CfD terminated due to inability to meet Milestone Delivery Dates. Despite recruitment efforts it was not possible to achieve interviews with any of the four developers of the Dedicated Biomass with CHP and Energy from Waste with CHP technologies. However, some representatives from developers of these technologies were captured through the survey and the interviews with non-CfD developers (see section below).

Technology	AR 1 Projects covered through interviews (Total awarded projects in brackets)	AR 2 Projects covered by interviews (Total awarded projects in brackets)	Total projects covered by interviews (Total awarded projects in brackets)
Advanced Conversion Technologies	1 (3)	4 (6)	**5 (9)**
Dedicated Biomass with CHP	0 (0)	0 (2)	**0 (2)**
Energy from Waste with CHP	0 (2)	0 (0)	**0 (2)**
Offshore wind	2 (2)	3 (3)	**5 (5)**
Onshore wind	10 (15)	0 (0)	**10 (15)**
Solar	3 (5)	0 (0)	**3 (5)**
Total development projects covered through interviews	16 (27)	7 (11)	**23 (38)**

Table 3. Overview of interviews with Developers awarded a CfD contract

Non-respondents - 15 CfD projects could not be covered through the interviews since they did not respond to invitations to participate. 11 non-respondents were AR1 projects and 4 from AR2. Overall, 7 of the 15 non-responding projects have faced issues with implementation of their CfD projects. This includes not signing their contract; delays due to construction, financial, or environmental impact challenges; and the termination of their CfDs. All but one project were small projects below 50MW capacity.

All 4 dedicated Biomass with CHP and EfW with CHP projects did not respond. However, as outlined above, interviews were carried out with some developers of these technologies through the sample of developers without a CfD. Overall, there appears to have been some increased reluctance to being interviewed among projects which did not sign the CfD or if the project has been terminated or is currently not on track to be delivered. However, 3 interviews were conducted with representatives of terminated and not-signed CfD projects, so these groups were not entirely excluded.

The interview data has been used to address a range of evaluation questions, including process evaluation questions around ways in which Scheme design may be improved, as well as to gather various points of information to inform our economic analysis, including insight into the impact of the scheme in reducing risks for developing projects in the UK and associated hurdle rates when making investment decisions.

WP2.4. Interviews with non-participating renewable energy developers – In addition to the interviews with developers who held a CfD, 17 semi-structured telephone interviews were carried out with wider developers of renewable electricity generation units in the UK who do not have a CfD contract (either because of failure at auction or because they had not applied to the CfD Scheme at all).

The Renewable Energy Planning Database was used as a sampling frame to select a sub-group of projects that have gained planning permission over the last 5 years but do not have a CfD. An initial sample of 196 companies was drawn from this database based on the criteria of having received RO support in the past or having project permission for projects larger than 5MW, of the type of technologies that are eligible for a CfD. The purpose of interviews with these developers was to gain insight on what the experiences of unsuccessful applicants were in applying for CfDs, or reasons why they did not apply at all. They were not to used as a direct control group to compare outcomes given their difference in characteristics would make this an imprecise approach to counterfactual assessment.

From this initial long list of projects in the REPD a shortlist sample of 40 companies was selected for recruitment, plus a further 7 developers suggested by BEIS in order to cover sites with co-located battery storage. From this sample of 47, interviews with 17 developers without a CfD were achieved.

Unlike the interviews with developers of CfD projects, these interviews did not primarily focus around their experience of developing one specific project (as they did not own a CfD project). The developer firms all had a portfolio of multiple projects that had been developed under the RO. In addition, most had experience of developing, or investing in, renewable energy electricity projects of different technology types. Table 4 shows the count of how many different types of technologies the 17 developer firms represented. The total adds to more than 17 because most firms had been involved in developing more than one type of technology.

	ACT	Biomass and CHP	EfW and CHP	Hydro	Offshore	Onshore	Solar	Tidal Power
Types of technologies covered by the 17 interviewed companies	2	5	2	1	4	9	10	2

Table 4 Types of technologies covered by non-CfD developers

The topic guide which was used for these interviews can be found in Annex E.

WP2.5. Quantitative online survey with developers and private investors – After the in-depth interviews, a follow-up self-completion online survey was sent to developers to provide a standardised template for capturing detailed information to inform our estimates of costs of debt and equity for different technologies and the minimum rate of return required to make a project viable (hurdle rates). This was sent to all 34 developer companies of CfD generation units, achieving 20 responses in total, although there were high rates of non-response to certain questions.

For some CfD generation units, more than one representative of the project's consortium of owners responded to the survey. Overall, responses were received for 15 distinct CfD projects. A breakdown of these 15 projects by type of technology is provided in the table below. With the exception of Biomass with CHP we received responses for all technologies which were awarded a CfD.

Technology	ACT	EfW with CHP	Offshore wind	Onshore wind	Solar-PV	Total
No CfD projects that respondents represent (total CfDs awarded for each tech in brackets)	**2 (9)**	**1 (2)**	**3 (5)**	**8 (15)**	**1 (5)**	**15**

Table 5 Breakdown of survey respondent by CfD project technology

This breakdown by type of CfD projects represented suggests there was an over representation of Onshore wind projects in this relatively small sample. However, this is partly because two respondents represented firms who had developed 5 CfD Onshore farms between them. When considering this from the perspective of what types of

technology each individual respondent represents, in total 5 respondents were developers of Onshore wind projects. This also reflects the fact that Onshore wind accounts for the highest number of individual CfD projects (15 Onshore wind projects were awarded a CfD).

Findings from the survey have been included in this report where the questions were answered by at least 50% of respondents. These include questions on:

- Whether the developer's CfD generation unit has co-located battery storage, or they intend to develop storage facilities in future?
- Their perception of how levels of risk differ between the CfD Scheme and RO across various types of project development risks?
- What the economic lifetime of their project is (the timeframe that the investment decision was assessed over)?

Other sections of the questionnaire, which asked developers to state what the value of different types of project development, construction and operational phases cost, were answered by fewer than 5 respondents each. As was a question which asked respondents to state their company's hurdle rate for investing in the project, and how this would have compared under a scenario where the same project was developed under the RO. This was likely to be due to the commercially sensitive nature of the information requested. Findings from these questions have been excluded from the analysis due to their low response. The survey questionnaire is provided in Annex F.

WP2.6. Cost-effectiveness analysis - This addressed the HLQ4 evaluation question "Does the CfD Scheme represent good value for money? The analysis compared outcomes of the current CfD Scheme with a modelled counterfactual scenario of subsidising the same level of generation under the Renewables Obligation. This required developing estimates of the total support costs per MWh of electricity produced, by each technology. This was used to compare overall costs and benefits (£value of energy produced) to a counterfactual scenario assuming the CfD Scheme had not been introduced and the RO continued to 2050. The BEIS Dynamic Dispatch Model (DDM) was used as the basis of this modelling work. Further description of the DDM and approach to value for money assessment is provided in Annex B.

Limitations of data collected

When forming conclusions on the evidence gathered, we have taken account of the following limitations of the underlying data:

Interviews with CfD developers

As outlined above, the achieved sample of telephone interviews with developers of CfD projects covered 23 out of the 38 projects that were awarded a contract through AR1 and AR2. Overall, respondents reflected a good range of most of the different types of technologies developed under AR1 and AR2. However, developers of CfD projects with

Energy from Waste with CHP and Dedicated Biomass with CHP were not included due to non-response. That said, the interviews with developers of ACT projects included firms that had also developed projects with these technologies (under the RO). In addition, our interviews with unsuccessful applicants to the CfD scheme included developers of Dedicated Biomass and Energy from Waste with CHP projects. Therefore, representatives from these bio-energy technology sectors had some coverage within our wider sample.

Interviews with developers of renewables without a CfD

The 17 interviews with developers of renewable electricity projects without a CfD aimed to gather insights from experiences of unsuccessful CfD applicants, and developers who may, in principle, have been eligible to apply to the CfD Scheme but chose not to. Whilst these groups were covered, it is not known how representative they are of the wider population of unsuccessful applicants, because data on the number and profile of unsuccessful applicants is kept confidential. In addition, the relatively small number of interviews included in this qualitative sample should not be considered statistically representative of the wider population of firms who develop renewable electricity across GB.

Online survey

The survey was sent to all 34 CfD developers, achieving 20 responses in total. Respondents represented 15 separate CfD projects, because for some projects, more than one member of the project's consortium of developer firms responded. There was a higher proportion of respondents representing Offshore and Onshore wind projects, and a relative under-representation of other technologies. There was a high rate of non-response to certain questions. Findings from the survey have been included in this report if the questions were answered by at least 50% of respondents. These include questions on:

- Whether the developer's CfD generation unit has co-located battery storage, or they intend to develop storage facilities in future
- Their perception of how levels of risk differ between the CfD scheme and RO across various types of project development risks
- The economic lifetime of their project (i.e. the timeframe that the investment decision was assessed against)

Other sections of the survey questionnaire, which asked developers to state what the value of different types of project development, construction and operational phase costs, were answered by fewer than 5 respondents each. As was a question which asked respondents to state their companies' hurdle rate for investing in the project, and how this would have compared under a scenario where the same project was developed under the RO. This was likely to be due to the commercially sensitive nature of the information requested. Findings from these questions have not been included in the analysis.

The economic modelling of CfD costs and benefits was therefore based upon estimates of project development costs and hurdle rates in BEIS's 2018 Reference case. The telephone interview data was used to provide further validation of ranges used for

estimating the impact of CfDs on hurdle rate reduction. Estimates of the impact of the scheme on hurdle rate reduction that were given by telephone interview respondents were within the range assumed by BEIS's 2018 Reference Case.

Estimates of impact of CfD Scheme on cost reduction

As with all modelling of future outcomes, there is a significant degree of uncertainty in the projections. To understand this uncertainty, we have tested variations in the key assumptions that drive the differences between the costs of the two regimes, such as hurdle rate differences and wholesale price levels.

However, a number of uncertainties remain. This analysis has focused on estimating the changes in cost of supporting a fixed level of low-carbon deployment under the two regimes. The level of deployment, and the mix of technologies deployed, has been held constant, in line with BEIS's latest reference case. The magnitude of the savings under the CfD scheme would likely vary materially under a different level and mix of low-carbon deployment.

Approach to analysis and synthesis of results

3.1. Approach to analysis of semi-structured interview data

The semi-structured telephone interviews with renewable project developers (with 23 developers of CfD units, and 17 developers of projects without a CfD) produced a large volume of qualitative data that required careful organisation and management for structuring the analysis. This section provides an overview of our approach to collating, transcribing, verifying, managing and analysing this data.

All interviews were audio recorded (with the respondent's consent) and then transcribed into individual Word documents. These Word documents were structured using consistent templates, based around answering each of the key topics in the Topic Guide (see Annex D and Annex E). The write-ups were reviewed for any missing information (e.g. where the audio quality was poor, there was insufficient time to cover all questions), or where the meaning behind a response was not clear. In cases where interview write-ups lacked important information, or certain responses required further clarification, we sent summaries of the interview to the respondent to request their input to add, amend and clarify these sections.

The interview transcript documents were collated into a Master Excel file and then stored in Nvivo. Nvivo is a Computer Assisted Qualitative Data Analysis Software (CAQDAS) package which is used to provide structure to qualitative data and support systematic organisation of text, coding and analysis. It can be used to analyse text such as interview transcripts, and also to combine this with other supporting documentation to help classify information, such as background documents about each generation unit based on the CfD Register.

Nvivo works like an advanced set of highlighters with an unlimited number of different colours to identify different concepts arising from the text. These different concepts are assigned to “Nodes”; a function for assigning labels to describe different themes of interest. For example, when analysing questions around how the CfD Scheme design may be improved in future, we can identify how often the theme of making changes to rules on “Milestones Delivery Dates” (MDD) is mentioned. “Scheme Design changes” may form the top level “node”, with issues related to MDDs forming sub-category, along with lists of other common areas discussed, a such as “Pot structure”.

As well developing nodes “bottom-up” as emerging from the text, Nvivo was used to assess whether a priori theory around the relationship between concepts hold true. For example, to test whether the assumed linkages between our CMOs are valid, or whether there are more salient types of contextual factors that are associated with outcomes of interest.

The overall approach to qualitative analysis of the interview transcripts can be summarised in five steps:

- Prior to analysis, all interview transcripts were thoroughly read to obtain a general understanding of the data; to form an idea of the common themes discussed and tone of the interviews
- The transcripts were looked at on a per question basis. Each participant’s response to each key section of the topic guide was read consecutively to reflect on the range of concepts emerging in relation to each topic
- The responses were analysed for commonalities. Typically, a project researcher will look for agreement among three participants to consider a response a commonality. Commonalities that were discovered were extracted to become sub-themes under each ‘node’, with the node reflecting the overall topic category (e.g. ‘impact on investor confidence’). The data were also examined for irregularities or responses that were unusual. Any irregularities that were discovered were summarised in the write-up to interpret the reasons for differences (for example, where a respondent had particularly strong negative views on the scheme, this may have been because they were an unsuccessful applicant).
- The subjective coding of themes to each topic were quality assured by peers. Project team members first worked individually to code emerging themes under each sub-category of nodes. A second researcher then reviewed this categorisation (a consultant not involved in the initial round of coding). They performed a matching task by reading the excerpts from transcripts, and then either endorsed or queried whether it was relevant to the theme assigned. They also looked for alternative emerging themes or potential new sub-categories. Where discrepancies between the two researchers existed, these were discussed with the project team before the lead analyst (Project Manager) drew conclusions on the most appropriate categorisation of themes.

- Lastly, the text referenced against each node and sub-category formed the source material used for reflecting the range of responses given to each key topic in the report (alongside other supporting evidence).

Approach to testing Context Mechanism Outcome configurations

As outlined in Annex C, each of the four CMO's present a 'Programme Theory' of how developers are expected to respond to the CfD Scheme (mechanism-response) and how this leads to intended outcomes. Plus 'Alternative Theories' which illustrate how differences in the developer's background or context may influence different types of responses and actions which may lead to unintended or negative outcomes.

We followed the general principles of realist approaches to testing CMOs and used a qualitative method for exploring and categorising responses and then assessed how findings varied by context. The aim was to explore why the differences in context influence whether mechanisms "fire' or not and lead to intended outcome. Sometimes based on synthesising evidence across multiple strands of data sources, sometimes based on a single source (e.g. interviews). Published information on project background was used with interview data to inform our categorisation of differences in context. For example, whether the developer participated in AR1 as well as AR2, if the project developer is a large multi-national, if the developer also has other types of technology etc. This synthesis of information was used to draw conclusions around how differences in responses related to different contexts.

The CMO descriptions were agreed as an initial Phase 1 draft before the analysis phase began. Although it should be noted that they were not finalised before fieldwork interviews with developers began. Therefore, the interviews were not directly structured around discussing and testing each of the CMO theories. Nevertheless, the interviews were used to explore respondent's views towards the core aspects of the scheme's theory of change and how this varied according to the key contextual differences highlighted during the development of CMOs. The CMOs formed the basis of identifying what types of responses to look for, at the analysis phase, to gather evidence in support for either the programme theory or alternative theories being true. Following new evidence emerging from this analysis on the key contextual factors which influence how developers respond to the scheme, the CMOs will be revised and refined, in advance of Phase 2.

To give an example, CMO1 explored how the opportunity to obtain a 15-year price stabilisation contract (CfD) affected developers' decisions to participate in the Scheme and whether the offer of a CfD resulted in decisions by investors to reduce hurdle rates, leading to the intended outcome of lowered costs of capital for developers. A difference in context explored here was timing and stages of project development. Prior to award of the CfD, a proposed project is subject to allocation risk. At this stage it is less attractive to developers and investors with lower thresholds for risk (potentially increasing cost of capital for early development work). After a CfD is awarded, allocation risk has been

mitigated and the project may become more attractive to a wider pool of different types of investors.

As detailed in Annex C, this resulted in the following Programme and Alternative Theory CMO descriptions:

CMO1 Programme Theory: If the project has been awarded a CfD contract (Context) then the assurance provided by long term (15 year) revenue stabilisation guarantee (mechanism – resource) will attract a wider pool of different types of investors to decide to invest (mechanism – response). The increased competition within financial markets helps to reduce hurdle rates and lowers costs of capital for developers (outcome).

CMO1 Alternative Theory: If the project has not yet been awarded a CfD (Context) then the allocation risk associated with competitive auctions (mechanism-resource) may deter investors from providing finance to projects at this stage (mechanism -response). This leads to increased reliance on developers' own capacity for debt finance to cover costs until allocation of contract. This allocation risk limits participation to larger developers and utility companies, reduces the pipeline of participants and reduces competition in longer term (unintended outcome).

Using Nvivo we coded responses that supported either the CMO 1 Programme Theory (PT) or the Alternative Theory (AT). This included interviews with developers who held a CfD contract and also the interviews with developers who do not (either through non-participation in the Scheme or having bid in a previous allocation round but not been successful). The types of evidence used in support of both the Programme and Alternative Theories are summarised below.

- **Evidence in support of Programme Theory** – Code for instances where developer states that the assurance provided by the price stabilisation contract attracted either their developer company to participate in the Scheme or other private investors to invest in their project. This included explanations of how the award of a 15-year CfD had reduced risks for their investors and associated costs of capital. In particular, we looked for instances where the respondent indicated that the potential prize of a CfD contract outweighed the allocation risks. For example, the potential prize of a 15-year CfD made it worthwhile to invest in pre-allocation development phase development work and to participate in auctions.

- **Evidence in support of Alternative Theory** – Code for instances where respondent discusses the impact of allocation risk as a deterrent for their company or others from participating in CfD Allocation Rounds (either past or future Allocation Rounds) or from investing in projects that are still in the pre-award phase.

Interview transcripts were analysed at a case-by-case level (e.g. one interview at a time) to code for examples where respondents indicated support for the CMO1 Programme Theory

(PT) or Alternative Theory (AT), with responses recorded into 'nodes' categorised according to each CMO PT or AT. To provide an initial sense of the overall proportion of respondents that gave responses in support to CM01 PT or AT, data queries were run in Nvivo to provide counts of the numbers of responses in support of each CMO theory.

As an example, Table 10 below provides a summary of overall results, split by whether the respondents were developers with a CfD contract or those without a CfD.

	No of CfD developers supporting	No of Non-CfD Developers supporting	Total no of cases in support of each theory
CMO1 Programme Theory	15	4	19
CMO1 Alternative Theory	7	8	15

Table 6. Frequency of cases in support for CMO1 Programme and Alternative Theories

We then reviewed the transcripts coded under each 'node' to explore any differences in context (aside from timing of project development) that offered alternative explanations behind the developers support for the Programme or Alternative theory. For example, that their view on the attractiveness of the Scheme varied according to the types of technology they develop or whether they had previously been unsuccessful in bidding at auctions.

This analysis was used to draw conclusions around the extent to which the evidence supported each CMO, why and in what contexts.

For Phase 1, we did not apply Bayesian Updating or Process Tracing methods to test the CMOs. Developing a Bayesian inference framework was considered a disproportionate use of resource for assessing the relatively high-level CMOs under consideration here. In addition, the relatively small numbers of responses in support of the programme theory and alternative theory for each CMO would make it difficult to categorise these across the evidence tests used for process tracing. Also, because the CMOs were not singed off until after fieldwork began, and evidence tests were not planned in advance, retrofitting the evidence gathered to any evidence tests would seem disingenuous.

Through the new evidence gathered through Phase 1 fieldwork and analysis, it has become apparent that the draft CMOs need revision. Some are too high level to be meaningful, and it has also become clearer that other types of context, such as the size of the firm, and whether they have an international portfolio, were more important factors in influencing how they respond to the scheme than the types of contexts set out in the draft CMOs. This was another reason why it was considered to be not worthwhile to develop process tracing evidence tests on the early draft CMOs at Phase 1, given some of the CMOs were not focused on the most salient contexts. It would also not change the findings in the main report. A priority for the next Phase will be to develop new, more nuanced CMOs, plus a set of evidence tests on what we would expect to see if they hold true or not.

Annex B: Methods for Modelling Impact on Cost Reduction

Introduction

Addressing core evaluation questions such as: “Does the CfD scheme represent good value for money?” required developing estimates of the equivalent support levels that would have incentivised the same level of low-carbon deployment under the RO scheme. This was used to compare overall costs and benefits to a counterfactual scenario assuming the CfD Scheme had not been introduced and the RO continued.

This analysis was carried out using BEIS’s Dynamic Dispatch Model (DDM). The analysis compared the costs of supporting low-carbon deployment through the CfD regime to a counterfactual assuming the RO scheme had continued.

Overview of the Dynamic Dispatch Model

The Dynamic Dispatch Model (DDM) is a comprehensive fully integrated power market model covering the GB power market over the medium to long term. The model was developed by LCP for BEIS in 2011 and has undergone continuous development since then to reflect market developments and policy reforms and improve functionality.

The DDM has two main purposes: modelling the electricity dispatch from GB power generators, and modelling the investment decisions in generation capacity in GB, both out to 2050. Based around data on the GB power market, users can study the evolution of the sector under the influence of various policy and cost regimes using bespoke scenarios.

Outputs include: wholesale electricity market prices, generation mix, capacity levels, emissions and spend on low carbon electricity generation based on inputs including fossil fuel price projections, demand, technology costs, low carbon support levels and build rates. It also produces consumer cost and system cost outputs which allow for comprehensive and consistent Cost-Benefit Analysis.

The DDM considers electricity demand and supply on a half hourly basis for sample days, allowing for plant dynamics and operating constraints. Investment decisions are modelled using an agent-based approach, which includes detailed simulation of the annual Capacity Market auctions. Investment decisions are based on projected revenue and cashflows allowing for policy impacts and changes in the generation mix. The full lifecycle of power generation plant is modelled, from planning through to decommissioning.

Modelling of renewable support regimes

The DDM models the impact of all major GB electricity supply policies including small scale Feed-in Tariffs, the Renewables Obligation (RO), Contracts for Difference (CfDs), Carbon Price Support, the Capacity Market and Industrial Emissions Directive. It has been developed in parallel with the UK's Electricity Market Reforms (EMR) and was used by BEIS (then DECC) and National Grid to model the CfD regime as part of the initial EMR delivery plan.

The CfD and RO support regimes are modelled in detail, with the flexibility to vary support levels by technology and commissioning year. Different CfD contract types are modelled, including exposure to the intermittent market reference price (IMRP) and the baseload market reference price (BMRP). Investment decisions factor in the policy support payments, contract length and hurdle rate adjustments assumed under each regime. The impacts on dispatch and wholesale price are also modelled, with the short run marginal cost of plant adjusted to account for policy support payments.

Model quality assurance

The DDM has undergone extensive quality assurance:

- Internal & external (BEIS) back-testing has been performed to verify that the model replicates historic results to a high level of accuracy. Back-testing on the initial release was conducted over a four-year period and showed very close agreement of prices across the period. Extensive back-testing was also conducted with the introduction of the new "look-forward" dispatch algorithm in 2015.
- External reviews of the modelling methodology and results have been conducted by external experts. David Newberry, (Professor of Economics at Cambridge University and Head Energy policy research group) conducted a quality assurance on both the methodology and the models results. Subsequently, BEIS's "Panel of Technical Experts" reviewed the model as part of its report on National Grid and DECC's EMR analysis in 2013.
- A full QA of the underlying model code was performed in 2014 by PWC.
- All model updates undergo thorough regression testing, and any changes to the model are independently reviewed by model experts in both LCP and BEIS.

Approach and key assumptions

The modelling covered the period from 2016 to 2050, and considered two groups of CfD supported generators:

- Generators allocated CfDs via allocation rounds 1 and 2 **(primary focus)**;
- Generators projected to be allocated CfDs in the future, based on BEIS's 2018 reference case

Nuclear and potential future CCS CfD contracts were outside the scope of this analysis, and no variation in their support was modelled.

Generators allocated a CfD contract under the FIDER (Final Investment Decision Enabling for Renewables) were assumed to have been supported under the RO scheme in the counterfactual modelling, but these projects were not a focus of the analysis.

The modelling assumes that BEIS policy objectives would have remained the same if the RO scheme had continued, and the same level of renewable deployment would have been targeted and the same technologies supported. As a result, the analysis focuses on the **costs of supporting the same level of deployment** under the RO scheme**,** rather than seeking to model any differences in deployment.

With the same level of deployment, we also assume the same project costs for the supported plant under the two regimes. Falls in capital costs, as has recently been observed for offshore wind, are assumed to be due to the level of deployment (and wider global factors), rather than the type of low-carbon support regime.

These and other key assumptions that feed into the modelling are summarised below.

Assumption	CfD regime modelling scenarios	RO counterfactual modelling scenarios
Capacity mix	Held constant in all runs, in line with BEIS reference case.	Held constant in all runs, in line with BEIS reference case.
Eligibility for support	Same set of contracts assigned in all runs, in line with BEIS reference case.	Same set of contracts assigned in all runs, in line with BEIS reference case.
Contract length	15 years (except biomass cofiring and conversions, whose support ends in 2027)	20 years (except biomass cofiring and conversions, whose support ends in 2027)
Support levels for plant with allocated CfD contracts (AR1, AR2, FIDER)	Strike prices as per awarded contract.	RO banding calculated to achieve the equivalent level of return as the CfD contract (accounting for different hurdle rates). Based on model outputs, and taking into account contract length, adjusted hurdle rate and projected levels of generation and wholesale market income (for more detail provided in illustrative example provided in section 6 of main document).

Assumption	CfD regime modelling scenarios	RO counterfactual modelling scenarios
Support levels for projected future new build allocated a CfD contract	Strike prices are calculated, based on model outputs, to achieve the required hurdle rate. Plants are then assigned the highest strike price calculated for any plant with the same technology and online year.	RO banding levels are calculated, based on model outputs, to achieve the required hurdle rate. Plants are then assigned the highest banding calculated for any plant with the same technology and online year.
Zero or negative support	Generators are willing to take a CfD strike price that is below expected wholesale income levels due to the reduced risk that a CfD contract provides. In this case we calculate the CfD strike price to represent the point of "indifference". For example: strike price of £45/MWh is sufficient to cover a generator's costs and it is expected to earn £55/MWh in wholesale income. In this case the generator may be indifferent at a strike price of £50/MWh, as this is high enough to cover its costs and represents the same risk-adjusted return as the £55/MWh it will earn unsupported. In this case we set the strike price is set to £50/MWh. This level of support is still desirable from a consumer-perspective, as the expected CfD support payments are negative.	Generators would not accept a negative RO support level, as they would rather operate unsupported. In cases where expected wholesale income is sufficient to cover the project's costs, the plant operates unsupported.
Support mechanism	Two-way CfD, generators are paid (or pay) the difference between their strike price and reference price. Wind and solar use the intermittent market reference price (IMRP); other technologies use the baseload market reference price (BMRP). BMRP is set using the season-ahead baseload wholesale power price.	Generators receive a fixed payment for every MWh of generation, based on banding level x ROC buyout price (and adjusted for headroom). The ROC buyout price varies year to year according to the RPI.
Hurdle rates	As per BEIS 's latest assumptions, accounting for reduced risk under CfD regime (full detail in section 6 of main document).	As per BEIS latest assumptions
Commodity prices (gas, coal, oil)	Scenarios based on BEIS 2018 published projections.	Scenarios based on BEIS 2018 published projections.
Capital costs	Held constant between runs, as per BEIS reference case.	Held constant between runs, as per BEIS reference case.

Assumption	CfD regime modelling scenarios	RO counterfactual modelling scenarios
Social discount rate	3.5%	3.5%
All other input assumptions	As per BEIS reference case.	As per BEIS reference case.

Table 7. Key modelling assumptions

Overview of Scenarios

Six comparison scenarios have been explored to understand the sensitivity of the results to key assumptions. Each of the scenarios includes a CfD baseline run and an RO counterfactual run. The scenarios are:

- CfD baseline vs RO counterfactual under central assumptions[7]
- CfD baseline vs RO counterfactual under low commodity prices
- CfD baseline vs RO counterfactual under high commodity prices
- CfD baseline vs RO counterfactual with lower hurdle rate differences (-0.5%)
- CfD baseline vs RO counterfactual with higher hurdle rate differences (+0.5%)
- CfD baseline vs RO counterfactual where RO support levels are higher due to reduced price discovery & competition (equivalent to a 5% rise in strike price)

The results are presented in Chapter 6.

Methodology for Commodity Price scenarios

We have tested two scenarios for variations in commodity prices. Under **Scenario 2** BEIS's low commodity price projections are used for both the CfD baseline and RO counterfactual, and under **Scenario 3** BEIS's high commodity price projections are used.

When calculating the required levels of support under these scenarios, it is important to base these calculations on what would have been a "best view" at the time the support was set. For example, if calculating the required RO banding for a plant in 2020 in the low commodity price scenario, the best view would not be that the low-price projection continues – there has not yet been enough evidence to be confident that low prices will persist. However, when calculating support levels in 2040 within the low scenario, we have now had over 20 years of low prices so would expect this trend to continue.

[7] Note that under central assumptions we assume that projects supported under RO have higher hurdle rates than under CfDs

To deal with this problem, a blend of results from a central commodity price run and a run with low or high commodity prices are used to form a “best view” of wholesale income and generation in calculating support levels. The weighting of the central run in this view decreases over the years.

This was parameterised using historical BEIS commodity price forecasts (7 years of data, 2012-2018), which were used to analyse the correlation between changes in short-term commodity prices and changes in the BEIS long-term projections.

The analysis showed, as expected, a correlation between short-term price increases/decreases and movements in BEIS’s long-term projections. These long-term movements are relatively small, with the previous central projection accounting for 91% of the updated long-term central projection. This 91% parameter is used in the modelling, defining the divergence away from the original central projection for each year in the low or high scenarios.

For example, after one year where the price follows the original low/high price projection, the new long-term projection is made up of 91% weighting from the original central long-term forecast and 9% weighting from the original low/high long-term forecast.

In addition, we assume a 10-year period over which prices trend back to this updated long-term assumption, after 2-year flat period to represent market forwards (so 12 years in total to get to the long-term projection).

Two illustrative examples of this are shown below, showing the updated “best view” of gas prices in 2020 and 2030 under low and high scenarios. Note: We do not run a separate scenario with this blended projection for every modelled year (as this would have required an impracticable number of runs), so instead we blend the outputs from the central run and low/high price run in the same way.

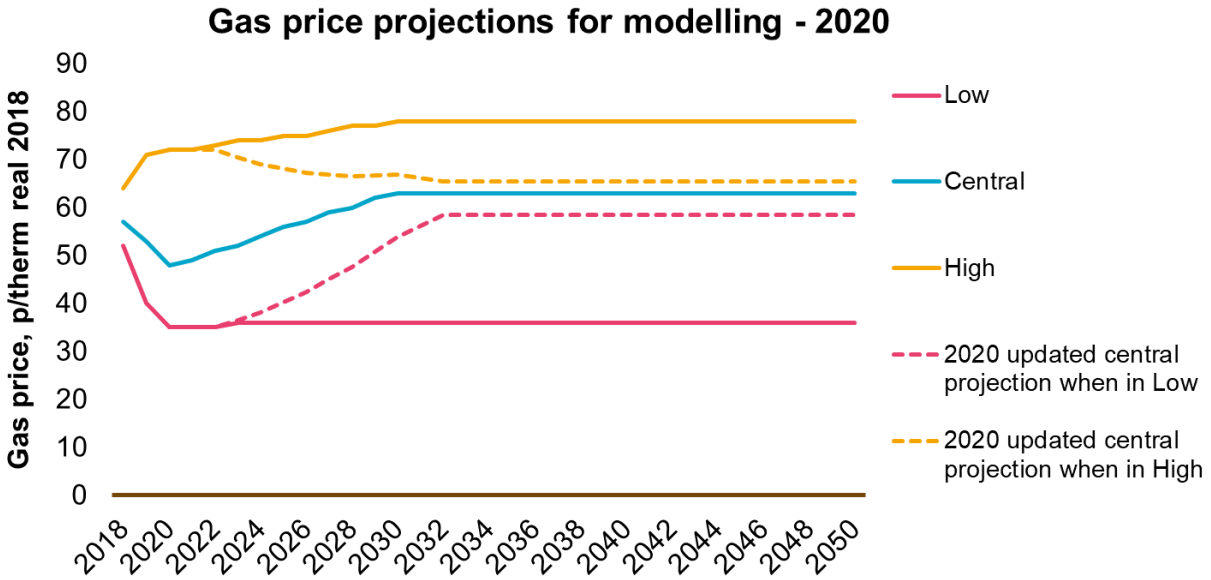

Figure 1. Gas price projections for modelling – 2020. Source: LCP analysis using 2018 BEIS commodity price projections

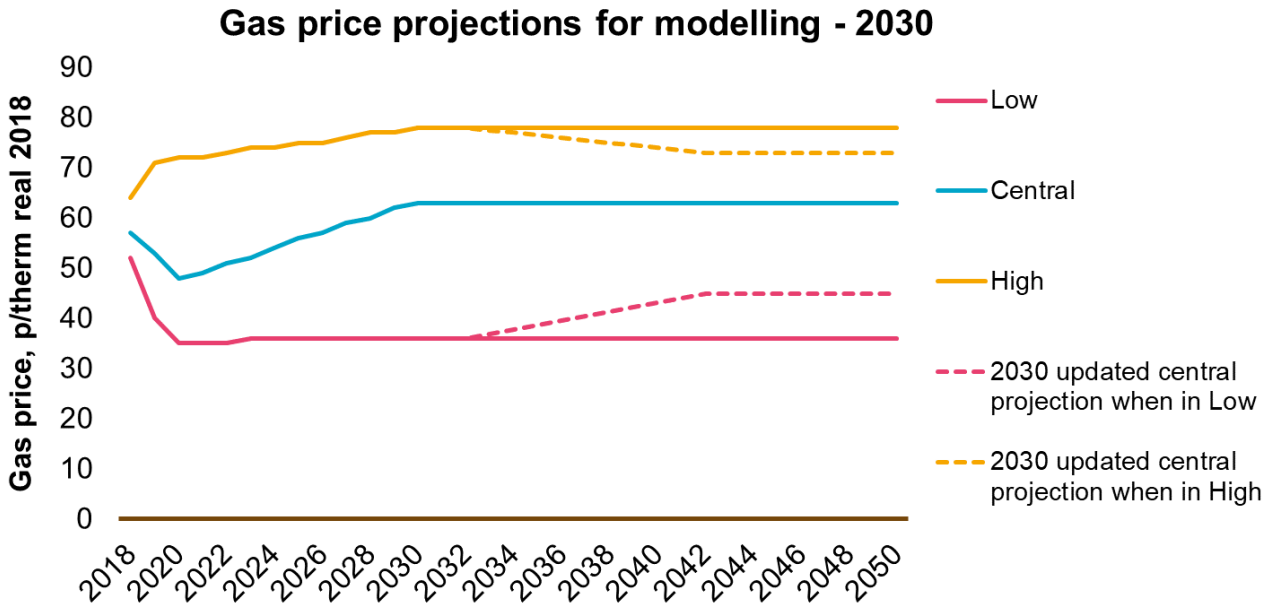

Figure 2. Gas price projections for modelling – 2030. Source: LCP analysis using 2018 BEIS commodity price projections

Level of uncertainty in this analysis

As with all modelling of future outcomes, there is a significant degree of uncertainty in the projections. To understand this uncertainty, we have tested variations in the key assumptions that drive the differences between the costs of the two regimes, such as hurdle rate differences and wholesale price levels.

However, a number of uncertainties remain. This analysis has focused on estimating the changes in cost of supporting a fixed level of low-carbon deployment under the two regimes. The level of deployment, and the mix of technologies deployed, has been held constant, in line with BEIS's latest reference case. The magnitude of the savings under the CfD scheme would likely vary materially under a different level and mix of low-carbon deployment.

The analysis of future projects does not include nuclear or gas CCS. Under some scenarios, CCS could form a significant proportion of future support, but the precise structure of this support is not clear.

Below we have outlined the key modelling outputs and discussed our level of confidence around them:

- **CfD strike prices.** CfD strike prices for the AR1 and AR2 projects are known. Strike prices for potential future CfD projects have been calculated based on cost assumptions and modelling outputs, so there is a degree of uncertainty in these. The project costs and hurdle rates are the main driver and therefore the main area of uncertainty. In the near to medium term (2020s) we have a reasonable degree of confidence, as the cost and hurdle rate assumptions produce strike prices that are consistent with what has been observed in AR2. We have less confidence in the longer term, as wholesale costs in particular are uncertain.

- **RO bandings.** The RO bandings– which determine the £/MWh support payments received under the RO regime – have all been calculated for each technology in each year. For AR1 and AR2 projects, the bandings are set at a level that would provide the equivalent risk-adjusted return to their CfD contract. Therefore, the main area of uncertainty here is the hurdle rate assumptions, and in particular the difference between the two regimes. Due to this uncertainty, we have run scenarios to test the sensitivity of results under higher and lower hurdle rate differences. In the longer term, the RO bandings are subject to the same uncertainties as CfDs – project costs and hurdle rates – but in addition are also determined using the projected wholesale prices over the term of the contract. We have tested the sensitivity of the results under higher and lower commodity prices to test the robustness of results to this uncertainty.

- **CfD/RO support payments.** For the reasons discussed above, we are more confident in the CfD strike price assumptions than in the RO banding assumptions. However, once these have been determined, the level of support payments associated with the RO are reasonably certain (£/MWh, so only vary with the level of generation and the RO buy-out price inflating with RPI), whereas CfD support payments are much less certain. The reason for this is that CfD strike prices vary depending on outturn wholesale prices. So if wholesale prices are lower than expected, CfD support payments will be higher than expected, but if wholesale prices are lower than expected CfD support payments will be lower than expected. Again, we have tested this area of uncertainty by running scenarios with higher and lower commodity prices.

Annex C: Theory of Change and Context Mechanism Outcome (CMO) Configurations

1. Theory of Change

A Theory of Change (ToC) for a policy or programme illustrates the flow of cause and effect between inputs and activities (e.g. Government resources and delivery actions) to their expected, outputs, outcomes and longer-term impacts. The UCL scoping study provided a Policy Map, which illustrates these causal links in a flow chart diagram (on page 43). This Section outlines the supporting narrative of the ToC, which was based upon findings emerging from the three Scoping Phase work packages.

Realist evaluation is concerned with unravelling the "inner mechanisms" at work in different contexts. As described by Barbara Befani (2016), this can entail refining the ToC into one or more Context-Mechanism-Outcome (CMO) configurations, where **Contexts** are made of resources, opportunities and constraints available to the beneficiaries; **Mechanisms** are choices, reasoning or decisions that individuals take based on the resources available in their context; and **Outcomes** are the product of individuals' behaviour and choices.

Section 2 refines the overall programme's Theory of Change (ToC) into a series of Context Mechanism Outcome (CMO) configurations. This assesses not only what overall outcomes have been achieved, but also the causal pathways of *why* they were achieved, and *how* this may be driven by differences in **contexts**.

Inputs

In setting up and implementing the CfD Scheme, Government determines the regulatory framework; it's budget and design rules, including the following **inputs:**

Budget Notice and Allocation Rounds: Allocation Rounds are announced by BEIS, which sets out its intentions regarding the budget available and the specific delivery years for the technology pots it wishes to make the subject of the allocation round. This is done via a "Budget Notice". The first Allocation Round ("Allocation Round 1") took place in 2014/15. Allocation Round 2 was announced in 2016.

The Budget is allocated to different technology pots at the discretion of BEIS with minima and maxima potentially applied to specific technologies. The total budget is controlled by HMT through the Levy Control Framework. The source of funding comes from payments

from electricity suppliers, via the Supplier Obligation, which is ultimately paid for by consumer bills.

Delivery Years and Administrative Strike Prices are announced around 5 months before auctions open. The Administrative Strike Price sets out the maximum support, presented on a price per MWh basis, that the Government is willing to offer developers for each technology in each delivery year, otherwise known as the reserve price.

Pot Design – In previous auctions, technologies have been divided into 2 pots:

- 'Established' technologies: Onshore Wind (>5 MW), Solar Photovoltaic (PV) (>5 MW), Energy from Waste with CHP, Hydro (>5 MW and <50 MW), and Landfill Gas and Sewage Gas, biomass conversion.

- 'Less established' technologies: Offshore Wind, Wave, Tidal Stream, Advanced Conversion Technologies, Anaerobic Digestion, Dedicated biomass with combined heat and Power and geothermal.

The central offer to successful bidders is to be awarded a 15-year Contract for Difference (CfD), with payments indexed to inflation, and a set of obligations to deliver the contracted capacity in a timely manner (DECC, 2013[8]). The basic premise is as follows: the contract guarantees additional revenue to developers when the wholesale market price, the "reference price", is below the "strike price", which is a measure of the cost of investing in a low-carbon technology. When the reference price is higher than the strike price, developers are required to make payments back to the counterparty (LCCC).

Activities

Auction process – as the CfD Delivery Body, National Grid Electricity Transmission plc (NGET) manages the auction process. In summary, the main activities will include:

- Confirm eligibility – check applicants meet pre-qualification criteria, such as having secured planning permission, grid connection agreements and that the project is not already in receipt of other public support e.g. Renewables Obligation Certificates. This step is carried out with supporting input from Ofgem, who carry out the check whether the applicant is in receipt of other renewables support subsidies.
- If the sum of the budget required to allocate a CfD to all applicants is less than or equal to each of the pot budgets, all applicants will be offered a CfD at the applicable Administrative Strike Price (Auction is not required).
- If applications exceed the budget, NGET will invite applicants to submit a sealed bid containing the strike price which each applicant is willing to accept for their project. Bidders also need to indicate the delivery year, i.e. the project's Target Commissioning

[8] Electricity Market Reform Delivery Plan. DECC. 2013

Date. Projects will compete across all delivery years and all technology types (within the pot of the respective technology).

- NGET ranks all bids by strike price bid from lowest to highest (regardless of delivery year or technology type). Each delivery year will have its own clearing price, and the clearing price will be that of the highest successful strike price bid in that year.
- Any successful project will be paid the clearing price for its delivery year, capped at the relevant administrative strike price. This means that if the clearing price for a particular delivery year is higher than the strike price in that year for a technology, the strike price is awarded as the contract price.

Contract award: NGET sends notifications to which bidders have been successful to the LCCC. As CfD counterparty, the LCCC offers the contracts to developers and obtains their signatures.

Disputes and Resolution: Unsuccessful applicants have the right to appeal if they have reason to believe they were incorrectly deemed ineligible. The first step is for the applicant to ask NGET to review their original decision, based on their grounds for appeal (a "Tier 1 dispute"). Following a Tier 1 review, where NGET upholds its original decision, the applicant can then ask Ofgem to review NGET's decision and make a final decision (a "Tier 2 dispute"). Responses to our Scoping Stage Key Informant Interviews suggest that Ofgem have upheld National Grid's original decision, in all cases to date. Further information on the dispute resolution process can be found on Ofgem's website[9].

Post-award project development activities: the LCCC then manages the contracts and payments to generators for the 15-year duration of the contract. Before projects begin generating electricity, the LCCC carries out **contract management activities** to guide contracted projects through the following milestones and development stages[10]:

- **Milestone Delivery Date** - the CfD requires generators to demonstrate that, by the "Milestone Delivery Date" set out in their CfD, they have made a significant financial commitment to and are progressing the construction of their project (i.e. new generation plant). This date is 12 months from the date of entry into the CFD agreement. Generators demonstrate this requirement by providing LCCC with evidence that they have either spent 10% of the project cost or have entered into contracts committing to expenditure and development of the project.
- **The Operational Conditions Precedent** is another milestone whereby the LCCC checks that projects satisfy (at least 80%) certain commissioning and other tests ahead of qualifying for CfD payments.

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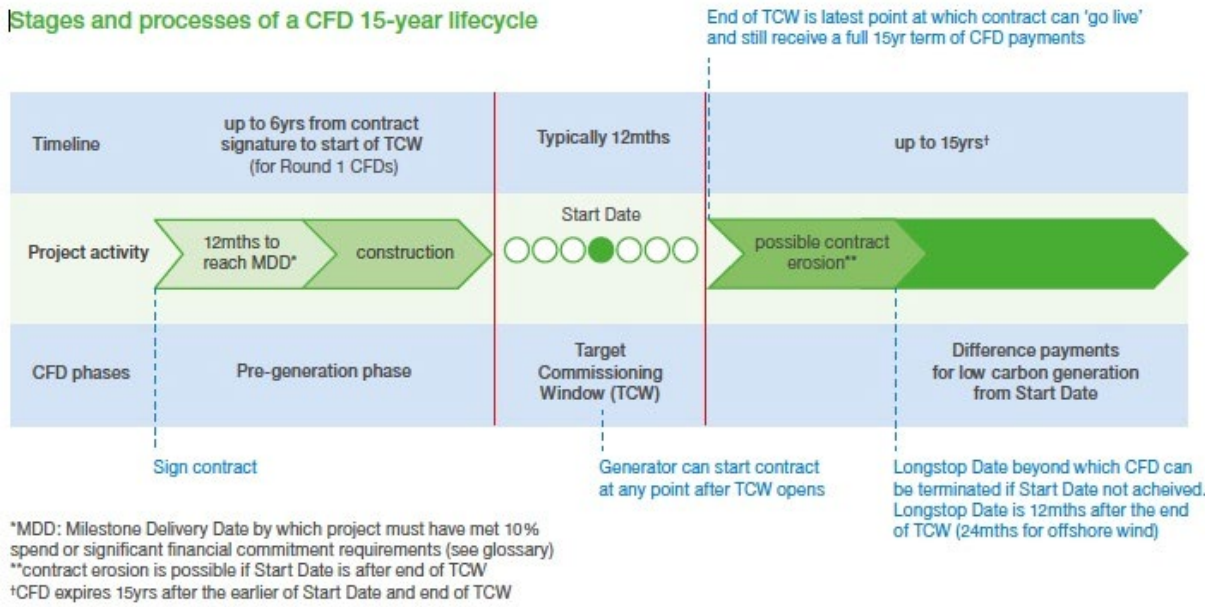
[9] https://www.ofgem.gov.uk/electricity/wholesale-market/market-efficiency-review-and-reform/electricity-market-reform/electricity-market-reform-emr-dispute-resolution

[10] LCCC Annual Report 2017/18.

- **Target Commissioning Window** – The TCW is the period during which the generator is obliged to fulfil all its operational conditions precedents, one of which is a requirement to achieve 80% of the project's required generation capacity. The generator must achieve this level before it is entitled to issue a start date notice under the CfD, triggering its entitlement to CfD payments. If the generator does not fulfil its Operational Conditions Precedent by the end of the TCW, its entitlement to CfD support payments will reduce day for day for each day of delay in fulfilling this requirement.
- **Longstop Date** - this date is specified in each contract and is the last date by which the generator's project must achieve its required minimum generation capacity. It is generally 12 months after the end of the Target Commissioning Window for onshore technologies and 24 months for offshore wind.

These stages and process, which are managed by the LCCC, are illustrated in Figure 1 below.

Figure 1 Stage and Process of a CfD project lifecycle



Source: LCCC Annual Report 2017/18

Outputs

The immediate outputs arising may include the number of projects awarded a contract through auctions, their reports on supply chain plans and initial forecasts produced of their future generating capacity, split by types of technology and delivery years. Figure 2 below provides overview of when each project's expected start date for beginning generation is, split by types of technology and capacity.

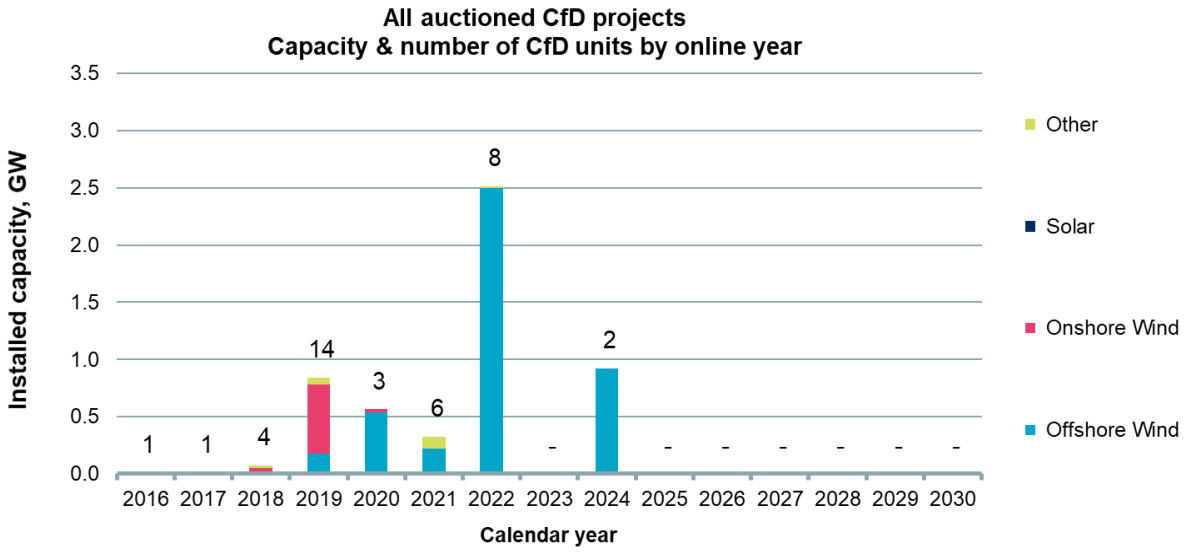


Figure 2 All auctioned CfD projects capacity per delivery year & number of units (phased projects treated as multiple units). Source: CFD register 25/01/2019

Approved Supply chain plans – applicants for a generating station with capacity of 300MW or more will be required to submit a report on their supply chain plans for BEIS's approval. The Supply Chain Plan assessment process is intended to encourage the development of open and competitive supply chains and the promotion of innovation and skills. This will in turn drive down the cost of low carbon electricity generation over the long term and contribute to lower costs for consumers.

Theory of change: Outcomes

The above inputs and activities are intended to result in the following range of beneficial outcomes.

Competitive auctions lead to lower costs for consumers – competition between bidders to win contracts encourages developers to propose their best offer on strike prices, economic rent-seekers are unable to prosper and overall costs to consumers are reduced.

Reduced risk and increased confidence for investors - The index-linked Contract for Difference, together with the backstop Power Purchase Agreement (PPA), give investors more certainty that they will achieve their projected revenue, giving them some protection both from inflation and from uncertainties over future fluctuation in wholesale market prices.

Reduced cost of capital for developers - Higher security of revenue means that investors will be prepared to accept lower interest rates, in return for the lower risk presented (lowering the "hurdle rate" for investors). This results in lower costs of capital for developers, and lower overall Levelised Cost of Electricity (LCOE) for the project.

As noted in the Scoping Stage *Investment Trends* report, renewable electricity power plants are characterised by high upfront capital expenditure and the cost of financing it. These costs are only gradually recovered over the project's lifetime. Conversely, operating expenditure is low especially for wind and solar technologies with costless fuel. For instance, the International Energy Agency (IEA 2017a, p. 50) estimates that for an offshore wind power plant, about one third of the Levelised Cost of Electricity (LCOE) comes from capital expenditure, and around one half from the cost of financing these. These financing costs arise either as interest on loans or bonds, or as the required return on equity. The remaining 20-30 per cent are operating and maintenance costs (O&M).

Therefore, policy measures aimed at reducing the cost of capital, have the potential to significantly lower the overall costs of renewable energy deployment.

Diversifying investment: in recognition of the scale of investment required to meet clean electricity generation targets to 2030 and 2050, the CfD aims to attract new sources of investment, for example pension funds or other institutional investors. An intended outcome arising from the provision of a 15-year CfD revenue support mechanism is to attract new investors who may not have previously financed renewable energy projects.

Pot design supports innovation for emerging technologies: Pot-specific funding provides a more level playing field for less developed technologies to compete against developers with similar costs and win contracts. This support for the development of less mature technologies encourages investment in innovation and they gradually become more advanced. The stable procurement environment provided by CfDs, together with the requirement for supply-chain plans, leads to stronger, competitive supply chains, as well as technological innovation and up-skilling of the workforce.

Reduction in strike prices and costs for consumers: Taken together, the outcomes above will be indicated through lower strike prices being achieved over time, leading to overall cost reductions for consumers. The outcomes achieved through Allocation Round 1 and 2 support this theory of change, especially for Pot 2 emerging technologies. As shown in the fall in strike prices for Offshore wind and ACT technologies, in Figure 3 below.

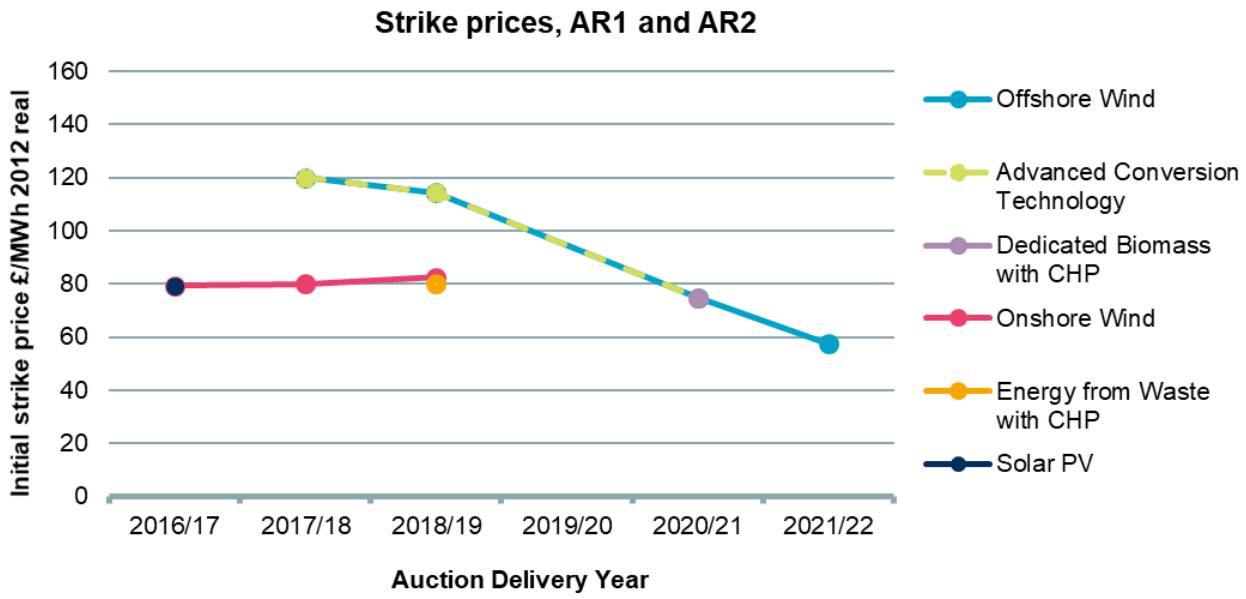


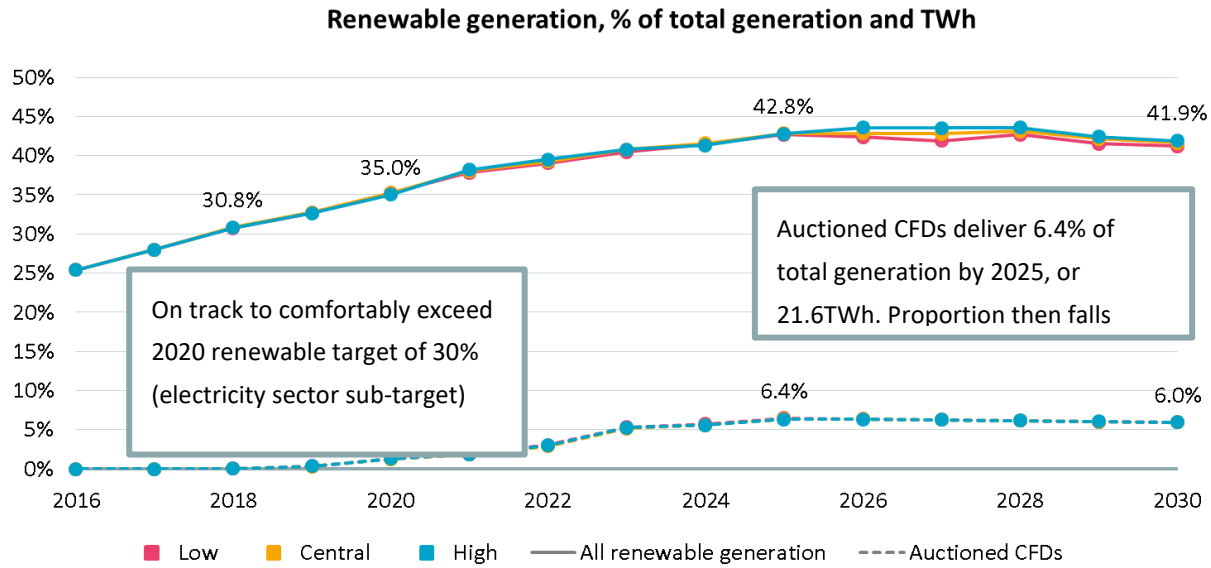
Figure 3. Average strike prices by delivery year. Source: LCP analysis based on CfD register 25/01/2019

Theory of Change: Impacts

CfDs make positive contribution to decarbonisation targets in a cost-effective way: The increased investment in low-carbon generation leads to a reduction in emissions, helping the UK comply with its domestic and international climate obligations. Including EU led targets for 2020 (by 2020, 30% of electricity will come from renewable sources) and longer-term domestic Carbon Budgets targets through to 2050 (reduce CO2e by 80% by 2050 compared to 1990 baseline).

If committed projects deliver as planned, then they are currently forecast to contribute towards these targets being successfully met.

Figure 4 CFD Renewable generation, by % of total electricity generation



Source: LCP Composition Analysis (2018)

CfDs make positive contribution towards delivering Industrial Strategy: Revenue for generators is stabilised, giving developers and their investors assurance that their businesses will be viable, attracting inward investment into the UK. The supply chain plans create a competitive environment for supply-chain growth. The Pot structure to support innovation in emerging technologies results in first mover advantage for UK based developers; increasing opportunities to export technologies internationally. Together, these maximise investment opportunities and bolster UK interests.

2.4. Risks and assumptions: alternative hypotheses

The Theory of Change section above provides a positive summary of how the Scheme's design can lead to the achievement of its objectives. There are of course a range of risks and assumptions embedded here, including ways in which investors may not respond to the Scheme as expected or reasons why projects will not be delivered as planned. This section summarises these risks, in order to highlight potential unintended consequences and alternative theories of change which the evaluation will explore in order to assess whether the Scheme is on track to meet long-term objectives.

Risks are categories under two main heading; Scheme Design Risks (which relate to the design of the scheme itself) and External Market Risks (e.g. factors which are beyond the direct control of the scheme, such as changes to wholesale price of electricity).

Scheme Design Risks

Allocation Risk: the introduction of auctions creates a new form of 'competition risk' for participants, increasing the cost of capital for investments which occur prior to an auction. Prior to participating in an auction, the developer will have to complete a range of development work stages, including: undertaking technical feasibility studies, public consultation, Environmental Impact Assessments, gaining planning permission and grid connection agreements. A report by Cornwall Insight on behalf of LCCC[11] exemplifies this by illustrating the case of East Anglia One offshore wind farm which took five years to get from initial plans through to being awarded a CfD.

During this phase, investors are fully exposed to 'development risk' given there is no guarantee they will win a CfD. This may deter some investors or increase their required rates of return. Therefore, whilst CfDs may reduce the cost of capital for developers at the post contract award stage, there is a risk that it will not reduce overall investment costs when the whole project lifecycle is accounted for.

Assumptions on competitive auctions: a precondition for successful auctions is sufficient competition. Supply must exceed demand in a way that enough bidders are attracted to participate and to submit competitive, but realistic and deliverable bids. The first two Allocation Rounds have been successful in attracting sufficient numbers of participants to trigger auctions and the reduction in strike prices between rounds suggests that the competitive nature of auction has achieved its aims in terms of lowering costs. However, it remains to be seen whether this level of competition will continue in future, or whether previously unsuccessful project developers may be deterred from bidding in future.

Strategic bidding: given the competitive nature of the auctions, bids will in part be determined by perceptions of what price their competitors may bid. The "pay as clear" design means that the clearing price for each delivery year will be that of the highest successful strike price bid in that year. A negative consequence is therefore that some bidders may submit unrealistically low bids, in the expectation that the clearing price will be higher and they will be awarded a contract at that rate. This can result in contracts being awarded to projects that are not financially viable to deliver.

- **Pot Design** and barriers to participation for less developed technologies. Although a Pot for "Less Developed Technologies" is in place, some of the less mature technologies within this pot may struggle to compete with others, such as offshore wind, which may be considered more mature. This may inhibit investment in R&D and innovation for these technologies.

[11] The EMR Schemes; Simplifying, Streamlining and Alignment. Cornwall Insight. 2018.

Non-delivery disincentives – The LCCC manages contracts to ensure they begin generating within agreed timeframes. A series of non-delivery penalties are in place to disincentivise late delivery or non-delivery of projects. However, the success of the CfD Scheme depends on attracting sufficient numbers of developers to ensure competition. If non-delivery disincentives are perceived as being too risky or if administrative work required to meet contract management milestones is perceived as too resource intensive for some (smaller) developers, then an unintended negative consequence of non-delivery disincentives may be that they deter sufficient numbers of developers applying in future.

- **A non-delivery disincentive** to discourage strategic bidding is that in cases where developers refuse to sign a contract that has been offered, a 13-month planning permission block is placed upon developing renewable energy projects on the proposed location. One potential negative outcome is that this delays the deployment of renewable projects, with the feasible location being blocked for any potential developer to use (not just the applicant).

- **'Novelty premium' for investors** – given the CfD Scheme is still relatively new (in comparison to the long-established RO and FITs), financial investors may have concerns over how the scheme specific risks might affect delivery of proposed projects. Where uncertainty exists over new schemes, investors may add an additional 'novelty premium' to their required interest rate for providing finance. Therefore, whilst some aspects of the Scheme may provide more certainty and reduce risk (the 15-year revenue contract), other aspects (e.g. allocation risk, strategic bidding) may introduce new perceived risks for investors which could mean that overall hurdle rates are not reduced by as much as expected.

External Market Risks

Wholesale price fluctuation: The changing technology mix and arrangements within the wholesale electricity market are leading to trends of lower wholesale market prices in recent years. However, future wholesale prices are difficult to predict over ten years in advance. If the wholesale price is lower than expected for prolonged periods of time, this may result in higher-than-expected payments being levied on suppliers via the Suppler Obligation, with increased costs to consumers.

Site availability and construction costs: the availability of prime locations for large scale developments (e.g. offshore wind farms relatively close to shore) will gradually decrease in future and increase development costs. This may limit the extent to which LCOEs, and strike prices, will continue to decrease.

Changes to Supplier Obligation and consumer willingness to pay: A recent report by Cambridge Economic Policy Consultants[12] highlighted a number of ways in which recent electricity market reviews may limit the scope for payments to be made to CfD developers, including:

- The introduction of a price cap on electricity bills to protect consumers may limit the scope for increasing levies on Supplier Obligation (SO) to pay for CfD projects.
- Similarly, if increasing numbers of consumers are given exemptions to SO components of bills e.g. energy intensive industries, or households using local sources of renewable supply, this would decrease the base of customers on which to collect levy payments.
- The Targeted Charging Review that Ofgem could reform the embedded benefits that are available to renewables and the profitability of CfD projects.

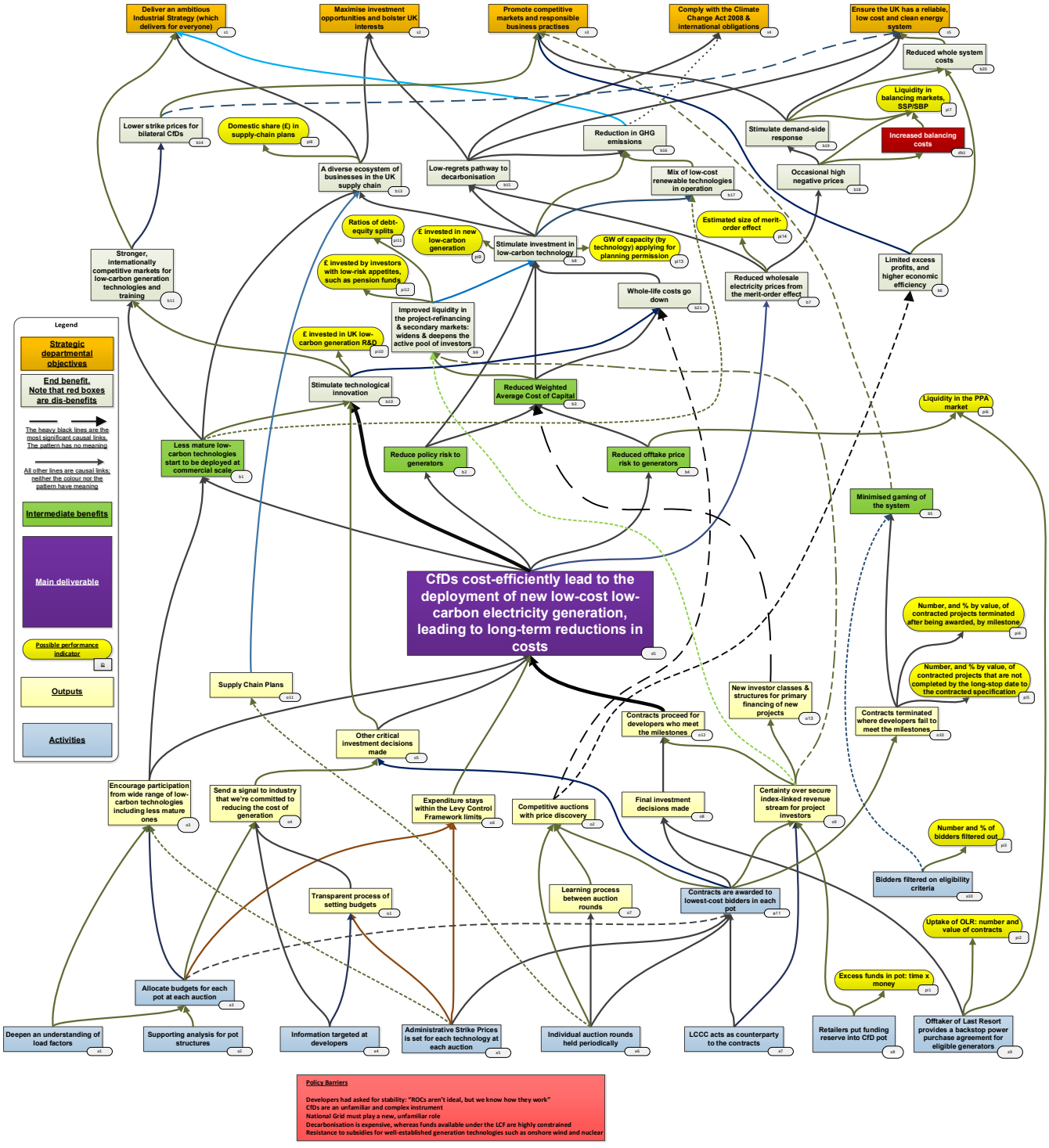
The above list of risks and assumptions provided an outline of issues to explore in primary research interviews with developers and investors in order to assess which are low/high risks and the extent to which they may affect achievement of intended objectives.

A separate scoping phase study carried out by University College London (UCL), commissioned prior to this evaluation, provided a Policy Map, which illustrates the causal links of the Theory of Change in a flow chart diagram and is reproduced overleaf.

[12] The EMR Schemes: Coherence Analysis: Market Evolution vs EMR. Cambridge Economic Policy Analysis Ltd on behalf of the LCCC. 2018.

CfD Scheme Policy (By UCL, on behalf of BEIS, 2017)

Contracts for Difference POLICY MAP



2. Context Mechanism Outcome configurations (CMOs)

The previous sections provided a Theory of Change for how the Scheme will lead to its intended impacts and then risks and assumptions for delivering these. In reality, a mix of both is likely to be true; while many projects will deliver the outcomes that are intended, the risks involved means that some level of unintended negative outcomes can be expected. Adopting principles of a realist approach, the evaluation will investigate, test and refine the programme's Theory of Change (ToC), to focus not only on what overall impacts have been achieved, but to understand the causal pathways of how they were achieved, and how this may be driven by differences in contexts.

Realist evaluation is concerned with unravelling the "inner mechanisms" at work in different contexts. As described by Barbara Befani (2016[13]), this can entail refining the ToC into one or more Context-Mechanism-Outcome (CMO) configurations, where **Contexts** are made of resources, opportunities and constraints available to the beneficiaries; **Mechanisms** are choices, reasoning or decisions that individuals take based on the resources available in their context; and **Outcomes** are the product of individuals' behaviour and choices.

Breaking an overall programme ToC down in this way also enables us to provide a more nuanced understanding of how developers respond to the Scheme and the causal pathways to outcomes.

The development, testing and refinement of CMOs is an iterative process. This Annex provides an assessment of draft CMOs that were developed prior to the analysis phase. Including the extent to which responses from developers supported programme or alternatives theories described in each draft CMO. The findings from this Phase 1 stage of the evaluation suggest that other contextual factors which were not explicitly stated in the draft CMOs were important in influencing how different groups of developers responded to the scheme and led to different outcomes. For example, whether the developer had participated in AR1 as well as AR2, whether they part of a large multi-national development firm with an international portfolio of renewable development projects, and whether they developed more than one type of technology. Development work in advance of Phase 2 fieldwork will take account of these findings to revise these draft CMOs and the overall programme theory of change.

[13] Choosing Appropriate Evaluation Methods: A Tool for Assessment and Selection, October 2016. Bond.

Objective 1: Increase investor confidence to attract greater investment at a lower cost of capital and from a wider pool of sources.

Introduction

A number of contexts influence how developers and investors will respond to the CfD Scheme's offer to bid for a 15-year price stabilisation contract. Differences in context may include: investor's appetite for risk, which can vary by type of investor (e.g. banks and debt providers, private equity investors, pension fund manager or large utility company), the stage of project development (pre or post contract award), the developer's previous experience in implementing projects of similar scale and the developer's estimates of future rise or fall in costs of technologies.

These may all influence responses such as willingness to invest in a project's development at pre-auction stage or the required rate of return if doing so (hurdle rate). This is turn will contribute towards variation in the extent to which intended outcomes are achieved, including: aims to diversify investment sources, increased total investment and lower costs of capital for developers.

The following draft Context-Mechanism-Outcome (CMO) configurations illustrate how these differences in context may lead to differences in response from stakeholders (mechanism) and then either intended or unintended outcomes.

Objective 1: Increase investor confidence to attract greater investment at a lower cost of capital and from a wider pool of sources

CMO 1 - Participation theory for investors (Timing: pre and post contract award development stages)

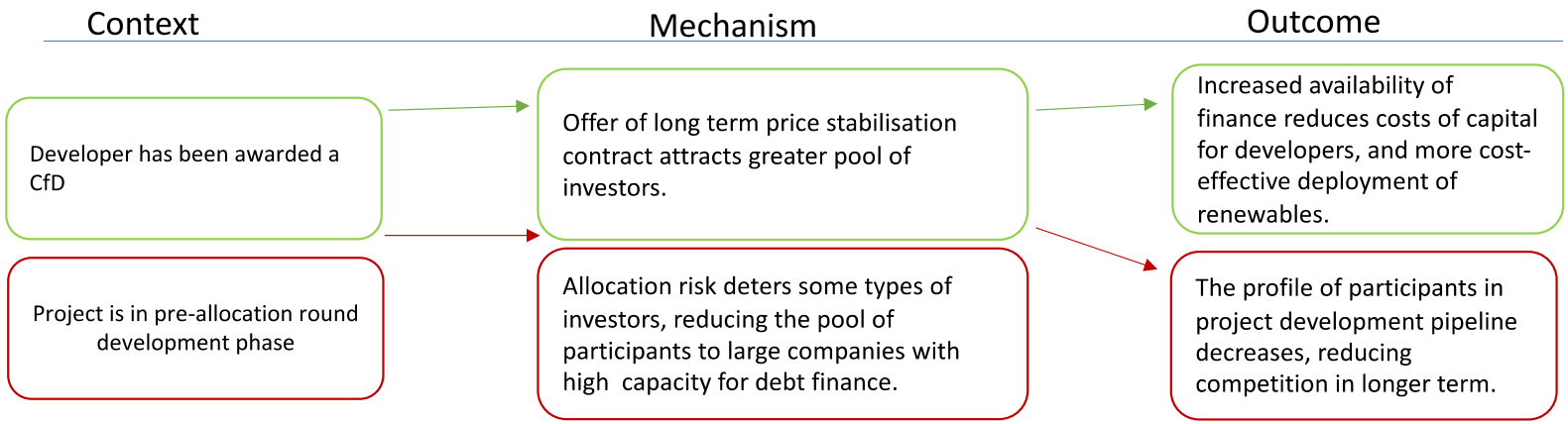
Notes: the key difference in context explored here is timing and stages of project development. Prior to award of the CfD, a proposed project is subject to allocation risk. At this stage it is less attractive investors with lower thresholds for risk (e.g. pension fund managers). After a CfD is awarded, allocation risk has been mitigated and the project may become more attractive to a wider pool of different types of investors.

Programme theory:

- If the project has been awarded a CfD contract (Context) then the assurance provided by long term (15 year) revenue stabilisation guarantee (mechanism – resource) will attract a wider pool of different types of investors to decide to invest (mechanism - response). The increased competition within financial markets helps to to reduce hurdle rates and lowers costs of capital for developers (outcome).

Alternative theory:

- If the project has not yet been awarded a CfD (Context) then the allocation risk associated with competitive auctions (mechanism-resource) may deter investors from providing finance to projects at this stage (mechanism -response). This leads to increased reliance on developers' own capacity for debt finance to cover costs until allocation of contract. This allocation risk limits participation to larger developers and utility companies, reduces the pipeline of participants and reduces competition in longer term (unintended outcome).



TESTING CMO1

Interviews with developers

Our interviews with developers asked questions around what effect the introduction of the CfD Scheme had on both attracting developers to participate in the Scheme and attracting additional investment from third party finance providers after a contract had been awarded. We probed for responses on the extent to which award of CfD reduced risks for investors, and lowered costs of capital for developers. In addition, we asked about the effects of 'allocation risk' e.g. whether the risk of winning a contract at the pre-auction phase would deter some developers from participating, or third-party investors from agreeing to invest until after contracts were confirmed. We also asked general questions around whether the CfD Scheme, on the whole, was more attractive to investors than the RO, taking both the benefits of CfDs and the allocation risk into account.

Using Nvivo we coded responses that supported either the CMO 1 Programme Theory (PT) or the Alternative Theory (AT). This included interviews with developers who held a CfD contract and also the interviews with developers who do not (either through non-participation in the Scheme or having bid in a previous allocation round but not been successful). The types of evidence used in support of both the Programme and Alternative Theories are summarised below.

- **Evidence in support of Programme Theory** - Code for instances where developer states that the assurance provided by the price stabilisation contract attracted either their developer company to participate in the Scheme or other private investors to invest in their project. This included explanations of how the award of a 15-year CfD had reduced risks for their investors and associated costs of capital. In particular, we looked for instances where the respondent indicated that the potential prize of a CfD contract outweighed the allocation risks. For example, the potential prize of a 15-year CfD made it worthwhile to invest in pre-allocation development phase development work and to participate in auctions.

- **Evidence in support of Alternative Theory** - Code for instances where respondent discusses the impact of allocation risk as a deterrent from their company or others from participating in CfD Allocation Rounds (either past or future Allocation Rounds) or from investing in projects that are still in the pre-award phase.

Examples of responses that were coded as evidence in support of the Programme Theory include those which supported the point that the award of a CfD with its 15-year price stabilisation were viewed as beneficial for reducing risks for the developer and costs of capital. Including:

> *The CfD contract has a number of benefits which help reduce the cost of capital. We have [x] contracts under the CfD, and others under the RO. In comparison to the RO, the CfD does have an allocation risk, given the*

competition for contracts. Which in some regards is less attractive than a quota led scheme, but overall, we are more supportive of the CfD Scheme. (Developer, multiple technologies)

Our view is that the CFD is a more attractive proposition for investors than the RO, as it mitigates exposure to UK power price volatility, which is a significant risk to return in power generating projects. The CfD acts as a natural hedge against this risk and allows the project developer to lock into a long-term PPA with a certain rate of return. It is this stability, as much as the additional subsidy that is the critical factor in reducing costs of capital and attracting investors. (Developer, Offshore Wind)

Absolutely, definitely, it's good for investors (award of a CfD). It definitely reduces the risk for investors as it gives an idea of their return rates and the value of the project resulting from that. Broadly speaking, the best scenario for low hurdle rates is CfD, then ROCs in the middle, then no subsidy as the worst option. This is due to the volatility of the income of those different scenarios. (Developer, Onshore wind)

Examples of responses that support the theory that the CfD is attractive to a broader pool of different types of investor (CMO1 PT) include:

The CfD scheme is more attractive to banks, and we found there is more competition among lenders to provide funding than under the RO. The CfD structure seems to be very attractive to both equity and debt investors (developer, multiple technologies)

They (CfD projects) are partly debt financed by banks and partly funded by pension fund investors. The CfD scheme has very quickly become established with lenders, and they are all very keen to fund the projects. (Developer, Onshore wind)

Examples of responses in support of the **Alternative Theory for CMO 1** include:

We're having discussions at Board level as to whether it is worth re-engaging with the CfD bid process due to the cost and complexity and poor chance of success due to the inappropriate award criteria (ACT developer)

Development is very risky now. You have to put somewhere between a £1m / half a million on the line to get a project to a state where it could bid for a CfD. Only then you go into an auction where you have fundamental uncertainty about whether you will get the tariff or not. With ROCs there was a clear target price, so the challenge was meeting that known target. With CfDs we don't know if we will win a contract, which makes the development process too risky for us. (ACT developer)

In comparison with the ROs there was no allocation risk back then. If the project was designed in a way that it is a renewable project which complied with RO regulations, you could develop it and whenever you are ready…But with the CfD you need to go and get planning consent which costs you around £250,000, plus around a year of work to get planning consent. Also, you need the grid connection which also costs you significantly. All

of this needs to be done before you even be able to enter the auction and you might not even get it then.
(Developer, multiple technologies)

The auction process means development is too risky and competing with other technologies means the prices are too low. And the CHP technology specific factors means there is a very real risk of total loss. There is no hurdle rate for a project with that level of risk. It simply can't be done. (Dedicated Biomass with CHP developer)

Overall results

Interview transcripts were analysed at a case-by-case level (e.g. one interview at a time) to code for examples where respondents indicated support for the CMO1 Programme Theory (PT) or Alternative Theory (AT). To provide a sense of the overall proportion of respondents that gave responses in support of CM01 PT or AT, data queries were run in Nvivo to provide counts of the numbers of responses in support of each CMO theory.

In some instances, the same developer interviewed may be coded as having given some responses that were in support of the PT as well as other responses that were coded as being support of the AT. This was common where the developer firm had a broad portfolio of developing, or investing in, different types of renewable energy technologies. In these cases, some responses gave support to the theory that introduction of the CfD was beneficial for attracting investment in the context of offshore wind development (in support of PT) but when considering their experience of investing in other forms of emerging technologies (such as marine technologies), would explain that the allocation risk is greater and therefore the alternative theory was applicable in that context.

Table 12 below provides a summary of overall results, split by whether the respondents were developers with a CfD contract or those without a CfD.

	No of CfD developers supporting	No of Non-CfD Developers supporting	Total no of cases in support of each theory
CMO1 Programme Theory	15	4	19
CMO1 Alternative Theory	7	8	15

Table 8. Frequency of cases in support of CMO1 PT or AT

Interpretation of results and difference by context

Developers who had won a CfD were more likely to provide responses in support the Programme Theory. For them, it was self-evident how the award of a CfD was attractive to investors and could reduce the costs of capital in their projects. There was a general consensus across developers of all types of technology who had won a CfD that it increased their access to finance and reduced costs of capital (or reduced their company's

own internal hurdle rate where funded from own balance sheet). In this Context, the "mechanism-response" to the offer of investing a project with a CfD was said be increased attraction among investors, leading to the types of **outcomes** described in CMO 1 (lower costs of capital and more cost-effective deployment of projects).

However, some developers with a CfD also provided responses in support of the Alternative Theory when considering the how certain types of technology they previously developed were no longer likely to win a CfD, including solar, onshore wind and marine technologies. In addition, some developers of ACT technologies, who had won a CfD previously now considered that the competition to win a contract in future rounds would be so high that the risks of not being awarded a contract may outweigh the costs of participating in Scheme. Here, the main difference in context that accounted for these responses was type of technology, and perceived likelihood of these technologies being awarded a CfD in future allocation rounds.

Developers who had not won a CfD were more likely to provide responses in support of the Alternative Theory. This was emphasised particularly among those who had bid at previous auctions and been unsuccessful. In this context, the implications of allocation risk in terms not being able to progress with projects without a CfD were strongly expressed.

Developers and investors in renewable who had not participated in previous auctions at auctions at all expressed mixed views. These were companies who may have previously developed a project in the UK under the RO, or invested in one, but had not yet participated in the CfD Scheme. For example, developers of onshore wind and solar projects, where there had not been opportunity to obtain a CfD since Allocation Round 1. The potential benefits of the CfD in terms of reducing risks and costs of capital, were recognised, although overall it was considered a less attractive Scheme to the RO given the opportunities for project progression were now more limited.

Conclusions

Overall, the majority of developers interviewed provided responses in support of the CMO1 Programme Theory that award of the CfD reduces risks, attracts more investors, and reduces costs of capital. The main difference in Context tested in this CMO was how this varied by timing and phase of project development (pre or post contract award stage). Support for the Alternative Theory and Programme theory were not mutually exclusive, as it was valid for a developer to provide the view that introduction of the CfD Scheme has increased risks for developers and investors at the pre-allocation stage (particularly for higher cost technologies), but then if awarded a CfD, the project was more attractive to investors.

We explored the question of whether on the whole, is the CfD Scheme more attractive to developers of renewable technologies than the RO, taking both the benefits of CfDs and the allocation risk into account. Here, the main difference in context that accounted for the

varied responses was type of technology and **perceived likelihood of these technologies being awarded a CfD in future allocation rounds**.

The CMO1 PT is more likely to hold true for **developers of offshore wind**, than for developers of less competitive technologies, or technologies that were included within Pot 1, where there have been no further opportunities to participate since Allocation Round 1 (e.g. solar and onshore wind). In summary, the extent to which the scheme is attractive to developers is correlated with types of technology, and the perceived likelihood of proposed developments for those technologies being awarded a CfD.

In drawing conclusions from these interview responses, it is important to consider the profile of CfD participants; in terms of the developers of which technologies have participated in the scheme and successfully been awarded a CfD. The CfD Register shows that developers of a range of 6 different types of technology have successfully been awarded a CfD. For these developers at least, the potential prize of a CfD outweighed the allocation risk. It is not known how many developers of other types of technology applied and were unsuccessful.

The relatively small number of projects awarded a CfD in AR2 (11) and the smaller range of technologies these represent (3), provides further background context when considering why developers of other technologies (e.g. Pot 1, or unsuccessful Pot 2 technologies) may perceive introduction of the scheme to have limited their opportunities for development.

Technology	AR 1 Projects	AR 2 Projects	Total projects covered by AR1 and AR2
Advanced Conversion Technologies	3	6	**9**
Dedicated Biomass with CHP	0	2	**2**
Energy from Waste with CHP	2	0	**2**
Offshore wind	2	3	**5**
Onshore wind	15	0	**15**
Solar	5	0	**5**

Technology	AR 1 Projects	AR 2 Projects	Total projects covered by AR1 and AR2
Total development projects covered through interviews	27	11	**38**

Table 9. Breakdown on auctioned CfD projects by technology. Source: CfD Register

Objective 2: Decarbonising at least cost - Minimise risk of overcompensation and ensure value for money for consumers.

Introduction

One of the key Scheme design features which prevents overcompensation is the agreed strike price over a 15-year period. If wholesale prices rise above the strike price, the developer pays back the difference, preventing overcompensation.

Some contextual factors which will affect whether or not this ensures value for money for consumers include:

- Whether the agreed strike price was originally set too high (potentially higher risk for Allocation Round 1, before prices were revealed)
- The developers' bidding strategy, and their perception of opportunity to win contracts at an overly generous clearing price
- The developers' perception of levels of competition and the extent to which perceived high competition can drive down costs and minimise likelihood of submitting over-inflated bids when applying
- If the agreed strike price is too low, and future wholesale prices rise higher than expected, then there is a risk some generators may deliberately break the terms of the contract if they believe it is feasible to receive better rates by selling the electricity through a new form of PPA. Whether or not non-delivery penalties are perceived as sufficiently severe to act as a disincentive may influence this. Note this is not likely to be a risk for projects awarded a CfD under Allocation Round 1, given strike prices agreed were relatively high. It may also be considered a minimal risk for some Allocation Round 2 projects, but potentially more of a salient risk for Allocation Round 3, where clearing strike prices may be closer to wholesale prices.

CMO 2: (allocation risk and bidding strategy)

Programme Theory (green in diagram on next page):

- If the developer is experienced and has implemented projects of similar scale in the past (Context) they may regard the security of revenue (mechanism – resource) the CfD provides as attractive and submit a realistic bid at a financially viable price (mechanism - response) because they are confident their project is competitive and their cost estimates for development are built upon experience (context). The mix of competition and deliverability leads to lower strike prices and cost-effective deployment of renewable energy (intended outcome).

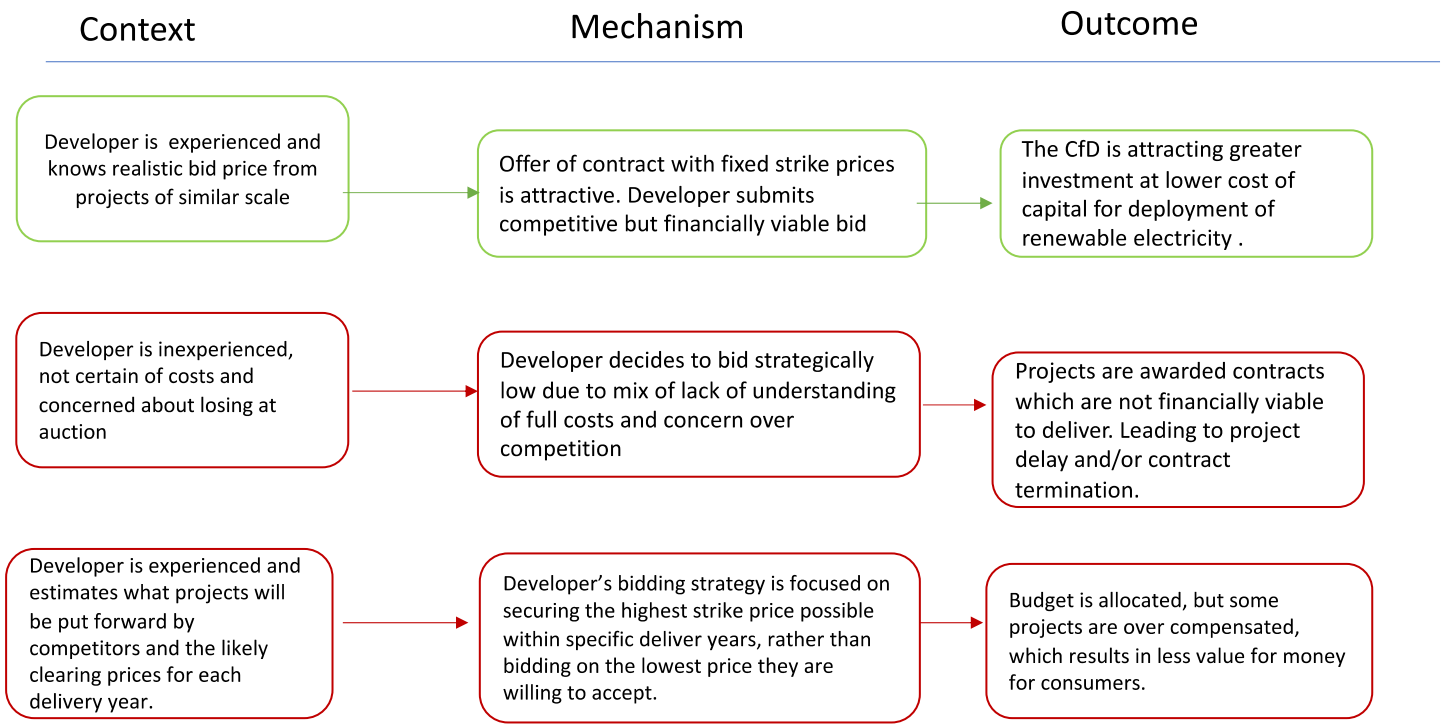
Alternative Theories (red in diagram below):

- AT1 - In the context where the developer is inexperienced and is concerned with high competition and losing at auction (Context), they may also regard the security of revenue the CfD provides as attractive (mechanism – resource), however, their concern over **competition** leads to submission of bids which are unrealistically low (mechanism - response) and award of contracts to projects that are not financially viable to deliver. This results in contract termination and non-deployment (unintended outcome).

- AT2 - In the context where the developer is experienced and is able to estimate the likely bid price of their competitors and/or the delivery years of other bidding projects (Context), they may also regard the security of revenue the CfD provides as attractive (mechanism – resource) but implement a bidding strategy which aims to secure the highest possible strike price for particular delivery years (mechanism – response), rather than their least cost bid, because they are confident that sufficient budget will be allocated within their delivery years (context). This focus on maximising strike prices may lead to overcompensation (unintended outcome).

Objective 2 Decarbonising at least cost - Minimise risk of overcompensation and ensure value for money for consumers

CMO 2: Participation theory for developers (allocation risk and bidding strategy)



TESTING CMO2

Sources of evidence

The primary source of evidence for assessing the extent to which the CfD Scheme is meeting objectives around ensuring value for money at an overall Scheme level (in comparison to the RO) was the cost-effectiveness analysis based upon DDM modelling, as described in Chapter 5.

In relation to assessing the prevalence of negative outcomes described in CMO2 Alternative Theory 1(CMO2 AT1), such as projects strategically bidding too low and then being unable to sign contracts at the clearing price offered, or subsequently being cancelled due to inability to reach Financial Close, we have used the CfD Register to obtain information on the numbers of projects that are currently on track and those which did not sign a contract or have subsequently been terminated. As described in Chapter 2, out of the 46 CfD individual generation units that have been awarded a CfD in the two Allocation Rounds, 7 are no longer progressing, either through non-signature or contract termination. Projects that are currently on track to be delivered represent around 96% of the total generation capacity initially awarded a CfD.

Interviews with developers

The interviews with developers were used to provide insight into how developers 'respond' to certain features of the auction design. For example, how perceptions of level competition may influence bidding behaviour and the extent to which this led to positive outcomes (e.g. low but financially viable bids) or negative outcomes (e.g. strategically bidding too low at prices that are unfeasible to deliver).

This CMO intended to assess how difference in "experience of developers" influenced their responses. In practice, it was difficult to make clear distinctions in levels of experience between the developers interviewed. Respondents interviewed represented firms which all had several years' experience of developing renewable energy projects in the UK and all had previous experience of participation in the RO. However, two distinctions relating to levels of 'experience' were observed to have influenced responses:

- Whether they had **only participated in AR 1** (where the competitive auction process was run for the first time) or whether they **participated in AR2.** In AR2, participants benefited from being able to learn from the experience of those who had bid too low in AR1 and were unable to sign contracts.

- Whether their company had participated in **renewable energy auctions internationally**. In these cases, they had more experience of developing a bidding strategy in similar 'pay-as-clear' type auctions and were well informed of the opportunities and risks this auction design offered to developers.

One challenge with assessing this CMO in interviews is that asking respondents to reveal their bidding strategy is a highly commercially sensitive issue. Developers who had bid either strategically low, or at a considerably higher price than necessary to make the project viable, would perhaps be unwilling to admit to having done so as part of a BEIS commissioned evaluation of the CfD Scheme. Therefore, the subject was approached more indirectly. For example, by first asking for their general views on pay-as-clear vs pay-as-bid auction designs, and whether or not they felt pay-as-clear had resulted in strategic bidding in the CfD auctions, and why.

Another "mechanism-response" that was explored in this CMO was the extent to which perceptions of **levels of competition** at the auction influenced bidding strategy. We do not have access to information on the total numbers of bids that were submitted in each Allocation Round (including unsuccessful applicants). Therefore, cannot independently verify the extent to which high/low levels of competition for contracts in each Pot affected the prices that were bid or cleared at. Again, asking directly whether perceived levels of competition had influenced their company to bid too high or low, may have been subject to positive confirmation bias. Therefore, this subject was also approached more indirectly, where we probed for responses around whether developers felt the competitive nature of the CfD auction design (in comparison to RO) was a factor in reducing costs and, if so, why.

Using Nvivo, the interview transcripts were coded for the following types of evidence in support of the Programme or Alternative Theories:

CMO2 Programme Theory:

- Code for instances where the responses support theory that developer had submitted a realistic bid at a financially viable price because they are confident their project is competitive and their cost estimates for development are built upon experience.
- Code for instances where respondents state they do not believe pay-as-clear led to widespread instances of strategic underbidding.
- Code for instances where respondents indicate that competition more generally was a factor in driving down costs.

Alternative Theory 1:

- Code for instances where the response indicates that concern over competition, and/or the pay-as-clear mechanism, led to submission of bids which were unrealistically low and award of contracts to projects that are not financially viable to deliver.
- Include cases where the respondent discusses their perception of this form of unsuccessful strategic bidding taking place at auctions, even if they did not admit to doing it themselves. Evidence is stronger in cases where respondents have admitted to strategic bidding.

Alternative Theory 2:

- Code for instances where respondents indicate they implemented a bidding strategy which aims to secure the highest possible strike price for particular delivery years, rather than their least cost bid, because they were confident that sufficient budget will be allocated within their delivery years.

Examples of responses indicating support for CMO2 Programme Theory (CMO2 PT), through developer's response to competition:

Competitive allocation has been one key driver of cost reduction, in comparison to demand led schemes. (Offshore Wind developer, AR2)

The competitive nature of the CfD has pushed the turbine manufactures to come up with more innovative ways of reducing costs e.g. through rotor diameters to gain better performance. (Offshore Wind developer, AR1)

Examples of responses indicating support for CMO2 Programme Theory (CMO2 PT), through developers stating they do not believe strategically bidding too low was widespread:

Speculative bidding is quite unlikely in offshore wind projects – being large infrastructure projects they are very involved in community, society and government, and so are accountable to a range of stakeholders. Our business case and bid price is approved at company Board level. A strategy based on bidding low then and pinning our hopes on bumped to an acceptable clearing price just would not be accepted. (Offshore Wind developer, AR2)

Pay as clear has worked for Offshore Wind. I don't believe that strategic bidding is a huge concern. Most developers will not bid much below the reference price (Developer, multiple technologies, AR1 and AR2)

We bid our lowest feasible price (ACT developer, AR2)

Examples of responses indicating support for CMO2 Alternative Theory 1 - that concern over competition, and/or the pay-as-clear mechanism, led to submission of bids which were unrealistically low and award of contracts to projects that are not financially viable to deliver:

We found that we were almost alone in bidding for the first year and so, our very low bid didn't get a reasonable strike price, everyone else had the same strategy and it left us with an unfinanceable bid. (Participant in AR1, contract awarded but not signed)

In theory, in a perfect market, pay as clear and pay as bid, should give the same result. But what we've seen, particularly for solar, is that some developers have bid too low in the hope of getting a higher price at clearing, and then projects are being cancelled. I can see benefits of pay-as-clear, but perhaps

there needs to be a tightening of non-delivery disincentives e.g. financial penalties like a bid bond, rather just been banned from developing on the site for a couple of years (investor in Solar projects)

My view is that pay as clear effectively encourages gambling. (Developer, multiple technologies)

We bid at a real price that was assessed as being financially viable for the project to proceed. However, because of the way the pay as clear competitive auctions are run, other biomass and ACT companies bid in strategically lower. This means that they were awarded the contracts and we lost out. But they bid too low and were not viable, so many of them are now being cancelled (Unsuccessful applicant, AR1)

Alternative Theory 2 – we found no instances of respondents stating that they had deliberately bid higher than necessary because they were confident that competition would be low and sufficient budget will be allocated within their delivery years.

Overall results

Interview transcripts were analysed at a case-by-case level to code for examples where respondents indicated support for the CMO2 Programme Theory (PT) or Alternative Theory (AT2). To provide a sense of the overall proportion of respondents that gave responses in support to CM02 PT or AT, data queries were run in Nvivo to provide counts of the numbers of responses in support of each CMO theory.

In some instances, the same developer interviewed may be coded as having given some responses that were in support of the PT as well as other responses that were coded as being in support of the AT. This was common where the developer stated that they had bid a real price (competitively low, but financially viable), although they believed that strategic bidding had been common in the auction among other participants.

Table 13 below provides a summary of overall results, split by whether the respondents were developers with a CfD contract or those without a CfD (including unsuccessful applicants).

	Developers with CfDs	Developers without CfD	Total in support of each Theory
CMO2 Programme Theory	7	2	9
CMO2 Alternative Theory 1	5	5	10

	Developers with CfDs	Developers without CfD	Total in support of each Theory
CMO2 Alternative Theory 2	0	0	0

Table 10. Frequency of responses in support of CMO2 PT and AT.

Responses were only coded if they provided examples of support for the descriptions of the Programme or Alternative Theory. Some respondents gave views that were not coded as supporting either the of the theories. In these cases, the main reasons include:

- Being unsure or ambivalent towards whether or not pay-as-clear may result in different bidding strategies to pay-as-bid. Here the response did not indicate a clear opinion either way
- Providing short answers to questions on bidding strategy and being unwilling to discuss this openly due to the commercially sensitive nature of the topic.

Interpretation of results and difference by context

Overall the results are mixed, as there was no clear general consensus among developers in support of the CMO2 PT or AT. However, as shown in table above, developers without a CfD more commonly gave responses in support of the Alternative Theory. This was most strongly expressed among developers who had **unsuccessfully bid** in previous auctions. Primarily among the few cases where the respondent openly admitted to having strategically bid too low and then not been able to accept the strike price offered. Or where they believed they lost out at the auction because other developers in the same Pot had **bid strategically low** and are now struggling to reach Financial Close and implement their contract.

Support for the CMO2 Programme Theory was slightly more common amongst developers with a CfD. The key contextual factors which appear to have influenced this were:

- **Type of technology** – developers of **offshore wind projects** were almost unanimous in the view that bidding strategically low, or too high, is unlikely for large offshore projects, where the business case may relate to investments of over a £billion. Here, a strategy based on hoping for a favourable clearing price was considered too risky for the amount of investment at stake. This difference is likely to be driven by the scale of the investment and level of scrutiny involved, rather than because it relates to the Offshore wind technology itself. Business cases and the price to bid at were said to be subject to lengthy internal scrutiny, with the resulting strategy based around bidding a price bid at auction which should be competitively low enough to win, but financially viable to deliver.

- **Allocation Round 2** – participants in Allocation Round 2 more commonly gave responses in support of the Programme Theory (regardless of the type of

technology they develop). Instances of projects that had bid too low in AR1 and been unable to sign contracts or progress to Financial Close were discussed by respondents, indicating this may have influenced their bidding strategy to avoid such negative outcomes.

Conclusions from these findings should be treated with caution given the relatively low number of responses that clearly supported the programme or alternative theories. This in part may be due to the commercially sensitive nature of the topic of bidding strategy. Very respondents openly admitted having bid strategically low themselves, with the aim of getting a higher price through clearing. Although many did express views that they believed other developers in the auction had done so, particularly at AR1 and generally for projects with relatively small generating capacity.

Overall, the evidence does not entirely support or refute either the programme or alternative theories. Respondents gave views in support of each, with the main differences in context being around the size and scale of the project (and scrutiny of investment decision) and whether or not discussion related to AR1 or AR2.

Objective 2: Decarbonising at least cost - Minimise risk of overcompensation and ensure value for money for consumers

CMO 3– Delivery risks and non-delivery disincentives.

The Scheme can only be considered a value for money approach to supporting deployment of renewable electricity if the CfD contracted projects actually become operational and generate electricity. There is a risk that some developers may speculatively submit low bids in the hope of achieving a higher strike price through clearing, but then do not sign the contract (or deliberately break it) if the strike price awarded is too low - and they view the non-delivery disincentives as being an insufficient deterrent (e.g. a risk worth taking).

There is also a risk that if **future wholesale prices** of electricity are forecast to rise significantly higher than expected at the time the strike price was agreed, then a developer may deliberately break the contract in order to secure a more attractive PPA. This is perhaps more a risk for future Allocation Rounds.

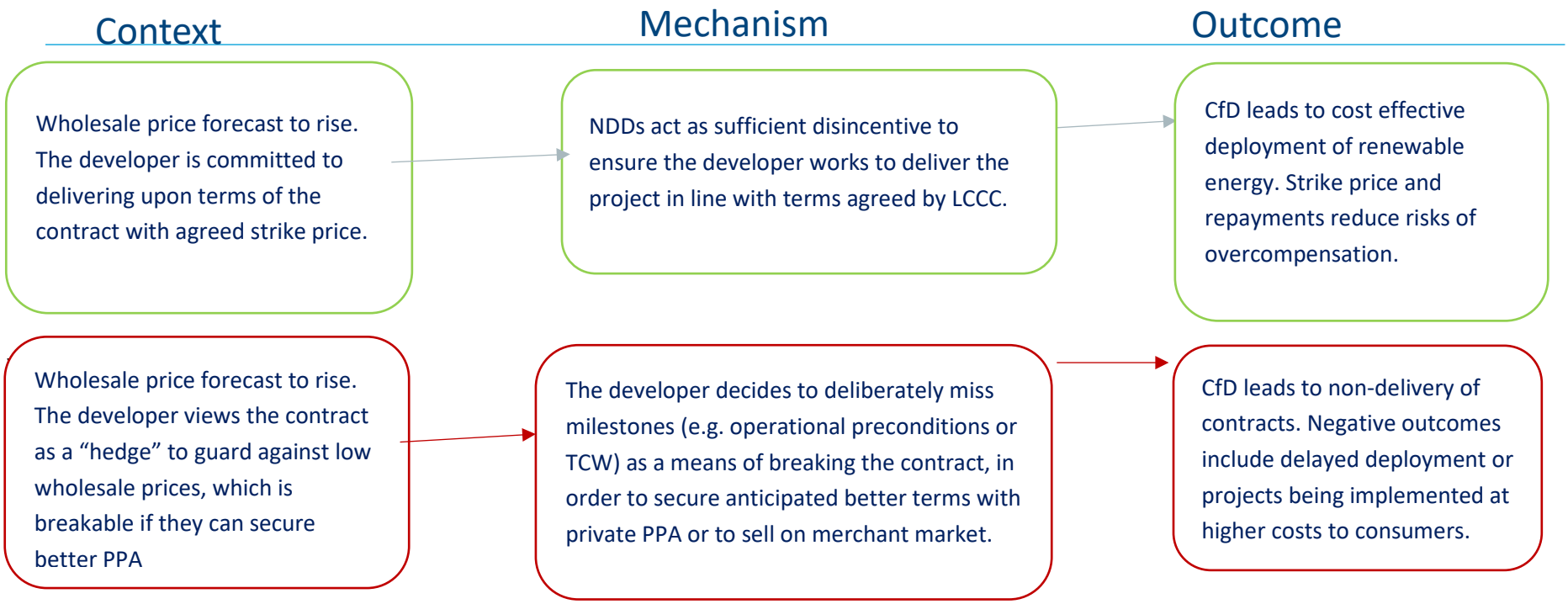
Programme theory:

- Even if wholesale prices rise higher than expected after contract award (Contexts) the non-delivery disincentives (mechanism-resource) will be sufficient to commit the developer to implement and deliver their project (mechanism - response). The agreed strike price and repayment rules mean that developers are not overcompensated, ensuring value for money for consumers (outcome).

Alternative theories:

- In the context in which developers perceive the non-delivery disincentives (e.g. temporary restriction from developing on a specific site) to be a weak deterrent (context) then they may submit a speculatively low bid in the hope of achieving a higher strike price through clearing (mechanism – response). If the strike price awarded is not considered sufficient for the developer, they may break (or not sign) the contract awarded and not proceed. This can lead to non-deployment of renewable electricity and loss of opportunity through budget not being allocated to other potentially viable but unsuccessful applicants (unintended outcomes).

- If wholesale prices rise higher than expected after contract award and the agreed strike price is considered to be too low by the developer (Contexts), the non-delivery penalties may not act as a sufficient deterrent against deliberately breaking their contract (mechanism - resource). For example, by missing milestone delivery dates (mechanism-resource). The generator may then create a new form of private PPA at a higher price, increasing the costs to consumers (negative outcome).


Context
Mechanism
Outcome
Wholesale price forecast to rise. The developer is committed to delivering upon terms of the contract with agreed strike price.
NDDs act as sufficient disincentive to ensure the developer works to deliver the project in line with terms agreed by LCCC.
CfD leads to cost effective deployment of renewable energy. Strike price and repayments reduce risks of overcompensation.
Wholesale price forecast to rise. The developer views the contract as a “hedge” to guard against low wholesale prices, which is breakable if they can secure better PPA
The developer decides to deliberately miss milestones (e.g. operational preconditions or TCW) as a means of breaking the contract, in order to secure anticipated better terms with private PPA or to sell on merchant market.
CfD leads to non-delivery of contracts. Negative outcomes include delayed deployment or projects being implemented at higher costs to consumers.

TESTING CMO 3

It is currently too early in the process to observe how contracted developers will respond to spikes in increased wholesale prices of electricity and whether this may be sufficient incentive to discontinue their CfD, in order to progress on merchant terms. This CMO was developed to be forward looking; as one to be kept under review and potentially explored in Phase 2 and Phase 3 of the evaluation (after Allocation Round 3).

As outlined in Section 2, evidence from the CfD Register suggests that very few projects have not signed a contract once offered. Also, only a small minority have had their contracts terminated at this stage.

There is therefore little evidence in support either of the CMO3 Alternative Theories at this stage. As discussed in Section 3 in relation to views on pay-as-clear auction design, some developers may have viewed the penalty of being excluded from develop on the site proposed for a period of 13 months[14] if they refuse to sign the contract as an insufficient deterrent to their longer-term implementation plans. For example, one proposed 15 MW Solar project which was offered a CfD in AR1, declined to sign at clearing price offered and was subject to NDD penalties. However, the developer later went on to build the project by splitting it into three 5MW generation units, so that it was eligible for FITs.

Other developers with an international portfolio commented that the NDD in the CfD scheme is a relatively weak penalty in comparison to other renewable electricity auctions in other countries. It was suggested that inclusion of financial penalties for non-contract signature (such as bid bonds or deposits), which are used in other countries[15], may act as a further deterrent against speculative biddings.

This indicates there is potentially insufficient deterrent to break the contract in the context of rising wholesale prices. However, the benefits of having a 15-year CfD, in terms of providing assurance over financial profile and reducing costs of capital, were commonly described as being a strong incentive to deliver the contract.

[14] 13 months was the exclusion period for AR1, which has since been amended to 24 months.
[15] See Rapid Evidence Assessment Annex for review of non-delivery disincentives used in other countries.

Objective 3: The CfD Scheme is attractive to a broad range of energy sources (investment in proven technologies, as well as less mature technologies).

Participation theory: pot design ensures an appropriate level of competition between technologies with similar costs. The differences in prices awarded to less mature technologies in Pot 2 means that technologies with potentially strong future learning curves can still receive support. Outcomes include diversity in forms of supply (reducing the risks of intermittency from a few dominant sources) and supporting innovation and future cost reduction for less mature technologies.

In addition, the allocation of different strike prices by delivery years enables smaller projects with relatively high overall costs, but quicker implementation periods to win contracts (for example, smaller biomass projects compared with offshore wind). This helps maintain competition between technologies and continue diversity in supply.

CMO 4 – Pot Design and support for less mature technologies

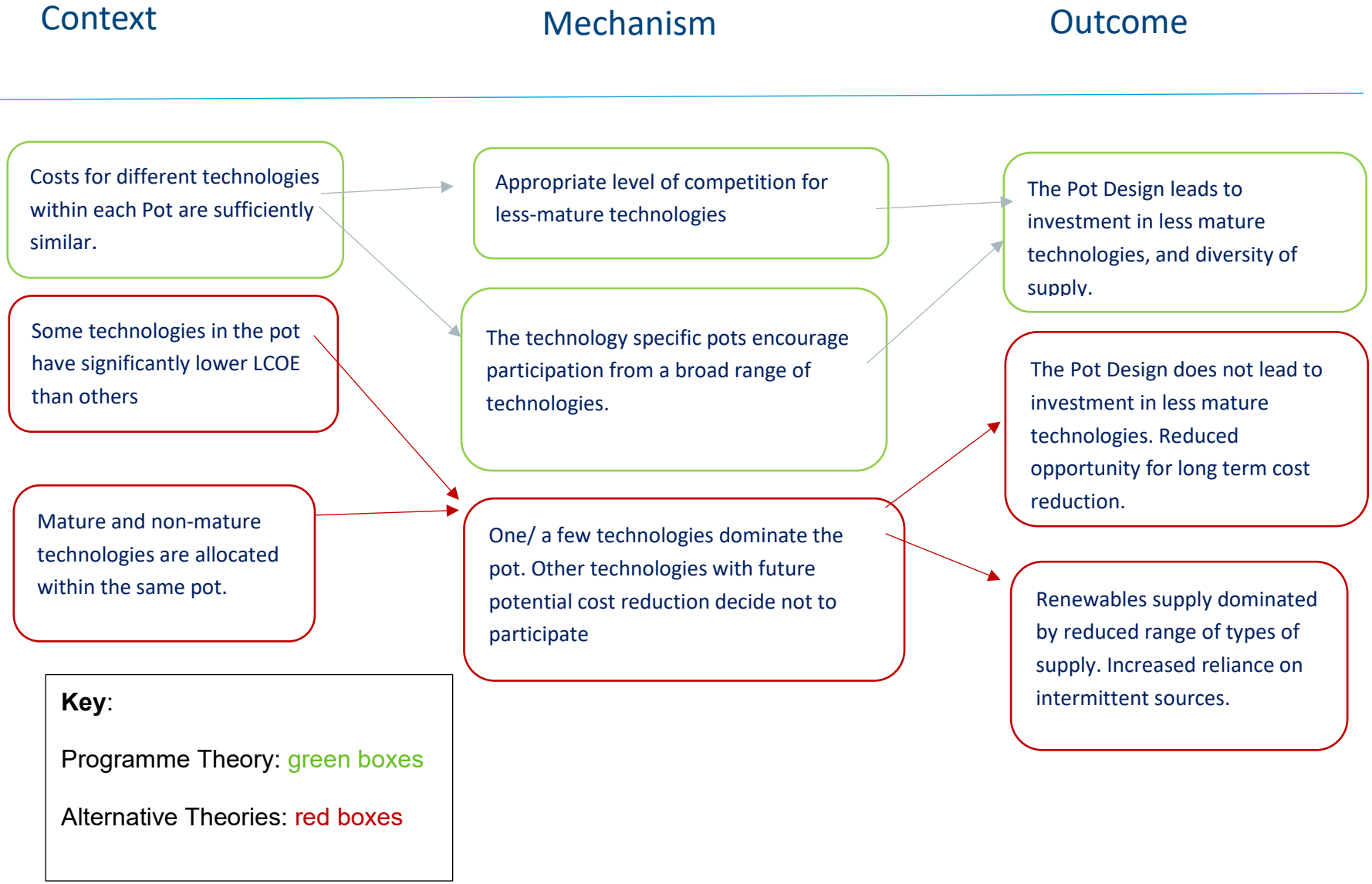
Programme theory (in green boxes in diagram below):

- In the context where Allocation Rounds have Pots to set higher administrative strike prices for less mature technologies (Contexts) then this will enable developers of generation units with less mature technologies and higher costs to compete in auctions (mechanism - response). Outcomes may include: supporting investment for R&D in innovation and future cost reduction of less mature technologies, plus diversification of sources and security of supply (through allocation of contracts to less intermittent technologies).

Alternative theory (in red boxes in diagram below):

- If Pot design and minima/maxima criteria do not allow for differences in strike prices for a diverse range of less mature technologies (Contexts), then developers of technologies with higher costs will not be competitive and will not participate (mechanism - response). Whilst this may be more cost-effective in the short term (as cheaper technologies win contracts, and higher cost technologies are not subsidised) the lack of support for less developed technologies may result in less investment in innovation and lost opportunities for longer term cost reduction (negative outcome). In addition, the dominance of a smaller number of types of technology creates risks of future increased grid balancing costs due a higher proportion of supply from intermittent sources (e.g. offshore wind).

CMO 4 – Pot Design and support for less mature technologies



TESTING CMO 4

Introduction and use of administrative data

At an overall Scheme level, we can see from the CfD Register that Allocations Rounds 1 and 2, were successful in delivering the intended outcomes described above in terms of enabling developers of generation units with less mature technologies to compete and win contracts and in supporting diversity in supply. As described in Chapter 2 of the main report, the majority of technologies eligible in Pot 1 and 2 won contracts. To summarise, the allocation of contracts across AR1 and AR2 was as follows:

Outcomes of Allocation Round 1:

- 27 renewable energy projects secured a CfD[16]. Of these 27 projects; 3 were ACT projects, 2 Energy from Waste with CHP (Combined Heat and Power), 2 Offshore wind,15 Onshore wind, and 5 were Solar-PV-PV projects.

Outcomes of Allocation Round 2:

- 11 renewable energy projects secured a CfD[17] 3 projects were Offshore wind, 6 ACT, and 2 Dedicated Biomass with CHP.

Although Offshore Wind projects account for a minority of the number of contracts awarded, their expected generation capacity accounts for around 80% of the total generation capacity of awarded contracts across AR1 and AR2.
This CMO aims to explore how the Pot 2 'emerging technologies' design, enabled less mature technologies, with relatively high costs but the potential for future cost reduction to receive support. As described in Chapter 3, we can see that for certain types of technologies this was successfully achieved. The strike prices for Offshore wind in Allocation Round 2 has reduced by around a half, in comparison to Allocation Round 1. In addition, Advanced Conversion Technology (ACT) prices fell on average by 37% between rounds 1 and 2.

Therefore, it is clear from existing administrative data that the intended outcome of supporting cost reduction of less mature technologies was achieved (for the technologies developed by successful applicants, and for offshore wind in particular).

[16] There were 29 individual CfD units in AR 1since East Anglia One is a phased project with 3 separate CfD units but one contract.
[17] Hornsea Project 2, Triton Knoll, and Moray Offshore had 3 phased individual generation units each. Overall the second allocation round had 17 CfD units awarded.

The interviews with developers were used to gain further insight into how they "responded" to the Pot Design, the implications this had on **their investment decisions**, what effect this has had on decisions around **investing in R&D for innovation** in wider types of emerging technologies and what positive and negative outcomes this will lead to in terms of supporting further **cost reduction** and **diversity of supply**.

Interviews with developers

The interviews with developers were used to test the following aspects of CMO4 Programme Theory and Alternative Theory:

- **CMO4 Programme Theory (CMO4 PT)** – code for responses which indicate that pot design led to investment decisions that supported investment in emerging technologies, and increased R&D spend for innovation and future cost reduction.
- **CMO4 Alternative Theory (CMO4 AT)** - code for instances where responses support CMO4 AT theory around pot design leading to a lack of investment in some emerging technologies may result in less investment in innovation and lost opportunities for longer term cost reduction.

Responses in support of the Programme Theory were primarily in recognition of the success that Pot 2 has had in supporting investment and cost reduction for Offshore Wind. This was particularly evident among respondents who represent Offshore Wind developers, although not exclusively. There was general recognition across developers of most technologies (including Onshore Wind and Solar), that for AR1 at least, separating emerging technologies into Pot 2, with higher administrative strike prices, supported their development, future investment and cost reduction. Example responses include:

Certainly, having the CfD has helped us to have a clear commitment to work on aspects of onshore and offshore wind development. There's no doubt that the CfD has been very helpful for R&D investment. I do know that every single discussion in R&D in renewables in the UK includes some sort of reference to the fact that there is a CfD Scheme and a long-term Government commitment. (Offshore and Onshore Wind developer)

The way that it was done at the start made sense, the pots make sense. (Developer, multiple technologies)

Generally, the emerging technologies pot structure worked well. (Offshore Wind Developer)

So it has been successful in terms of stimulating investment in offshore, and that's the main success story. (Offshore and Onshore Wind developer)

Evidence in support of Alternative Theory (CMO4 AT) – evidence in support of CMO4 AT generally recognised three main types of response to the Pot Design in terms of how it affected their investment decisions:

1) That whilst Pot 2 has been beneficial for supporting investment in Offshore Wind, and this "made sense" for Allocation Round 1, the lack of further auctions for Pot 1 technologies has led to a decrease in their investment for both deployment and R&D.
2) Within Pot 2, the dominance of Offshore Wind has led to reduced investment among other Pot 2 technologies that cannot compete with Offshore Wind.
3) The overall nature of competitive auctions is not conducive to supporting investment in R&D and development of emerging technologies. As the purpose is for the lowest cost projects to win contracts, technologies which have higher costs because they are lower down the Technology Readiness Level scale, will not be able to compete.

Examples of responses coded in support of point 1 above include:

> What now happens is that without subsidy we think why we should invest in Onshore R&D if there is no chance for developing it. (Onshore and Offshore wind developer)

Examples of responses coded in support of point 2 above include:

> It only really helped Offshore wind. Subsidies should bridge the gap and they only did that for Offshore while ACT really is one of these technologies as well. Offshore Wind should drop out of this pot.
> (ACT developer)

> We had previously been active in investing in marine technologies (wave and tidal) but don't now because they are in the same Pot as Offshore wind and can't compete. Tidal technologies were classed in the same 'emerging technologies' pot as offshore wind. But they were at different stages of emerging. Tidal technologies were really at the pre-commercialisation stage, whereas offshore had already been proven and commercialised. So they weren't competing at the same stage of the innovation and cost reduction curve. There wasn't enough diversification within the Pot 2 structure to take account of that
> (developer, multiple technologies)

Examples of responses coded in support of point 3 above include:

> The Pot designs do not facilitate the strategic development of the diverse technologies required for future security of supply. They cause competition between technologies with very different cost structures and levels of development, which disadvantages the less developed technologies in the Pot and limits innovation (and consequently the diversity of our future energy mix).
> (developer, multiple technologies)

> There is no support mechanism for technology which is very early in an R&D for example for wave and tidal there is no business case for us, and it is very difficult to justify early investment.
> (developer, multiple technologies)

Developers of Offshore Wind also recognised that the competitive nature of Pot 2 auctions means that only the most cost-effective projects will win contracts, but that this does not

support investment in more innovative forms of Offshore Wind technologies where costs are currently higher.

> We think there are large scale commercial opportunities to develop the Offshore Floating Wind Turbines, both in the UK and worldwide. At the moment they cannot compete in the same Pot as fixed bottom offshore wind, so they are not being commercialised at scale, but there is a big industrial development opportunity there. So there is a potential industrial prize here – to develop a floating wind industry in the UK first and then export the technology. At present we cannot persuade our board to commit to large scale investment in floating wind, without any assurance of receiving subsidy support through winning CfDs (Developer, Offshore Wind)

> The lesson we can learn from Offshore Wind is that following initial rounds of commitment for relatively high subsidy, investment comes forward, as does competition to win contracts, then the industry develops, and costs come down. It's reasonable to assume we could achieve something similar with floating wind. (Developer, Offshore Wind)

Some offered alternative points of view to the response that overall CfD Scheme design cannot support emerging technologies. In these cases, they believed all the necessary policy tools do currently exist within current CfD Scheme regulations to support investment in a broader range of technologies (for example altering the composition of technologies in each Pot, applying maxima/minima criteria and difference in administrative strike prices for different technologies) and it just depends on how these are applied.

> *We do not want the CfD policy design changed. We just need it to have some ringfenced support to enable other new and emerging technologies to come down the cost curve. It currently does not do that. (Developer, multiple technologies)*

Overall results

Interview transcripts were analysed at a case-by-case level to code for examples where respondents indicated support for the CMO2 Programme Theory (PT) or Alternative Theory (AT2). To provide a sense of the overall proportion of respondents that gave responses in support of CM02 PT or AT, data queries were run in Nvivo to provide counts of the numbers of responses in support of each CMO theory.

In some instances, the same developer interviewed may be coded as having given some responses that were in support of the PT as well as other responses that were coded as being in support of the AT. This was common where the developer's company was involved in investing in development of multiple technologies. For example, they recognised the benefits that Pot 2 has had for the Offshore side of their business, but also explained that it led to decisions to invest less in other types of technology.

Table 14 below provides a summary of overall results, split by whether the respondents were developers with a CfD contract or those without a CfD (including unsuccessful applicants).

	CfD Developers	Developers without a CfD	Totals
CMO4 Programme Theory	4	2	6
CMO4 Alternative Theory	8	8	16

Table 11 Frequency of support for CMO4 theories

Interpretation of results and difference by context

Overall, there was a general consensus across all categories of respondents that Pot 2 "emerging technologies" design had supported investment in Offshore Wind, innovation in this sector and subsequent cost reduction.

There was also a common view that Pot design and decisions not to include Pot 1 technologies in Allocation Round 2, had led to a decrease in investment in Pot 1 technologies, plus other types of technologies within Pot 2 that were less competitive than Offshore wind. These views varied little by most contextual factors explored; including whether the developer had a CfD or not, what types of technology they develop and whether participated in AR1 and/or AR2.

Responses describing the benefits of the CfD Scheme for investment in Offshore Wind were, perhaps unsurprisingly, more strongly emphasised among Offshore Wind developers. However, the companies which develop Offshore Wind projects are mostly large, multi-national firms with a broad portfolio of investment in various types of renewable technology. Therefore, respondents representing these firms commonly explained that whilst the CfD Scheme had been beneficial for the Offshore side of their business, it had led to decisions to invest less in other types of emerging technologies that were less likely to win CfDs.

To conclude, the evidence suggests that scheme has supported cost reduction and innovation for Offshore wind and, to a lesser extent, ACT technologies. Given the relatively small number of contracts awarded to other technologies, and the fact that Pot 1 technologies have not been eligible to participate since AR1, there is little evidence the scheme has been beneficial for supporting innovation and cost reduction for other emerging technologies,

Annex D: Topic Guide for interviews with developers with a CfD

1. Introduction and background to project

Pre-interview background information on project and respondent	
Respondent's name and Job title	
Name of company	
Name of CfD Units (e.g. Triton Knoll)	
Type of Technology	
Installed Capacity Estimate	
Allocation Round 1 or 2	
Current Strike Price	
Target Commissioning Date	
Financial Structure [any information we have from Bloomberg on how project has been financed and by which companies]	

Source: From CfD Register and LCCC contact information

Could you briefly tell me about your role in the company and the [name of project]?

Probe for:

- Check the details we have for respondent and the project are correct.

Can you tell me some background to how this project was developed? For example, has your company led on development from its inception phase, or did it take over from another company which may have led on pre-contract development phases such as securing planning permission and grid connection?

Probe for:

- When did the project first receive planning permission?
- Was development underway before the CFD Scheme was announced?

Why did you decide to apply for a Contract for Difference? Did you consider applying for a Renewables Obligation Certificate (ROC) instead?

Probe for:

- What attracted them to apply for the CfD Scheme?
- Had they previously applied for ROC and been unsuccessful?
- Was CfD Scheme considered more attractive form of subsidy than RO? If so, explain why.

Check on current status of project

The CfD Register states that the project(s) is currently [*insert overview of status e.g. when expected to reach target commissioning date, or date when began generating*]. Is that information still up to date?

Probe for:

- Whether there are any changes in expected commissioning date. If so, what are the reasons for any delays?

The CFD Register states that the installed generating capacity is estimated to be [X MW]. Is that still accurate?

Probe for:

- If not, what are the reason for any changes?

Has your company developed any other renewable electricity generation projects in the UK?

Probe for:

- If so, how many?
- When were these projects commissioned (e.g. when all development phase work was completed and signed off to begin implementation)?
- What type of technology are they? What is their installed generating capacity?
- Were they accredited with Renewables Obligation (RO) Certificates?
- Were they developed without RO? For example, only supported by FiTs or a form of private PPA?

Note: list of other projects they have developed are available on the RES website .

Has your company developed any other renewable electricity generation projects in other countries before?

Probe for:

- Brief overview of how many and types of technology [A full list and all specific details not necessary]
- Is this the first project you have developed in the UK?

- What motivated your company to develop projects in the UK? [Probe for extent to which CfD Scheme had attracted them to the UK]

2. Views on CfD contracting and delivery processes

Application Process

Before submitting an application for a CfD, did you receive sufficient information and guidance about the requirements of Scheme in order to provide all the information needed to submit a full proposal?

Probe for:

- Clarity around requirements to demonstrate eligibility criteria (e.g. grid connection, planning permission, etc).
- Clarity around the Pot Structure and eligibility criteria of technologies within each Pot
- Information provided in the Budget Notice around available budget within each allocation, and the Administrative Strike Price.
- Guidance on estimating strike prices and delivery years.
- Overall, were the auction processes clear to understand in advance of participating? If not, which aspects were confusing or unclear?

Do you have any recommendations on how BEIS or the National Grid might improve the application process in future?

Probe for:

- Whether timescales between announcing dates of Allocation Rounds and deadline for application are sufficient.
- Use of National Grid's pre-application validation service to check whether application meets all requirements before the deadline date.

Supply Chain reports [Ask in cases where project is >300MW]

Can you provide an indication of the amount of time and resource was required to develop and submit the supply chain report?

Probe for:

- Number of FTE working days required by their company
- £Costs if work to draft report was commissioned.

Have there been any changes to suppliers for the project since the report was submitted? If so, please briefly explain e.g. changes in companies providing components or services.

Contract and development phase

Can you provide an indication of the amount of time and resource that was required to agree and sign off the contract, once it was awarded by LCCC?

Probe for:

- Number of FTE staff working days required by their company
- £Costs for any commissioned work e.g. legal fees.

Do you have any recommendations on ways in which BEIS or LCCC may be able to improve the contract award and sign off process in future?

Probe for:

- Any particular parts of the contract which they feel should may be shortened, streamlined?
- Any ways in which contractual requirements could be better tailored to projects of their size and scale?

Is your project on track to meet to your Milestone Delivery Dates (MDD) and Target Commissioning Windows (TCW), or Longstop Date? [*Note if project has already passed these milestones, tailor these questions to whether it did meet the original dates on time.]*

Probe for:

- If any delays, what were the reasons

How much time and resource did it take your company to secure a Power Purchasing Agreement?

Probe for:

- Has the CfD Scheme changed the ways in which a developer will secure a PPA, in comparison to the RO? If so, how?

Do you have any recommendations on ways in which LCCC or other CFD delivery bodies may be able to support projects through the post-contract award delivery phase up until implementation?

3. Impact of CfD on attracting finance

Intro:

The CfD Scheme has a range of objectives. To paraphrase, these include giving investors the confidence they need to invest in UK renewable energy projects; and to attract greater investment at a lower cost of capital and from a wider pool of sources.

Our evaluation aims to assess the extent to which the Scheme is meeting these objectives. Therefore, the following questions ask about the ways in which your project(s) is/are financed and any ways in which the CfD Scheme has affected your experiences in attracting finance and the associated costs of capital. I'd like to remind you that any responses you provide will be kept strictly confidential.

In general, what do you think the impact of the scheme has been on attracting investment in this type of renewable energy project? [In comparison to RO]. Please explain why

Probe for:

- Do you believe the Scheme has changed overall hurdle rates for investors for projects such as yours? If so, probe for precise estimates on what level of decrease/increase it has had.
- Do you believe the Scheme has introduced new novelty premium risks for investors?

Can you please provide a brief overview of the financial structure of [name project]?

Probe for:

- For example, to what extent is the project funded through the companies' own equity capital vs creditor financing [e.g. the debt-to-equity leverage rate]?
- Was a Special Purpose Vehicle set up to develop the project and receive investment?
- Why were these financial structures chosen? Were others considered?
- Who is the Power Purchase Agreement (PPA) with?

Can you tell us which companies have provided third party financed the project? For example, who is the parent company, senior lender, major private equity investors, mezzanine investors etc?

Probe for:

- Names of companies [Note request for contact details comes at the end of interview]

Has the project's financial structure changed since the CfD contract was signed?

- If so, how? To what extent has this reduced the cost of capital for the project?

Probe for:

- If possible, ask for precise figures on changes to WACC.
- Or any changes to levels of interest rates paid on loans.

What will happen to your project once the 15-year CFD contract ends? For example, do you think it will require further forms of support to continue to operate?

Probe for:

- Any ways in which the envisage the financial structure of the generation unit to change after the contract ends.
- Extent to which this depends on future price scenarios.

Do you believe your project would have been developed if it was not for the CfD Scheme? For example, in the absence of the CfD Scheme, would you have applied for a ROC to develop it?

Probe for:

- Whether it would have been feasible to develop the project in the absence of either the CfD or RO. For example, through FITs alone (at the prevailing rates in year they applied for CfD). Or through a corporate PPA.
- Whether would have gone ahead, but at a later point in time e.g. once the LCOE of that technology has fallen to enable subsidy free development.

Do you believe the profile of investors which provide finance to UK renewables energy projects has changed since the introduction of the CFD Scheme? For example, has there been an increase in private equity investors supporting CFD projects, in comparison to projects developed under the RO?

Probe for:

- As a developer, has the CFD Scheme opened up new opportunities for your company in attracting finances from different sources?

4. Views on Scheme Design: Auction and Pot structure

What are your views on the pay-as-clear pricing rules for determining strike prices in an auction? Explain reasons.

Probe for:

- Whether they would you prefer a pay-as-bid approach. If so, why?
- Whether the pay as clear auction design has affected their bidding strategy e.g. the strike prices offered.

Do you believe that the "Allocation Risk", of not winning a contract through the competitive auction had any effect on the amount of new projects that renewable electricity developers have proposed in the UK? If so, please explain why.

Probe for:

- Any effects that allocation risk has on securing investment, or changes to cost of capital at different stages of project lifecycle.
- The extent to which this has increased or decreased overall development risks in comparison to RO.

Has your company submitted an application for a CfD in Allocation Round 1 or 2 that was not successful?

Probe for:

- If so, how many unsuccessful applications were there? What Allocation Rounds were these?
- What were the reasons that your application was not successful? Probe for whether it was rejected on grounds of eligibility or whether it did not win on price.

Pot Structure and Innovation

Do you think the division of auctions into pots of technologies has enabled an appropriate level of competition between developers?

Probe for:

- What, if any, unintended consequences have there been from the way the pots of technologies were designed?
- What types of technologies do think will be the main winners and losers from CfD auctions?

Was the initial classification of technologies in Pot 1 and Pot 2 effective in supporting the development of emerging technologies?

Has the introduction of the CfD Scheme changed how your company invests in R&D to develop new technologies? Please explain.

Do you have any recommendations on how the allocation of technologies into different Pots should be changes in future Rounds? Please explain

5. Overall views and next steps

Did the introduction of the CFD scheme have any negative effects or unintended consequences on your business?

Do you believe it has had any negative effects or unintended consequences on the wider UK renewable energy market?

Are you planning to participate in future CfD Allocation Rounds? (emphasise confidentiality)

Do you have any wider suggestions in terms of how the CfD Scheme could be improved in future? Or alternative ways in which the Government should support deployment of renewable energy?

As part of the evaluation, we wish to gain a better understanding of the overall cost and benefits of participating in the CfD Scheme. We will do this through use of a short, online survey that requests some more information about the development phase and operating costs involved with your CfD contracted projects. Would you be happy to participate in this short survey?

As part of the evaluation, we are also interviewing representatives of different types of financial investment institutions to understand their views on the extent to which the introduction of the CFD Scheme has increased or decreased risks for investing in UK renewable energy projects. Would you be willing to put us in contact with some of the main investors of your project?

We can provide you with an email to send to them on our behalf requesting consent for us to contact them. If they are happy to take part, we will then follow up to request their participation in either a short telephone interview or online survey.

Note response:

Thank and close.

Annex E: Topic Guide for interviews with developers of non-CfD generation units

1. Background information on projects

Pre-interview background information on project and respondent [From REPD and Bloomberg]	
Respondent's name and Job title	
Name of company	
Type of technology(s) developed	
Estimated generating capacity	
Development Status When planning permission granted When commissioned (or date expected to be in future)	
Does project have ROC?	
Financial structure (any relevant info from Bloomberg on how project was financed, and how much has been invested).	

1.1. Could you briefly tell me about your role in the [name of company]?

Probe for:

- Check the details we have for respondent and the project are correct.

[1 answer here]

1.2. Can you give me some background details on what renewable electricity generation projects your company developed in the UK?

Probe for:

- How many?
- What type of technology are they? What is their installed generating capacity?
- What is their development status e.g. currently operational or still in development phase?
- Were they accredited with Renewables Obligation (RO) Certificates?
- Check whether they have been involved in developing any projects with a CfD

[1 answer here]

1.3. Can you please provide a brief overview of the financial structure of [name of project/ generation unit from which they were selected]?

Probe for:

- Who parent company is
- To what extent is the project funded through the companies' own equity capital vs creditor financing [e.g. the debt-to-equity leverage rate]?
- Was a Special Purpose Vehicle set up to develop the project and receive investment?
- Who senior lender and major investors are
- Why were these financial structures chosen? Were others considered?

1.4. Has your company developed other renewables projects in other countries?

If so, probe for:

- brief overview of how many, which countries, types of technologies.

2. Participation in CfD

2.1. Has your company ever applied for a CfD?

If not, probe for:

- Please explain why not?
- Probe for whether it was because they focused on RO, or a corporate PPA. Any other reasons they did not wish to participate in CfD Scheme?
- Reasons relating to challenges with the application process. For example, whether felt the application process was too resource intensive, or timescales were too short. Or they did not receive sufficient information and guidance in time to develop and submit a full proposal.
- Whether felt their project would not be competitive against others within the same Pot
- Whether had intended to apply but could not progress for project-specific reasons. For example, unable to secure sufficient investment.
- Whether did not proceed due to technological/engineering challenges.

If previously applied but unsuccessful, probe for:

- Which Allocation Round was this?
- How many unsuccessful applications were there?

2.2. What were the reasons that your application(s) was/were not successful?

- Probe for whether it was rejected on grounds of eligibility or whether it did not win on price.
- Whether they believe the reasons were technology specific. For example, that LCOE of wave generators is higher that offshore wind, so can't compete on price.
- Non-financial contextual reasons (small company, legal problems etc.)

[l answer here]

3. Views on CfD contracting and delivery processes

If previously applied:

Application Process

3.1. What did you think about the information and guidance provided by BEIS or National Grid during the application process?

Probe for:

- Clarity around requirements to demonstrate eligibility criteria (e.g. grid connection, planning permission, etc).
- Clarity around the Pot Structure and eligibility criteria of technologies within each Pot
- Information provided in the Budget Notice around available budget within each allocation, and the Administrative Strike Price.
- Guidance on estimating strike prices and delivery years.

[answer here]

3.2. Do you have any thoughts on how BEIS or National Grid might improve the application process in the future?

Probe for:

- Whether timescales between announcing dates of Allocation Rounds and deadline for application are sufficient.
- Use of National Grid's pre-application validation service to check whether application meets all requirements before the deadline date.

[answer here]

4. Views on CfD Scheme Design: Auction and Pot structure

4.1. Are you familiar with the "pay-as-clear" pricing rules for determining the strike prices awarded through the CfD Scheme auction?

If aware of 'pay-as-clear' rules:

4.2. What are your views on the pay-as-clear pricing rules?

Probe for:

- Whether they would you prefer a pay as bid approach? Explain reasons
- [**If previously applied**] Whether the pay as clear auction design has affected their bidding strategy e.g. the strike prices offered.
- [Note to interviewer: explore theory around strategic bidding e.g. whether unsuccessful project was part of "bid shading" strategy, whereby high price was submitted in attempt to move clearing price higher so that another project they have invested in would benefit from slightly higher clearing price.]

[answer here]

Pot Structure and Innovation

4.3. What are your views on the ways in which previous Allocation Rounds have split applications for CfDs into two Pots? For example, how Pot 1 technologies were categorised as Established technologies and Pot 2 as the Less Established Technologies?

Probe for:

- Whether feel some Pot 2 technologies should have been classed as 'Established' e.g. offshore wind.
- Whether it was helpful to split techs into two Pots at all.
- Whether a different split of techs into Pots would have motivated them to apply (if haven't previously applied).

[1 answer here]

4.4. What implications, if any, have the division of technologies into pots had for the projects you develop?

Probe for:

- What, if any, unintended consequences have there been from the way the pots of technologies were designed?
- What have the implications been for your company specifically? For example, no longer able to develop projects in the UK (e.g. for onshore wind or solar developers).
- Whether company has now focused on development in other countries since introduction of CfD Scheme as their technology is unable to secure contracts. For example, as there have been no further Allocation Rounds for Pot 1. Or because their technology can't compete (e.g. wave and tidal).

[1 answer here]

4.5. Has the introduction of the CfD Scheme changed how your company invests in R&D to develop new technologies? Please explain.

[1 answer here]

4.6. Do you have any further comments on the allocation of technologies into different Pots? Please explain

[1 answer here]

5. Overall views and next steps

5.1. Do you have and further thoughts on the CfD that we have not discussed already?

[1 answer here]

- Probe: other impacts / consequences for their company/ or wider impacts on the renewable electricity sector.

5.2. Are you planning to participate in future CfD Allocation Rounds? (emphasise confidentiality)

Probe:

- Please explain why?
- What could make you reconsider applying in future?

[1 answer here]

5.3. Do you have any wider suggestions on how the CfD Scheme could be improved in future?

Probe for:

- Whether Government support is still needed for them to develop projects e.g. is it feasible for them to develop subsidy free?

[1 answer here]

Follow-up request:

5.4. We may wish to contact you again to follow-up on this interview. For example, to check points of accuracy or clarification on the notes from our interview. Or to take part in another interview at a future stage of the CfD evaluation. Are you happy for us to re-contact you?

Thank and close.

Annex F: Online Survey Questionnaire

Survey on costs and benefits of the CfD Scheme

The Department for Business, Energy and Industrial Strategy (BEIS) has commissioned Technopolis Ltd, with partner LCP LLP, to undertake an independent evaluation of the Contracts for Difference (CfD) Scheme. The evaluation will provide an evidence base that can inform the ongoing design, delivery and development of the CfD and related policies. The evaluation also aims to gather evidence on the extent the CfD Scheme is contributing to its intended objectives. In summary, the objectives of the Scheme include; contributing towards decarbonisation of electricity supply in a cost-effective way and attracting greater investment in UK renewable electricity deployment.

As an organisation that has been identified as a project developer, operator or financial investor in a generation unit with a CfD, we request your participation in this short survey to enable us to better understand the costs and benefits of renewables development under the CfD Scheme. The survey aims to assess whether implementation of the CfD Scheme has reduced risks for investors and the costs of capital for developers. It is divided into 4 sections:

1. **Background – the role of your company and contact details**
2. **Costs associated with developing the generation unit*(only for lead developer or operator companies)***
3. **The effects of the CfD Scheme on the costs of capital**
4. **Your views on the CfD Scheme and any recommendations on how it may be improved for future Allocation Rounds.**

All data produced from the survey will be anonymised and only used to derive aggregate statistics. Neither you nor your organisation will be named in any published outputs, or in any results shared with BEIS. Any information that you share with Technopolis will be confidential and stored securely, in accordance with the Data Protection Act.

The survey will take approximately 20 minutes to complete.

Thank you for participating in our survey. Your feedback is important.

1. Background - Contact details and role in CfD project

1.1 Please provide the following contact information

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- [ ] K3 CHP Facility, Energy from Waste with CHP
- [ ] Moor House Wind Farm / Kype Muir Wind Farm / Mynydd Y Gwair Wind Farm
- [ ] Moray Offshore Windfarm (East) Phase 1 / 2 / 3
- [ ] Nanclach Wind Farm
- [ ] Neart na Gaoithe, Offshore Wind
- [ ] Netley Landfill Solar
- [ ] Northacre Renewable Energy Centre, Advanced Conversion Technologies
- [ ] Rebellion (Meriden Quarry Biomass Energy Facility), Dedicated Biomass with CHP
- [ ] Sneddon Law Community Wind Farm
- [ ] Solwaybank Wind Farm
- [ ] Station Yard CFD 1, Advanced Conversion Technologies
- [ ] Tralorg Wind Farm
- [ ] Triangle Farm Solar Park
- [ ] Triton Knoll Offshore Wind Farm Phase 1
- [ ] Wren Power and Pulp, Energy from Waste with CHP

1. Background - Contact details and role in CfD project (continued)

1.3 What is the role of your company in developing the above CfD generation project? If your company is involved in developing more than one project, please answer separately for each one. [Please choose one option]

- ☐ Lead developer company (or part of lead developer consortium)
- ☐ Parent company of lead developer
- ☐ Lead operating company [If generation unit is in operational phase]
- ☐ Third party capital or finance provider e.g. debt or equity investor, not part of lead developer company

1. Background - Contact details and role in CfD project (continued)

1.4 At which stage of the CfD project's development did your company first get involved in developing or operating the generation unit?

- ◯ Development phase (prior to award of CfD)
- ◯ Construction phase (post CfD contract award but prior to commissioning)
- ◯ Operational phase (post commissioning)

1.5 Has your company developed any other renewable electricity generation units in the UK that were awarded a Renewables Obligation Certificate (ROC)?

- ◯ Yes
- ◯ No

1. Background - Contact details and role in CfD project (continued)

1.6 What forms of financial investment has your company provided to the CfD project?

- ◯ Equity investment
- ◯ Debt provider
- ◯ Other, please state

1.7 At which stage of the CfD project's development did your company first provide investment?

- ◯ Development phase (prior to award of CfD)
- ◯ Post CfD contract award construction phase (prior to commissioning)
- ◯ Post commissioning date operational phase

1.8 Has your company invested in any other renewable electricity generation units in the UK that were awarded a Renewables Obligation Certificate (ROC)?

- ◯ Yes
- ◯ No

2. CfD Scheme and effects on risks for investment

This section asks for your views on the factors which affect decisions on whether or not to invest in renewable electricity generation projects in the UK, and the relative importance of different project risk factors. Information gathered will be used to make an assessment of whether the introduction of the CfD Scheme has increased or decreased overall risks for investors (and associated costs of capital for developers) relative to the previous Renewable Obligation subsidy regime.

Again, please note that all data produced from the survey will be anonymised and only used to derive aggregate statistics. It will not be used to disclose any financial information that is specific to any one project or company.

2.1 The box below asks you to consider the relative importance of different risks when considering whether or not to invest in or develop renewable electricity projects in the UK. Please consider this in relation to the same type of technology for which your company has been involved in a CfD contracted generation unit (e.g. offshore/onshore wind, solar, ACT, biomass conversion etc).

You are asked to:

a) rank each type of risk on a scale of 1(no risk) to 10(very high) for developing a generation unit under the CfD Scheme, and;

b) rank each type of risk while considering a hypothetical scenario whereby the CfD Scheme was not previously introduced, and the same project was being developed under the Renewables Obligation (RO) subsidy policy.

	Project developed under CfD Scheme: Scale (1= no risk to 10 = very high risk)	Similar project developed under ROC: Scale (1= no risk to 10 = very high risk)
Construction (Delay) Risk - Refers to the impacts of unexpected construction delays of a project.		
Technology Maturity - Unforeseen underperformance or higher cost for emerging technologies		
Novelty Premium - Additional return that investors would price in for uncertainty around a new Government policy/		
Fuel Price volatility - Exposure to fuel input prices (e.g. for biomass, ACT technologies)		
Foreign Exchange ("FX") risk - The risk of adverse movements in the foreign exchange rate vis-à-vis the currency in which a large portion of the input costs of the generator is denominated.		
Wholesale market price risk - The volatility of earnings due to fluctuations in the wholesale market price.		
Duration Risk - Refers to changes in volume and price risk exposure, or earnings risk, associated with the length of the subsidy period		
Change in Law Risk /Policy Risk - The risk that a future law provision could change (reduce) the revenues or costs of the project		
Force majeure risk - The parties will not be able to honour the contract due to matters outside of their control		
Volume Risk - Inability to control output in the long-run due to weather (intermittent plant) and forced outages, which introduces volatility in their revenues.		
Imbalance Risk - Inability to accurately forecast output in the short-run (particularly for intermittent plant), which results in exposure to imbalance costs.		
Residual O&M risk - Escalating Operation and Maintenance costs.		
PPA Arrangements - Cashflow impacts from PPA related price volume/price changes		

2.2 In general, as a whole, do you consider that the introduction of the CfD Scheme for renewable electricity has reduced or increased risks relative to the RO?

- ◯ Reduced risk
- ◯ Increased risk

Please provide a brief explanation of your views

2. CfD Scheme and effects on risks for investment (continued)

As before, the next set of questions asks you to consider a hypothetical scenario whereby the CfD Scheme was not previously introduced, and the Renewables Obligation (RO) scheme remained open for developers to obtain RO Certificates (ROCs). The aim is to understand what effect this would have had on investors' perception of risks and associated costs of capital for developers.

2.3 Considering the CfD contracted generation unit(s) which your company has invested in, how likely is it that your company would have invested in that project(s) if the CfD Scheme had not been introduced and the Renewables Obligation had remained open?

- ◯ Certainly, would have invested
- ◯ Likely to have invested
- ◯ Unsure
- ◯ Unlikely to have invested
- ◯ Certainly would not have invested

2.4 In a scenario whereby the CfD Scheme did not exist, and the project was developed under the Renewables Obligation (RO) regime, please estimate what level of increase or decrease this would have on your hurdle rates for investment. By hurdle rate, we are referring to the minimum project return that a generation unit owner, or investor, would require over a project's lifetime on a pre-tax real basis.

Please express the change in basis points (100 basis points = 1%), e.g. an increase in hurdle rate from 10% to 10.6% represents an increase of 60 bps.
Indicate decreases using negative sign(-) before the number. If there is no change at all, please enter "0"

Equity specific hurdle rate	
Debt finance specific hurdle rate	
Overall capital or project investment decision hurdle rate	

ase provide an estimate of hurdle rates (%) in pre-tax, real terms.

Equity specific hurdle rate	

3. Annual Load Factor

percentage per annum:

4. Operating and Economic Lifetime

over). No of years:

5. Costs associated with developing and operating the generation unit

5.1 The next section of the survey is on technology costs. Please select your project's technology type from the following six options to be directed to the relevant cost survey.

Please select your project's technology type from the following four options

- ◯ Onshore Wind
- ◯ Offshore Wind
- ◯ Solar PV
- ◯ Advanced Conversion Technologies
- ◯ Dedicated Biomass with CHP
- ◯ Energy from Waste with CHP

6. Onshore Wind: Costs associated with developing and operating the generation unit

So that the evaluation can make an assessment of the overall value for money of the CfD Scheme, we would like to gather some information about the costs of developing and operating your CfD contracted generation unit(s).

All data produced from the survey will be anonymised and only used to derive aggregate statistics . It will not be used to disclose any financial information that is specific to any one project or company.

6.1 Please provide an estimate of the total CAPEX for the project's development phase (prior to operational phase). Please respond with estimates in terms of £ per kW.

- ◯ 30 to 62
- ◯ 63 to 94
- ◯ 95 to 126
- ◯ 127 to 158
- ◯ 159 to 190
- ◯ Other (please specify)

6.2 Please provide an estimate of the total CAPEX for the project's post CfD contract award construction phase (prior to commissioning). Please respond with estimates in terms of £ per kW.

- ◯ 600 to 799
- ◯ 800 to 9,999
- ◯ 1,000 to 1,199
- ◯ 1,200 to 1,399
- ◯ 1,400 to 1,600
- ◯ Other (please specify)

6.3 Please provide an estimate of the the project's total fixed Operations and Maintenance (O&M) costs (post-commissioning). Please respond with estimates in terms of £ per MW p.a.

- ◯ 15,000 to 16,999
- ◯ 17,000 to 18,999
- ◯ 19,000 to 20,999
- ◯ 21,000 to 22,999
- ◯ 23,000 to 25,000
- ◯ Other (please specify)

6.4 Please provide an estimate of the the project's insurance costs (post-commissioning). Please respond with estimates in terms of £ per MWh p.a.

- ◯ 500 to 899
- ◯ 900 to 1,299
- ◯ 1,300 to 1,699
- ◯ 1,700 to 2,099
- ◯ 2,100 to 2,500
- ◯ Other (please specify)

6.5 Please provide an estimate of the the project's Connection and use of system (e.g. TNUoS, BSUoS, DUoS and OFTO) costs (post-commissioning). Please respond with estimates in terms of £ per MW p.a.

- ◯ 2,000 to 2,799
- ◯ 2,800 to 3,599
- ◯ 3,600 to 4,399
- ◯ 4,400 to 5,199
- ◯ 5,200 to 6,000
- ◯ Other (please specify)

6.6 Please provide an estimate of the project's total variable Operations and Maintenance (O&M) costs. Please respond with estimates in terms of £ per MWh

- ◯ 0 to 2.3
- ◯ 2.4 to 4.7
- ◯ 4.8 to 7.1
- ◯ 7.2 to 9.5
- ◯ 9.6 to 12
- ◯ Other (please specify)

6. Offshore Wind: Costs associated with developing and operating the generation unit

So that the evaluation can make an assessment of the overall value for money of the CfD Scheme, we would like to gather some information about the costs of developing and operating your CfD contracted generation unit(s).

All data produced from the survey will be anonymised and only used to derive aggregate statistics . It will not be used to disclose any financial information that is specific to any one project or company.

6.1 Please provide an estimate of the total CAPEX for the project's development phase (prior to operational phase). Please respond with estimates in terms of £ per kW.

- ◯ 10 to 39
- ◯ 40 to 79
- ◯ 80 to 119
- ◯ 120 to 159
- ◯ 160 to 200
- ◯ Other (please specify)

6.2 Please provide an estimate of the total CAPEX for the project's post CfD contract award construction phase (prior to commissioning). Please respond with estimates in terms of £ per kW.

- ◯ 1,200 to 1,619
- ◯ 1,620 to 2,039
- ◯ 2,040 to 2,459
- ◯ 2,460 to 2,879
- ◯ 2,880 to 3,300
- ◯ Other (please specify)

6.3 Please provide an estimate of the the project's total fixed Operations and Maintenance (O&M) costs (post-commissioning). Please respond with estimates in terms of £ per MW p.a.

- ◯ 25,000 to 30,999
- ◯ 31,000 to 36,999
- ◯ 37,000 to 42,999
- ◯ 43,000 to 48,999
- ◯ 49,000 to 55,000
- ◯ Other (please specify)

6.4 Please provide an estimate of the the project's insurance costs (post-commissioning). Please respond with estimates in terms of £ per MWh p.a.

- ◯ 1,000 to 1,599
- ◯ 1,600 to 2,199
- ◯ 2,200 to 2,799
- ◯ 2,800 to 3,399
- ◯ 3,400 to 4,000
- ◯ Other (please specify)

6.5 Please provide an estimate of the the project's Connection and use of system (e.g. TNUoS, BSUoS, DUoS and OFTO) costs (post-commissioning). Please respond with estimates in terms of £ per MW p.a.

- ◯ 30,000 to 34,999
- ◯ 35,000 to 39,999
- ◯ 40,000 to 44,999
- ◯ 45,000 to 49,999
- ◯ 50,000 to 55,000
- ◯ Other (please specify)

6.6 Please provide an estimate of the project's total variable Operations and Maintenance (O&M) costs. Please respond with estimates in terms of £ per MWh

- ◯ 0 to 2
- ◯ 3 to 4
- ◯ 5 to 6
- ◯ 7 to 8
- ◯ 9 to 10
- ◯ Other (please specify)

6. Solar PV: Costs associated with developing and operating the generation unit

So that the evaluation can make an assessment of the overall value for money of the CfD Scheme, we would like to gather some information about the costs of developing and operating your CfD contracted generation unit(s).

All data produced from the survey will be anonymised and only used to derive aggregate statistics . It will not be used to disclose any financial information that is specific to any one project or company.

6.1 Please provide an estimate of the total CAPEX for the project's development phase (prior to operational phase). Please respond with estimates in terms of £ per kW.

- ◯ 5 to 44
- ◯ 45 to 79
- ◯ 80 to 114
- ◯ 115 to 149
- ◯ 150 to 185
- ◯ Other (please specify)

6.2 Please provide an estimate of the total CAPEX for the project's post CfD contract award construction phase (prior to commissioning). Please respond with estimates in terms of £ per kW.

- ◯ 450 to 509
- ◯ 510 to 569
- ◯ 570 to 629
- ◯ 630 to 689
- ◯ 690 to 750
- ◯ Other (please specify)

6.3 Please provide an estimate of the the project's total fixed Operations and Maintenance (O&M) costs (post-commissioning). Please respond with estimates in terms of £ per MW p.a.

- ◯ 4,400 to 4,749
- ◯ 4,750 to 5,199
- ◯ 5,200 to 5,549
- ◯ 5,550 to 5,899
- ◯ 5,900 to 6,250
- ◯ Other (please specify)

6.4 Please provide an estimate of the the project's insurance costs (post-commissioning). Please respond with estimates in terms of £ per MWh p.a.

- ◯ 1,400 to 1,599
- ◯ 1,600 to 1,799
- ◯ 1,800 to 1,999
- ◯ 2,000 to 2,199
- ◯ 2,200 to 2,400
- ◯ Other (please specify)

6.5 Please provide an estimate of the the project's Connection and use of system (e.g. TNUoS, BSUoS, DUoS and OFTO) costs (post-commissioning). Please respond with estimates in terms of £ per MW p.a.

- ◯ 1,000 to 1,199
- ◯ 1,200 to 1,399
- ◯ 1,400 to 1,599
- ◯ 1,600 to 1,799
- ◯ 1,800 to 2,000
- ◯ Other (please specify)

6.6 Please provide an estimate of the project's total variable Operations and Maintenance (O&M) costs. Please respond with estimates in terms of £ per MWh

- ◯ 0 to 2
- ◯ 3 to 4
- ◯ 5 to 6
- ◯ 7 to 8
- ◯ 9 to 10
- ◯ Other (please specify)

6. Biomass / ACT: Costs associated with developing and operating the generation unit

So that the evaluation can make an assessment of the overall value for money of the CfD Scheme, we would like to gather some information about the costs of developing and operating your CfD contracted generation unit(s).

All data produced from the survey will be anonymised and only used to derive aggregate statistics . It will not be used to disclose any financial information that is specific to any one project or company.

6.1 Please provide an estimate of the total CAPEX for the project's development phase (prior to operational phase). Please respond with estimates in terms of £ per kW.

- ◯ 20 to 199
- ◯ 200 to 379
- ◯ 380 to 559
- ◯ 560 to 739
- ◯ 740 to 919
- ◯ 920 to 1,100
- ◯ Other (please specify)

6.2 Please provide an estimate of the total CAPEX for the project's post CfD contract award construction phase (prior to commissioning). Please respond with estimates in terms of £ per kW.

- ◯ 2,000 to 3,999
- ◯ 4,000 to 5,999
- ◯ 6,000 to 7,999
- ◯ 8,000 to 9,999
- ◯ 10,000 to 11,999
- ◯ 12,000 to 15,000
- ◯ Other (please specify)

6.3 Please provide an estimate of the the project's total fixed Operations and Maintenance (O&M) costs (post-commissioning). Please respond with estimates in terms of £ per MW p.a.

- ◯ 65,000 to 95,799
- ◯ 95,800 to 126,599
- ◯ 126,600 to 157,399
- ◯ 157,400 to 188,199
- ◯ 188,200 to 218,999
- ◯ 219,000 to 249,000
- ◯ Other (please specify)

6.4 Please provide an estimate of the the project's insurance costs (post-commissioning). Please respond with estimates in terms of £ per MWh p.a.

- ◯ 10,000 to 22,499
- ◯ 22,500 to 34,999
- ◯ 35,000 to 47,499
- ◯ 47,500 to 59,999
- ◯ 60,000 to 72,499
- ◯ 72,500 to 84,999
- ◯ 85,000 to 97,500
- ◯ Other (please specify)

6.5 Please provide an estimate of the the project's Connection and use of system (e.g. TNUoS, BSUoS, DUoS and OFTO) costs (post-commissioning). Please respond with estimates in terms of £ per MW p.a.

- ◯ 12,000 to 12,849
- ◯ 13,700 to 14,549
- ◯ 14,550 to 15,399
- ◯ 15,400 to 16,249
- ◯ 16,250 to 17,099
- ◯ 17,100 to 17,499
- ◯ Other (please specify)

6.6 Please provide an estimate of the project's total variable Operations and Maintenance (O&M) costs. Please respond with estimates in terms of £ per MWh

- ◯ 5 to 12
- ◯ 13 to 19
- ◯ 20 to 26
- ◯ 27 to 33
- ◯ 34 to 40
- ◯ 41 to 45
- ◯ Other (please specify)

1. Background - Contact details and role in CfD project (continued)

1.6 What forms of financial investment has your company provided to the CfD project?

- ◯ Equity investment
- ◯ Debt provider
- ◯ Other, please state

1.7 At which stage of the CfD project's development did your company first provide investment?

- ◯ Development phase (prior to award of CfD)
- ◯ Post CfD contract award construction phase (prior to commissioning)
- ◯ Post commissioning date operational phase

1.8 Has your company invested in any other renewable electricity generation units in the UK that were awarded a Renewables Obligation Certificate (ROC)?

- ◯ Yes
- ◯ No

2. CfD Scheme and effects on risks for investment

This section asks for your views on the factors which affect decisions on whether or not to invest in renewable electricity generation projects in the UK, and the relative importance of different project risk factors. Information gathered will be used to make an assessment of whether the introduction of the CfD Scheme has increased or decreased overall risks for investors (and associated costs of capital for developers) relative to the previous Renewable Obligation subsidy regime.

Again, please note that all data produced from the survey will be anonymised and only used to derive aggregate statistics. It will not be used to disclose any financial information that is specific to any one project or company.

2.1 The box below asks you to consider the relative importance of different risks when considering whether or not to invest in or develop renewable electricity projects in the UK. Please consider this in relation to the same type of technology for which your company has been involved in a CfD contracted generation unit (e.g. offshore/onshore wind, solar, ACT, biomass conversion etc).

You are asked to:

a) rank each type of risk on a scale of 1(no risk) to 10(very high) for developing a generation unit under the CfD Scheme, and;

b) rank each type of risk while considering a hypothetical scenario whereby the CfD Scheme was not previously introduced, and the same project was being developed under the Renewables Obligation (RO) subsidy policy.

	Project developed under CfD Scheme: Scale (1= no risk to 10 = very high risk)	Similar project developed under ROC: Scale (1= no risk to 10 = very high risk)
Allocation Risk - Development phase uncertainty around whether project will receive confirmation of Government support subsidy (either a CfD or ROC).		
Construction (Delay) Risk - Refers to the impacts of unexpected construction delays of a project.		
Technology Maturity - Unforeseen underperformance or higher cost for emerging technologies		
Novelty Premium - Additional return that investors would price in for uncertainty around a new Government policy/		
Fuel Price volatility - Exposure to fuel input prices (e.g. for biomass, ACT technologies)		
Foreign Exchange ("FX") risk - The risk of adverse movements in the foreign exchange rate vis-à-vis the currency in which a large portion of the input costs of the generator is denominated.		
Wholesale market price risk - The volatility of earnings due to fluctuations in the wholesale market price.		
Duration Risk - Refers to changes in volume and price risk exposure, or earnings risk, associated with the length of the subsidy period		
Change in Law Risk /Policy Risk - The risk that a future law provision could change (reduce) the revenues or costs of the project		

	Project developed under CfD Scheme: Scale (1= no risk to 10 = very high risk)	Similar project developed under ROC: Scale (1= no risk to 10 = very high risk)
Force majeure risk - The parties will not be able to honour the contract due to matters outside of their control		
Volume Risk - Inability to control output in the long-run due to weather (intermittent plant) and forced outages, which introduces volatility in their revenues.		
Imbalance Risk - Inability to accurately forecast output in the short-run (particularly for intermittent plant), which results in exposure to imbalance costs.		
Residual O&M risk - Escalating Operation and Maintenance costs.		
PPA Arrangements - Cashflow impacts from PPA related price volume/price changes		

Other (please specify)

2.2 In general, as a whole, do you consider that the introduction of the CfD Scheme for renewable electricity has reduced or increased risks relative to the RO?

- ◯ Reduced risk
- ◯ Increased risk

Please provide a brief explanation of your views

2. CfD Scheme and effects on risks for investment (continued)

As before, the next set of questions asks you to consider a hypothetical scenario whereby the CfD Scheme was not previously introduced, and the Renewables Obligation (RO) scheme remained open for developers to obtain RO Certificates (ROCs). The aim is to understand what effect this would have had on investors' perception of risks and associated costs of capital for developers.

2.3 Considering the CfD contracted generation unit(s) which your company has invested in, how likely is it that your company would have invested in that project(s) if the CfD Scheme had not been introduced and the Renewables Obligation had remained open?

- ◯ Certainly, would have invested
- ◯ Likely to have invested
- ◯ Unsure
- ◯ Unlikely to have invested
- ◯ Certainly would not have invested

2.4 In a scenario whereby the CfD Scheme did not exist, and the project was developed under the Renewables Obligation (RO) regime, please estimate what level of increase or decrease this would have on your hurdle rates for investment. By hurdle rate, we are referring to the minimum project return that a generation unit owner, or investor, would require over a project's lifetime on a pre-tax real basis.

Please express the change in basis points (100 basis points = 1%), e.g. an increase in hurdle rate from 10% to 10.6% represents an increase of 60 bps.
Indicate decreases using negative sign(-) before the number. If there is no change at all, please enter "0"

Equity specific hurdle rate	
Debt finance specific hurdle rate	
Overall capital or project investment decision hurdle rate	

ase provide an estimate of hurdle rates (%) in pre-tax, real terms.

Equity specific hurdle rate	

Storage

Has your company considered investing in co-located electricity storage alongside CfD supported generators?

- ◯ Yes, we currently have co-located electricity storage
- ◯ Yes, we plan to invest in co-located electricity storage in the future
- ◯ We don't currently have any plans to invest in co-located electricity storage, but might consider it in the future.
- ◯ No, we do not intend to invest in co-located electricity storage.
- ◯ Don't know

Final remarks

Scheme could be changed in the future?

Annex G: Evaluation Questions

This Annex provides a list of all High-level Questions (HLQs) and sub-questions that the evaluation aims to address, alongside a summary of how they will be assessed and what data sources will be used.

HLQ1	Evaluation question	Hypotheses tested by the EQ	Evidence if H is true	Evidence if H is not true	Indicators	Data Sources	Phase in which EQ is / will be addressed
HLQ1	To what extent, how and why is CfD contributing to its intended objectives, and do its outcomes, both intended and unintended, differ for different groups (project developers, investors, technology types)?						All
a	What capacity is on track to be delivered within agreed milestones, and how much has been invested in it?	H1.1 Contracted CfD projects will deliver their forecast electricity generation capacity.	Contracted CfD projects are delivering/on track to deliver expected electricity generation capacity targets (e.g. by 2030, renewable CfDs projected to contribute to 6.4% of total generation	E5. Contracted CfD projects are not delivering/on track to deliver capacity targets.	1) Total MW capacity forecast to 2030. 2) Proportion of electricity generation from CfDs	S1. LCP modelling using LCCC data and BEIS assumptions.	1
		H1.2 Most contracted projects will deliver the target capacity agreed in their contracts	Committed CfD contracts are delivering/on track to Milestone Delivery Dates (MDW) and Target Commissioning Window (TCW)	Higher than anticipated number of projects are not delivering/on track to meet milestones delivery dates.	1) Progress against MDD and 2) TCW timelines	LCCC reports; S3. Developer interviews; S4. Investor surveys	1
		H1.3 The total value of Supplier Obligation payments to CfD developers will be in line with forecast spend (cost for capacity achieved)	LCCC forecast on support payments are in line with estimated budget.	LCCC support payments are higher/lower than expected.	1) 'Total Operational Cost Levy' budget forecasts.2) 'Total Reserve Amount' budgets	LCCC reports	TBC

HLQ1	Evaluation question	Hypotheses tested by the EQ	Evidence if H is true	Evidence if H is not true	Indicators	Data Sources	Phase in which EQ is / will be addressed
b	To what extent has CfD contributed to meeting the 2020 renewables target?	H2.1 Online CfDs contribute to meeting the 2020 target of 30% of electricity coming from renewable sources.	E9. The installed capacity and generation levels of CfD projects online by 2020 is in line with 2018 forecasts and the UK meets the 2020 target.	E10. Online capacity and/or generation levels from CfD projects drops below expectations and UK misses 2020 targets.	1) Total MW of CFD renewable Capacity in 2020. Modelling of online CfD projects' generation in 2020	S2. CfD register; S1. LCP DDM of CfD to 2020	1
c	How does this contribution compare with that projected under the RO?	H3. The amount of renewable generation in 2020 will be greater than a modelled counterfactual scenario of continued RO and no CfDs	E11. The renewable generation from CfD projects in 2020 is greater that what would have been achieved from RO under the counterfactual scenario.	E12. Same or less generation is delivered by CfD projects compared to RO by 2020	1). Total MWh generation projected; 2) counterfactual modelling of RO vs. CfDs	S1. DDM (counterfactual comparison of CfD and RO to 2020 and 2030)	1
d	How does the CfD support the development of a mature and competitive industrial supply chain for renewable technology?	H4.1 UK RE industrial supply chain has become more mature and competitive because of CfDs	Developers report an increase in suppliers of components, capital or services for use in CfD supported projects	Developers report no increase in suppliers of components, capital or services in CfD supported projects	1) Proportion of suppliers that are UK based; 2) number of UK based developer firms.	S3. Developer interviews; S7. BNEF	2
		H4.2 UK R+D has increased for technologies supported by CfD	UK R+D has increased for technologies supported by CfD	UK R+D has not increased for technologies supported by CfD	1) Volume of R+D investment in the UK for less developed technologies	S3. Developer interviews; S4. Developer surveys; S7. BNEF data; S8. Expert interviews	2
e	To what extent and how have Pot 2 auctions led to greater developments in the less established technologies?	H5.1. Capacity of less established technology has increased following Pot 2 auction (disaggregated by technology type)	Capacity of less established technologies committed to CfD has increased by Round 2 and 3.	Capacity of less established technologies committed to has decreased or remained the same in Round 2	Total MW capacity by technology type comparison for Round 1, Round 2, and counterfactual analysis with RO.	S2. CfD register; S1. LCP modelling using DDM;	1
		H5.2. There will be an increase in financial investment in less established technology firms.	Financial investment trends show increase in amount invested for less established techs	There is no change in the investor/supplier profiles for LDTs	Amount of private sector investment, by technology types, over time. (comparison before and after Pot 2 auctions);	Bloomberg data; developer interviews; investor surveys	2
f	To what extent are CfDs accessible to a broad range of generators?	H6. The types of projects that are awarded contracts represent an even spread of those that eligible to participate (by type of technology,	The CfD Register of successful projects shows an even representation of different generator types and sizes.	An uneven representation of different generator types and sizes are committed to projects; some generators report poor accessibility to CfD	2) Type and number of generators committed to CfDs; 2) evidence of barriers to participation by unsuccessful applicants.	CfD register; interviews with developers and unsuccessful applicants	1

HLQ1	Evaluation question	Hypotheses tested by the EQ	Evidence if H is true	Evidence if H is not true	Indicators	Data Sources	Phase in which EQ is / will be addressed
		size, type of parent company)					
g	To what extent and how are CfDs providing suitable support for emerging near-market technologies (i.e. those at technology-readiness level 7)	H7. Emerging near-market technologies received increased support (investment in R+D; piloting; deployment) as a result of CfDs	Emerging near-market technologies have received increased investment, piloting and R+D as a result of CfD	Emerging near-market technologies have not received increased investment, piloting and R+D as a result of CfD	Investment trends in TRL 7 technologies; progress of TRL 7 technologies compared to pre and post CfD; confidence/attitudes of developers; confidence/attitudes of investors	CfD register; Bloomberg investor data; Key informant interviews	1,2
h	What has been the impact of the scheme on both developer and financial investor confidence, and how and why has this occurred?	H8.1. Increase in confidence among developers to propose projects in the UK and participate in Scheme.	Increased number of developers participating in CfD auctions over time.	Developer confidence has not been, or has been negatively, affected by CfD roll out	1) Number, type and capacity of developer projects; 2) type of investor partnerships (increased variety in financial structures); 3) number of developers who bid for CfDs	CfD register; LCCC data Bloomberg investor data; developer interviews.	1
		H8.2. CfDs have increased confidence among investors that CfD projects are an attractive investment.	CfD projects are able to attract sufficient investment, at lower costs of capital, compared to counterfactual scenario of continued RO.	A higher-than-expected number of CfD do not reach financial close or are financed with higher costs of capital.	Investment trends, cost of capital indicators (hurdle rates)	Bloomberg investor data; Investor interviews and surveys	1
i	How has this impact on investor confidence subsequently impacted on the hurdle rates of different projects?	H9. The 15-year guaranteed strike price reduces risks for investors from market fluctuations, improves investor confidences and lowers hurdle rates	Developers report a decrease in overall cost of capital for renewables projects backed by CfD. Investors report lower hurdle rates due to strike price certainty.	Investor confidence has not been sufficiently changed to lower their hurdle rates	1) Hurdle rates for CfD projects compared with estimates of hurdle rates for projects of similar size and scale. 2) Evidence of investors apply additional "novelty premium" to CfD.	BEIS Cost of Energy report. investor and developer interviews	1
j	What are the costs associated with CfD participation for different developers and technologies (administrative, capital, operating and supply chain)?	Note: this is more of an exploratory question, rather than aiming to test a specific hypothesis	LCOE for CfD projects is lower than compared to non-CfD and RO projects	Additional costs to developers are found/reported, as compared to non-CfD and RO projects	1) LCOE for techs in scope for CfDs. 2)Where possible, break down by CAPEX, fixed OPEX, variable OPEX and fuel costs	Bloomberg data; developer interviews, DDM	1
k	How do these costs compare with technologies and developers participating in similar international schemes?	H11. CfD Scheme has supported cost reduction to a similar or greater extent than international schemes.	Trends in reduction of LCOE for technologies supported by UK CfD projects show cost reduction relative to those in comparable countries	LCOE for technologies supported by UK CfD projects are higher compared to international trends	LCOE trends for types of supported technologies, in UK and internationally.	BNEF, AURES, IRENA, DDM	1

HLQ1	Evaluation question	Hypotheses tested by the EQ	Evidence if H is true	Evidence if H is not true	Indicators	Data Sources	Phase in which EQ is / will be addressed
				(among comparable countries)			
l	What would have happened to offshore wind support costs under the Renewables Obligations had it not been replaced by the CfD?	H12. CfD Scheme has reduced costs of offshore wind compared to the RO	Modelled RO offshore wind support costs are found to be higher than CfD project costs	Modelled RO offshore wind support costs are found to be lower than CfD project costs.	Counterfactual modelling of RO offshore wind support costs compared to current and projected CfD costs	BEIS/LCP counterfactual modelling of RO costs vs CfD; developer surveys, DDM	1
m	Has the CfDs impacted on competition in Europe?	Note: aims of this question still to be scoped.			Potentially include increased rate of UK based developers implementing projects in other countries across Europe	BNEF data; developer interviews; investor interviews; national LCOE and technology price data (BNEF/SE4ALL/IRENA?)	TBC
n	Are there any unintended effects of the CfD scheme, if so, on whom, why and how do they impact?	H14.1. The CfD has no unintended effects	There are no observed unintended effects of CfD. For example, minimal negative outcomes such as: crowding out less developed techs, introducing novelty premiums among developers, an over reliance on intermittent sources of supply and increased balancing costs or other increased network costs	Higher than expected cases of negative outcomes arising from the CfD auctions.	Energy market impacts; National Grid info on grid balancing, complaints from unsuccessful bidders of crowding out.	National Grid reports; developer interviews (incl. non-CfD committed); investor interviews; expert interviews	1

HLQ2	Evaluation question	Hypotheses tested by the EQ	Evidence if H is true	Evidence if H is not true	Indicators	Data Sources	Phase in which EQ is / will be addressed
HLQ2	Are the design parameters of the CfD scheme and auction allocations appropriate for achieving the intended objectives?						

a	How has competition between technologies, and the division of auctions into pots of technologies, impacted on different technologies? Has an appropriate level of competition been achieved?	Division of auction into pots has facilitated an 'appropriate level of competition' between developers. This means developers have proposed bids which have lowered costs for consumers, but whereby projects are still financially viable and deliverable.	The strike prices agreed within each pot are decreasing and have lowered costs for consumers (in comparison to modelled RO costs). The majority of CfD projects awarded a contract successfully progress towards operational phase.	Costs to consumers is higher than modelled comparison of deploying same level of electricity under RO.	1) Total amount levied on Supplier Obligation for CfD projects in comparison to costs for same of amount of expected MWh generation under modelled RO comparison. 2) number of projects on course to meet TCW and whether in line with expectations on number of cancellations.	LCCC and Ofgem reports. LCP advice on DDM modelling	1
		Division of auction into pots has enabled less developed technologies to participate in auctions and win an expected level of contracts.	Rates of LDTs coming online has increased through pot 2. Evidence of new developers participating and winning CfD contracts.	Lower than expected level of LDTs coming online through pots. Evidence that the same large and experienced developers win contracts and crowd out new entrants.	1) Profile of projects awarded contracts by type of tech and developer. 2) Extent of crowding out suggested by unsuccessful applicants.	CfD register; Interviews with unsuccessful applicants	1
b	Was the initial classification of technologies in Pot 1 and Pot 2 effective in supporting the development for emerging technologies?	More emerging technology capacity came online following CfD pot auctions compared to previous trajectory (RO)	More emerging technology capacity came online following CfD pot auctions compared to previous trajectory (RO)	No more emerging technology capacity came online following CfD pot auctions compared to previous trajectory (RO)	Total emerging technology capacity committed to vs modelled RO trajectory	CfD register; LCP modelling of emerging technology deployment in RO scenario	1
c	How would have the auction outcomes differed had all technologies been competing rather than being split into pots?	More exploratory rather than a specific hypothesis to test. Precise aims of question to be scoped and confirmed.				Interviews surveys with developers and Key Informant Interviews	1
d	Are the CfD delivery incentives (eligibility requirements, Non-delivery disincentive, milestone delivery date, target commissioning window, Long Stop date) suitable to encourage projects to deliver at all stages of delivery?	CfD delivery incentives encourage projects to progress towards operational phase in a timely and efficient way.	1) Timescales between reaching Financial Close to Commercial Operation Date (COD) are, on average, shorter for CfD projects than RO projects of similar scale and technology type. 2) The CfD delivery incentives have not introduced significant new costs for developers.	Conversely; 1) there is evidence to suggest that CfD projects take longer to reach COD after Financial Close 2) have introduced significant new administrative costs for developers.	1) timescales for reaching COD after securing a CfD contract 2) Success rate of committed projects disaggregated by type and size; impact reporting by CfD and non CfD developers 3) reporting of administrative costs by developers	Developer interviews; investor interviews; CfD register, LCCC reports.	1

e	Are administrative strike prices meeting their intended objectives as set out in the strike price methodology5? If not, why?	ASPs encourage developers propose bids that competitive, realistic, in line with LCOEs and are financially viable to achieve.	ASPs have been calculated at a rate which accurately reflects the LCOE for each technology and encourages competitive bids at a realistic price.	ASPs estimates do not correctly reflect the LCOE for some technologies, which has led to bids that are either over inflated (profiteering) or unrealistically low to achieve.	1) LOCE trends for each technology and comparison across Europe. 2) Interviews with sector experts and developers.	CfD; non/developer interviews; investor interviews. Bloomberg	1
f	Does the form and level of support allow the right balance between project delivery and efficiency? Is there evidence of developers being overcompensated?	Strike prices of committed projects are in line with LCOE trend and all projects are implemented within agreed timelines	Observed strike prices of committed projects are in line with LCOE trend and all projects are implemented within agreed timelines	Observed strike prices of committed projects are not in line with LCOE trend and not all projects are implemented within agreed timelines	1) Strike prices compared to historical/predicted LCOE trend; 2) rate of project completion and delivery	CfD register; BNEF	2
		Strike prices overcompensate developers	Strike prices are above average LCOE trend	Strike prices are in line with or below LCOE trend	Strike prices compared to historical/predicted LCOE trend	CfD register; BNEF	1
g	How does the complexity of the scheme, perceived or actual, affect participation and engagement in the scheme? Does this differ for different types of developers and technologies?	There are no barriers to participation caused by the complexity of the scheme's design	No reported or observed barriers to participation caused by the complexity of the scheme's design	There are reported or observed barriers to engagement caused by the complexity of the scheme's design	Some developers reporting or indicating barriers to engagement as a result of schemes design (disaggregated by type and size of developer)	Non-developer interviews; investor interviews	1
h	Is the chosen auction type (pay-as-clear) effective in driving competition and achieving cost reductions?	Pay-as-clear pricing drives better competition than alternative pricing options (e.g. pay-as-bid)	Pay-as-clear pricing is found to drive better competition than alternative pricing options (e.g. pay-as-bid) based on trends in reducing LCOE and reducing strike prices.	Pay-as-clear pricing is not found to drive better competition than alternative pricing options (e.g. pay-as-bid) based on comparison of strike prices over time, and internationally	1) CfD Register of strike prices and trends over time. 2) Modelling of auction pricing scenarios and comparison; comparison with similar international mechanisms use alternative pricing	REA. Bloomberg date on international strike prices from auctions with different design. Developer interviews.	1
i	What evidence is there of the cost to developers of securing Power Purchase Agreements, and what (if any) effect has the CfD had on this market?	Aims of question to be scoped and agreed.					1

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