



Department  
of Energy &  
Climate Change

# Annex E: EMR Panel of Technical Experts' Final Report for DECC

December 2013

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# Executive Summary

## Introduction

1. The Government commissioned, in February 2013, an independent Panel of Technical Experts (PTE) to impartially scrutinise and quality assure the analysis carried out by National Grid (in its role as EMR Delivery Body) for the purposes of informing the policy decisions included in the final EMR Delivery Plan.
2. The PTE has no remit to comment on EMR policy, Government's objectives, or the deliverability of the EMR programme. The Panel's Terms of Reference mean it cannot comment on affordability, value for money or achieving least cost for consumers. These matters are excluded from the Panel's scope and therefore from this report and the previous one.
3. The PTE has already scrutinised and made recommendations on the analysis completed prior to the consultation on the EMR Draft Delivery Plan in July 2013<sup>1</sup> and this report provides an update. This report should be read, therefore, in conjunction with the Panel's previous report<sup>2</sup>.

## Commentary on Analysis and Key Findings

4. The Panel's initial report was published in July 2013 alongside the consultation on the draft Delivery Plan. Our report was predominantly a commentary on the methodology and analytical techniques available to National Grid when conducting the analysis for the draft Delivery Plan as well as on the realism of modelled investor behaviour. We commented on four key areas:

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<sup>1</sup>  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/238867/Consultation\\_on\\_the\\_draft\\_Delivery\\_Plan\\_\\_amended\\_.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/238867/Consultation_on_the_draft_Delivery_Plan__amended_.pdf)

<sup>2</sup>  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/223656/emr\\_consultation\\_annex\\_f.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223656/emr_consultation_annex_f.pdf)

- Modelling Impacts of EMR;
- Electricity Generation costs;
- De-rated plant availabilities;
- Commentary on the Realism of Investor Modelled Behaviour.

## Our Comments on DECC's Responses to our July Recommendations

5. We made eight recommendations to Government based on these four areas of focus. To summarise, we welcome DECC's positive approach in addressing these recommendations, the responses to which are shown in the body of the report together with our reaction to those responses. We would draw out particularly the following salient observations:

- We note and welcome the indication of an earlier move to market allocation of Contracts for Difference as we believe that this approach will have the effect of reducing the reliance on data quality and analysis in order to achieve the desired outcomes for EMR;
- We welcome DECC's attempts to validate the assumptions regarding the hurdle rate for new generating plant. Nevertheless, we have reservations regarding the Weighted Average Cost of Capital assumptions used by DECC and we therefore comment on this extensively in the report;
- Particularly while awaiting any transition to market allocation of Contracts for Difference, we believe that new CfD's should be accompanied by effective requests for information from generating plant that would support the analysis of strike prices and we welcome DECC's current consideration of this approach;
- We reported that, in our view, National Grid (NG) was using an overly conservative assumption for peak power plant availabilities for assessing future system capacity margins and hence the amount of new capacity which would be need to be procured through the Capacity Market. We welcome DECC's engagement of a technical advisor to examine this question. We encourage even more transparency regarding the impact of EMR on bills for different categories of electricity consumer which shows the balance achieved in relation to the carbon, security and price hedge benefits of EMR;

- We understand the technical reasons why the impact of strike prices is not modelled stochastically, but we believe that using sensitivity analysis alone could lead to uncertainty not being fully appreciated. We therefore encourage the development of stochastic modelling where appropriate;
- DECC responded positively to our suggestion to consider using scenario planning approaches (such as that used most notably by Shell) and we continue to recommend its application in order to deepen, broaden and integrate the understanding of the market that DECC seeks to put in place;
- We were very pleased that DECC accepted and implemented our recommendation to compare and contrast the costs of relevant forms of generation and the support schemes to promote their development that are used in other jurisdictions although there is further work that is needed to explain all the differences.

## Our Work Subsequent to our First Report

6. Following on from our work culminating in our July report and the subsequent DECC consultation, closing in September, we continued our work. We looked particularly at the following areas:

- National Grid's December 2013 Analytical Report;
- The Role of the Banding Review in Setting Strike Prices;
- The Hurdle Rates.

7. These are summarised in this executive summary below and discussed in more detail in the report.

## Commentary on National Grid's December 2013 Analytical Report

8. Overall, our view was, and remains, that National Grid's analytical approach and its reliance on DECC's Dynamic Dispatch Model (DDM)<sup>3</sup> is a valid one for assessing the

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<sup>3</sup> <https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm>

different technology cost assumptions and market scenarios on different policy parameters.

9. We saw NG's December Analytical Report on 6 December 2013, only shortly before finalising our report. The impact on wholesale price, generation mix, total emissions and systems costs are tested using nine scenarios. In summary, our observations are as follows:

- There is not a lot of variation in the generation capacity mix in 2020 between these scenarios: only offshore wind varies significantly (with about 7GW between the highest and lowest deployment); onshore wind and biomass vary by 2GW, while other technologies see just hundreds of MWs. This excludes CCGTs which effectively act as the balancing item, with some 10GW difference between the high and low cases. Our view is that this underestimates the uncertainties regarding onshore wind and solar. The 1GW annual cap on new commissioning of large solar now looks low, given the recent high level of inquiry and the fact that several EU countries achieved 2-3 times this. The main driver of uncertainty regarding outturn wholesale prices and the LCF costs is seen to be fuel prices, which is to be expected given the level of uncertainty of gas and coal price and their high correlation to wholesale prices;
- Variations in electricity demand tested show little material impact on wholesale power prices and LCF costs, though a big impact on CCGT capacity required and the share of renewables;
- NG/DECC test the impact of much greater reliance on offshore wind. This high offshore wind case requires much higher strike prices than a lower wind case to bring forth the extra capacity (+7GW) and its impact is to increase LCF costs and lower wholesale prices;
- A high biomass conversion case is also tested, with 3.6GW installed versus 1.7GW in the other cases, but its impact is not material in the scheme of sensitivities shown;
- Variation in LCF costs would have been seen if investors' hurdle rates had been explicitly tested which instead were held constant across all scenarios. Sensitivities on capex, however, provide a proxy for variation in hurdle rates. (The same would apply to a lesser extent to PPA discounts for non-vertically integrated utilities).

## The Role of the Rebanding Review in setting strike prices

10. We examine in detail the important role that the Renewables Obligation banding review has played in setting CfD strike prices. Our principal observations are as follows:

- The guiding principle behind setting the CfD strike prices was that they should be set at a comparable level to that provided by the Renewables Obligation scheme with the more cost-effective CfD's being more attractive during the period when both schemes remain available until the end of 2016/17. This has the effect of linking the CfDs (and their cost) to the current Renewables Obligation (RO) prices, which were re-set for the period 2013-17 in July 2012. The main difference is the cost of financing the investment and the required returns to investors under the two schemes, implying that the hurdle rate is central in the EMR (this is discussed at length in the report);
- Following our concern that the hurdle rates used in the modelling may prove higher than necessary to induce the required supply of investment, DECC commissioned NERA to focus on evidence of the change in hurdle rates between the RO and CfDs, consulted extensively on the hurdle rate for the rebanding review and drew from other sources. We therefore accept that DECC has made the appropriate use of the evidence available at the time of setting the strike prices;
- There remains uncertainty on what the future financial terms might be for CfDs, once the market has become familiar with these new instruments. In consequence we consider the matter both sufficiently important and uncertain to require further scrutiny, as it should guide the kind of information to collect in setting future strike prices.

## The Hurdle Rates

11. The aim of the EMR is to reduce risk and hence lower the cost of finance, as measured by the hurdle rate used in appraising potential investments. In terms of calculating hurdle rates, we accept that DECC has made the appropriate use of the evidence available at the time of setting the strike prices. For the current purpose, for

setting strike prices in the period to 2017, the hurdle rate for CfDs is intended to make projects as attractive, but no more so, than if funded under the RO scheme. This is not simple.

- As the RO scheme is phased out, building up the Weighted Average Cost of Capital (WACC) from its component parts will become increasingly important. For mature technologies, that would start with the risk-free rate looking forward, the debt premium, the equity risk premium, the beta (which measures the extent to which the project returns are correlated with those of the stock market) and the comfortable level of gearing. The resulting WACC is the return to achieve from investments, and should be comparable to the hurdle rate;
- In order to secure comparability between the RO scheme and CfDs, DECC commissioned NERA to estimate by how much the hurdle rate should be reduced for CfDs compared with the RO. As part of an international comparison, the UK emerged as being more expensive than some countries such as Germany but we/NERA describe a number of factors that need to be taken into account when comparing rates across countries;
- We also discuss the impact of different classes of investor on hurdle rates, including companies, such as incumbents, that have the capability to hedge exposure to the electricity price under the RO compared with others, possibly infrastructure, pension or sovereign wealth funds, that require steady, long term returns;
- Although deceptively simple to calculate the implied return to equity given assumptions about the gearing, and the real interest on debt, accuracy relies on high accuracy and precision of self-consistent input data. High and different gearing along with differences in beta (depending on CfD or RO risk correlation with the relevant market for power) between companies strongly influences the calculation;
- Ultimately, we are not yet fully persuaded that the WACC adopted by DECC will be appropriate when setting future strike prices and recommend that they continue to monitor actual financial arrangements carefully as the market develops.



## Additional Recommendations

12. As the strike prices have already been published we have no recommendations on setting these prices. We note, however, that the Government considers it appropriate to create, using the powers in section 13 (Information and advice) of the Energy Act 2013<sup>4</sup>, an obligation on CfD generators (“a generator who is party to a CfD”) to provide the System Operator with certain information, including build, capital and operational costs of CfD plant. In the light of this and following on from our recent findings, additional recommendations to those stated in our July report are as follows:

- The Weighted Average Cost of Capital should be reviewed in the light of unresolved concerns that we have not had the time or means to resolve prior to the publication of this report;
- We further recommend that DECC continues to monitor actual financial arrangements carefully as the market develops;
- We recommend that the consequences of implementing the Target Electricity Model<sup>5</sup> with the possible price splitting between England and Scotland be further examined, to see what might be the implications for the choices between ROCs and CfDs and possible implications on the Levy Control Framework.

## Caveats

13. Certain aspects associated with EMR are outside of the remit of the Panel and are not included in this report or our July report:

- EMR policy decisions;
- EMR costs beyond 2020;
- The risk of a “capacity crunch” in 2014/15 due to the risk of plant “retiring” earlier than expected;

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<sup>4</sup> The Energy Bill 2012 received Royal Assent on 18 December 2013, becoming the Energy Act 2013.

<sup>5</sup> <https://www.ofgem.gov.uk/ofgem-publications/59309/eu-target-model-open-letter.pdf>

- The treatment and impact of Interconnectors on the strategic intent of EMR;
- Locational issues in relation to transmission pricing and constraints;
- Reviewing the Carbon Price Floor;
- Demand side forecasting and management;
- Value for money, costs to consumers and affordability.

14. This report has been prepared from information provided by DECC, National Grid and the collective judgement and information of its authors. Whilst this report has been prepared in good faith and with reasonable care, the authors expressly advise that no reliance should be placed on this report for the purpose of any investment decision and accordingly, no representation of warranty, expressed or implied, is or will be made in relation to it by its authors and nor will the authors accept any liability whatsoever for such reliance on any statement made herein. Each person considering investment must make their own independent assessment having made whatever investigation that person deems necessary.

# Introduction

## Role of the Panel of Technical Experts

15. The Government commissioned, in February 2013, an independent Panel of Technical Experts (PTE) to impartially scrutinise and quality assure the analysis carried out by National Grid (in its role as EMR Delivery Body) for the purposes of informing the policy decisions included in the final Delivery Plan<sup>6</sup>.

16. The background of the members and terms of reference of the Panel were published upon the Panel's appointment<sup>7</sup> in February 2013.

17. This report has been prepared for DECC by:

- Andris Bankovskis;
- Dr. Guy Doyle;
- Professor David Newbery CBE FBA.

18. The PTE wishes to point out that following Dr. Norma Wood's appointment to the post of interim Director General of the Government's Major Projects Authority, Dr Wood stepped down as Chair of the Panel in September 2013. Mr. Andris Bankovskis was subsequently appointed as the Chairperson of the Panel.

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<sup>6</sup> <https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan>

<sup>7</sup> <https://www.gov.uk/government/policy-advisory-groups/141>

19. The Panel, moreover, wishes to express its thanks to Dr. Wood for her leadership and invaluable input since the inception of the PTE, leading up to the publication of the PTE's July report.

20. The PTE has already scrutinised and made recommendations on the analysis completed prior to the consultation on the EMR Draft Delivery Plan in July 2013<sup>8</sup> and this report provides an update. This report should be read, therefore, in conjunction with the Panel's previous report<sup>9</sup>.

## Scope

21. The scope of the PTE is to impartially scrutinise and quality assure the analysis carried out by National Grid (in its role as EMR Delivery Body) for the purposes of informing the policy decisions included in the final Delivery Plan. This includes scrutinising the choice of models and modelling techniques employed; the inputs to that analysis (including the ones DECC provides); and the outputs from that analysis scrutinised in terms of the inputs and methods applied.

22. The Panel has no remit to comment on EMR policy, Government's objectives, or the deliverability of the EMR programme. The Panel's Terms of Reference mean it cannot comment on affordability, value for money or achieving least cost for consumers. These matters are excluded from the Panel's scope and therefore from this report and the previous one.

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<sup>8</sup>  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/238867/Consultation\\_on\\_the\\_draft\\_Delivery\\_Plan\\_\\_amended\\_.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/238867/Consultation_on_the_draft_Delivery_Plan__amended_.pdf)

<sup>9</sup>  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/223656/emr\\_consultation\\_annex\\_f.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223656/emr_consultation_annex_f.pdf)

## Timing

23. The Panel's key recommendations on the analysis informing the draft EMR Delivery Plan, including the analysis informing the draft CfD strike prices and reliability standard, were made in our report dated July 2013. The Government responded to these and, where applicable, included them within the Final EMR Delivery Plan (for further details on the Government's response to our recommendations).

## Approach

24. The Panel's approach to this work has been pragmatic. Our initial focus was on gaining an understanding of the methodologies and analytical techniques available to National Grid (NG) to conduct analysis commissioned by the Government for the first EMR delivery plan and to scrutinise the assumptions on which their analysis rests.

25. The Panel's report on this work was published in July 2013 (see Footnote 2). Overall, our view is that National Grid's analytical approach, as commissioned by the Government, and its reliance on the Dynamic Dispatch Model (DDM) is a valid one for assessing the impacts of different technology cost assumptions and market scenarios on different policy parameters such as the support cost attributed to the Levy Control Framework, the extent of decarbonisation and the share of renewable electricity.

26. The Panel made key recommendations in our report, which have been adopted and incorporated where possible into DECC's and National Grid's thinking and subsequent analysis, as outlined in the section entitled 'Discussion on Key Recommendations'.

27. The Panel have continued to scrutinise the work done by DECC and National Grid by focussing on the finalised data inputs, which underpin the analytical outputs and the subsequent policy decisions. The data inputs were agreed by DECC following a period of consultation and augmented by our initial recommendations as well as by internal DECC and National Grid analyses.

28. This review, in line with our first report, is not comprehensive and nor is it a due diligence exercise. In this report we have concentrated on key areas of data used in the modelling and as such we have provided commentary on:

- Hurdle rate assumptions;
- Modelling of the balance between ROs and CfDs;
- Running the DDM in stochastic mode and exploring the risk of breaching the LCF;
- State aids and the need for market allocation.

29. We have not revisited our earlier discussion of the analysis to inform the reliability standard and plant availability factors as DECC has accepted our earlier recommendation to commission an independent technical advisor to re-examine this issue. We note that the capacity payments themselves do not count towards the LCF and will be the subject of future analysis, and that their main impact would work through their effect on wholesale prices and hence on the magnitude of payments under CfDs – higher capacity margins that depress wholesale prices will raise the subsidy required, all other things being equal.

## Caveats

30. Certain aspects associated with EMR are outside of the remit of the Panel and are not included in this report:

- EMR policy decisions;
- EMR costs beyond 2020;
- The risk of a “capacity crunch” in 2014/15 due to the risk of plant “retiring” earlier than expected;
- The treatment and impact of Interconnectors on the strategic intent of EMR;
- Locational issues in relation to transmission pricing and constraints;
- Reviewing the Carbon Price Floor;
- Demand side forecasting and management;
- Value for money, costs to consumers and affordability;

31. This report has been prepared from information provided by DECC, National Grid and the collective judgement and information of its authors. Whilst this report has been prepared in good faith and with reasonable care, the authors expressly advise that no reliance should be placed on this report for the purpose of any investment decision and accordingly, no representation of warranty, expressed or implied, is or will be made in relation to it by its authors and nor will the authors accept any liability whatsoever for such reliance on any statement made herein. Each person considering investment must make their own independent assessment having made whatever investigation that person deems necessary.

# Findings of the Panel's Report on the Draft Delivery Plan

## Summary

32. The Panel's initial report was published in July 2013 alongside the consultation on the draft Delivery Plan. Our report was predominantly a commentary on the methodology and analytical techniques available to National Grid when conducting the analysis for the draft Delivery Plan as well as on the realism of modelled investor behaviour.

33. We commented on four key areas:

- Modelling Impacts of EMR;
- Electricity Generation costs;
- De-rated plant availabilities;
- Commentary on the Realism of Investor Modelled Behaviour.

### Modelling Impacts of EMR

34. Overall, our view was that National Grid's analytical approach and its reliance on DECC's Dynamic Dispatch Model (DDM)<sup>10</sup> was a valid one for assessing the different technology cost assumptions and market scenarios on different policy parameters.

### Electricity Generation Costs

35. In terms of electricity generation costs it was our view that DECC and National Grid had undertaken an extensive review and analysis of the costs of electricity generation in the UK, which has confirmed there is considerable variation within technology

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<sup>10</sup> <https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm>



bands. Our July report expressed our reservations about the related hurdle rate used in the analysis.

### De-rated plant availabilities

36. We reported that, in our view, National Grid (NG) was using an overly conservative assumption for peak power plant availabilities for assessing future system capacity margins and hence the amount of new capacity which would be need to be procured through the Capacity Market.

### Commentary on the Realism of Investor Modelled Behaviour

37. DECC recognised the need to augment the DDM and to build up a model of evidence to reflect real-world investor behaviour. The Panel commented on the importance of taking into account those factors which lie outside the DDM, such as supply chain constraints, planning consents, etc., but which can have a real impact on investor behaviour. The gap between modelled behaviour and real-world behaviour is something which DECC needs to continue to develop and incorporate into future analysis.

### Previous Recommendations

38. As a result of these findings the Panel made eight key recommendations:

- There are inevitable gaps in cost information because of the immaturity of technology, the evolving nature of many of the relevant markets (for the reference price and for balancing) and lack of experience in the cost of financing these new instruments. DECC should use all its opportunities to access data and understand cost drivers, to inform future strike prices;
- Industry owns the cost data for the more mature technologies and DECC's requests for this information need to be specific and defined, ideally in clear data catalogues. DECC should work with industry to develop "should" cost (i.e. benchmarked) and

“could” cost (i.e. collaboration to further reduce costs) models to improve the evidence base for future strike prices;

- DECC should commission an independent technical advisor to re-examine the question of appropriate availability levels for technologies during periods when operating plant margin is low including other jurisdictions where there is an incentive to be available at such times. This work should be done before the capacity market is implemented;
- There should be a stronger and more visible link between DDM modelling and the feed through to consumer prices;
- The DDM should be run stochastically to improve the reliability of outputs (e.g. to test the risk of missing targets, the Levy Control Framework and capacity mechanism costs);
- DECC should consider adopting best practice from the private sector by employing light-touch Scenario Planning methodologies to inform their assumptions concerning investor appetites;
- DECC should continue to monitor evolving market conditions (the spot and balancing markets) and the actual financing cost for these and similar investments to assess the extent to which changes alter risk and hence the hurdle rate to inform the setting of future strike prices;
- DECC should continue to monitor support conditions in other EU countries to learn what knowledge and evidence can be transferred to understand how they achieve more capacity at lower cost.

## Discussion on Key Recommendations

39. Following the publication of our July report the Government responded to our key recommendations as follows:

**Recommendation 1: There are inevitable gaps in cost information because of the immaturity of technology, the evolving nature of many of the relevant markets (for the reference price and for balancing) and lack of experience in the cost of financing these**

**new instruments. DECC should use all its opportunities to access data and understand cost drivers, to inform future strike prices.**

## **Government response**

40. DECC aims to ensure its evidence base is up-to-date and robust. For example, for the Draft Delivery Plan it considered nine different data sources for the cost of various renewable technologies, and commissioned an update report to ensure our data on the cost of non-renewable technologies was current. Furthermore, DECC has reviewed all additional evidence submitted as part of the consultation on the Draft Delivery Plan to ensure these estimates are up-to-date. In addition, DECC commissioned NERA to undertake independent analysis to review existing evidence (primarily consultation responses, analyst reports and interviews with the finance community on financing costs for renewable electricity generation under the CfDs). This analysis will be published alongside the EMR Delivery Plan<sup>11</sup>

## **Panel's comment**

41. We note that although the assumptions on generation, construction and maintenance costs were probably as good as could be achieved by consultation; market conditions and prices can change very rapidly, and indeed coal capex costs appear to have fallen dramatically recently, while the capex for CCGTs were very volatile over the boom and bust cycle in the dash for gas. In our July Report we therefore stressed the importance of the transition to more market-driven solutions, and we note that if the profile of the LCF is breached then a more market-driven approach may be invoked. The great advantage of the market is that it provides a discovery mechanism for assessing the costs facing different developers and different sources of finance, whereas the modelling approach followed by National Grid is inevitably broader brush, assumes a typical investor, and necessarily concentrates on average or even higher cost assumptions, as it is the marginal and most expensive plant that determines the

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<sup>11</sup> <https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan>

amount of investment, given the decision to offer the same strike price regardless of spatial differences in costs.

**Recommendation 2: Industry owns the cost data for the more mature technologies and DECC's requests for this information need to be specific and defined, ideally in clear data catalogues. DECC should work with industry to develop "should" cost (i.e. benchmarked) and "could" cost (i.e. collaboration to further reduce costs) models to improve the evidence base for future strike prices.**

### **Government response**

42. DECC aims to ensure its evidence base is up-to-date and robust. Currently data has been collected in several different ways including asking industry to provide data using a template and commissioning work from engineering consultants. DECC aims to ensure that it collects evidence on the current cost of generation, and understands how costs might evolve in future. This includes considering evidence based on learning and cost reduction reports (including the work of the Offshore Wind Cost Reduction Task Force and the CCS Cost Reduction Task Force). Furthermore, DECC has reviewed additional evidence collected as part of the consultation on the draft Delivery Plan to ensure these estimates are up-to-date.

### **Panel's comment**

43. We appreciate that DECC makes strenuous and concerted efforts in order to get the best technology cost data available. We would nevertheless reiterate that the best cost data resides within industry and that gaining access to such data, where it can be used for the purpose of making better estimates for the purposes of awarding support to those technologies, is both justified and necessary. In some areas, data have been very difficult to obtain through the normal methods either because it is regarded by industry as commercially confidential or perhaps because it is not in their interests to do so as the subsidy is available regardless of such cooperation. We suggest, therefore, that DECC reconsiders this recommendation with a view to reassuring industry that data will be used properly and securely.

**Recommendation 3: DECC should commission an independent technical advisor to re-examine the question of appropriate availability levels for technologies during periods when operating plant margin is low including other jurisdictions where there is an incentive to be available at such times. This work should be done before the capacity market is implemented.**

#### **Government response**

44. National Grid has significant expertise on plant availabilities and DECC considers, therefore, NG will be a more intelligent customer for this analysis. DECC will oversee the tender process and appointment of the independent adviser. Furthermore, DECC will ensure that any analysis adequately addresses the Panel of Technical Experts recommendations and, accordingly, has worked with National Grid in scoping the invitation to tender (ITT) document for this project. The independent technical adviser's report on the analysis will feed in to the analysis underpinning the setting of the demand curve for the Capacity Market scheduled to take place in the first half of 2014. DECC will ensure that the project delivers a final written report, which DECC has access to and which we expect to publish.

#### **Panel's comment**

45. We are content that DECC has addressed our request to commission an independent technical advisor to provide a second view on future plant availabilities under a regime where generating capacity is incentivised under the Government's proposed capacity payments mechanism. This therefore closes out this recommendation.

**Recommendation 4: There should be a stronger and more visible link between DDM modelling and the feed through to consumer prices.**

#### **Government response**

46. Chapter 4 of the Consultation on the draft EMR Delivery Plan<sup>12</sup> summarises the impacts on prices and bills both *relative* to the costs of achieving similar levels of decarbonisation using existing instruments, and also in *absolute* terms. In both cases the costs of CfDs and Capacity Market payments have been shown separately. Further details on prices and bills impacts are included in the accompanying Impact Assessment<sup>13</sup>, which also now has a clearer explanation of the comparison with Base case C (which has no explicit decarbonisation target or tools to mitigate against security of supply risks). An updated Impact Assessment will be published in December 2013, with a full version being published in early 2014.

### Panel's comment

47. We acknowledge that DECC has provided information on the impacts of implementing the EMR on customer prices and bills in its July 2013 Impact Assessment and also in its Prices and Bills Analysis Report. Our view is that it is difficult to see a clear linkage between the costs reported in the DDM modelling in terms of the aggregate of the LCF costs, capacity mechanism payments and network costs and the absolute impacts on average customers' bills. We accept that the calculation of impacts is not straight forward (given the need to take account of energy efficiency measures and the fact that costs may not be recovered equally over customer types).

48. Even so an indicative cost measure for an average domestic customer would provide a useful metric for non-experts to have in comparison to the expected benefits of implementing EMR, in terms of contributing to climate change mitigation, energy security and providing a hedge against future high fuel prices. It is our understanding that the impact by customer type is calculated and will be made available in an accessible form in due course. Notwithstanding this recommendation for a little more transparency, we are satisfied that the normal parliamentary process will provide sufficient scrutiny of the follow through of impacts for average customers and the economy versus the benefits.

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<sup>12</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/238867/Consultation\\_on\\_the\\_draft\\_Delivery\\_Plan\\_amended\\_.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/238867/Consultation_on_the_draft_Delivery_Plan_amended_.pdf)

<sup>13</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/226020/emr\\_delivery\\_plan\\_ia.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226020/emr_delivery_plan_ia.pdf)

**Recommendation 5: The DDM should be run stochastically to improve the reliability of outputs (e.g. to test the risk of missing targets, the Levy Control Framework and capacity mechanism costs).**

### **Government response**

49. DECC appreciates the merit of this recommendation, and the additional assurance it would provide on the robustness of outputs. However stochastic use of the DDM will be very limited due to the difficulty in defining suitable distributions for relevant input variables, meaning that output distributions are unlikely to be robust as well as the time taken to complete stochastic runs.

50. In addition, strike prices are fixed across all Monte Carlo simulations – the DDM does not endogenously vary the strike prices to respond to the effects of changing input variables, and the strike prices remain at the levels set in the input file. Given the tight publication timescales it will not be possible to address the above issues before the publication of the final Delivery Plan; however we will keep the option of stochastic modelling under review for future analysis. The modelling will continue to use a wide range of scenarios to explore different possible outcomes.

### **Panel's comment**

51. We welcome DECC's recognition of the value of stochastic analysis. We understand the modelling technique restrictions that are referred to arise because the DDM is written in code that does not lend itself to the use of efficient Monte Carlo techniques using software that is readily available for spread sheets. Also the DDM does not endogenously vary the strike prices to respond to the effects of changing input variables, and the strike prices remain at the levels set in the input file which would lead to misleading results. In addition, it is likely to prove difficult to obtain robust probability distributions for many of the input variables.

52. Our on-going review following our previous report continues to suggest to us that stochastic analysis would provide further insights that are missing from the simpler

analysis, even if the feedback from wholesale prices to demand is ignored for simplicity. There are a number of important parameters that are either uncertain, or which can only be represented as a range, such as fossil fuel prices, technology costs and hurdle rates, all of which elude precise quantification. These have been analysed through deterministic sensitivity analyses whereby point values of one or more parameters are flexed to “stress test” the impact on outputs, such as the containment of costs within the Levy Control Framework (LCF) limits, the forecast of new generation capacity and reductions in grid carbon intensity. Sensitivities are useful to indicate how sensitive outputs are to particular inputs, but the inevitable focus on a central case may lead to an underestimate of the possible range of outcomes for wholesale prices and the LCF.

53. A stochastic approach (given appropriately robust probability distributions for input variables) would enhance the understanding of these analyses, however, by giving a better sense of the collective impact of the uncertainty attaching to inputs, the parameters that give rise to that uncertainty and therefore suggestions to mitigate risks. In some situations, it may be more instructive to use scenarios: for example, the analysis to explore the on-going solvency and viability of generating plant in the event of sustained changes in economic conditions. There might, for example, be ranges of floating biomass fuel prices that they cannot be sustained by the fixed rate of income from Contracts for Difference, leading to the permanent removal of that capacity from service.

54. Similarly, there are ranges of costs which are uncertain or unknown pending the outcome of other reviews which at this point, such as network and ancillary costs which can only be represented by a range of possible outcomes. Moreover, ranges and probabilities are potentially better ways of representing inputs from consultations and in cases where the industry provides patchy data regarding costs (often to protect commercial confidentiality). We therefore continue to encourage further testing of stochastic methods in future analyses whilst recognising that this could require significant model enhancement.



**Recommendation 6: DECC should consider adopting best practice from the private sector by employing light-touch Scenario Planning methodologies to inform their assumptions concerning investor appetites.**

## **Government response**

55. DECC appreciates the merits of the specific suggestion around Scenario Planning and the specific examples provided by the Panel by way of exemplar. In response to the Panel's broader recommendation about increasing our focus on engagement with those sources of capital most likely to participate in low carbon generation projects, we have refined our approach. We believe that our approach at this stage provides us with sufficient confidence about the levels of deployment (and hence delivery against policy objectives) that the final strike prices and CfD contract terms are likely to engender, however we will continue to explore the techniques proposed by the Panel in relation to our activities going forward.

56. Since the Panel's first report, we have in relation to technologies where DECC believes deployment to be the most uncertain:

- Undertaken market intelligence work – including with developers, consultants and other market participants (including the Green Investment Bank) – both through consultation and informally to develop a greater understanding of which projects might be economic at varying levels of strike price;
- DECC has also undertaken in-depth research into a) the credit strength of the sponsors involved and b) their strategic aims. We do not believe that attempting to come up with a probability for each project would be meaningful, but this has given DECC a sense of the relative likelihood of projects proceeding;
- Many of these projects will likely require equity partners and/or project finance in order to reach financial close. DECC and UKTI have focussed recent engagement with the potential new entrants whom we consider to be the most likely to participate in construction phase offshore wind in the near future.

## Panel's comment

57. The DECC response to this recommendation shows that our point regarding the merits of scenario planning has been accepted. We understand that DECC collects and internalises copious information and intelligence, carries out deep research and analysis, and has engaged with many levels of industry, the financial community, NGOs and other government institutions in the UK and abroad. We would encourage DECC to consider whether such an approach would be of benefit in the future and we would point to Shell's latest scenario analysis, "New Lens Scenarios", as a useful exemplar. It may be found on Shell's website<sup>14</sup>.

**Recommendation 7: DECC should continue to monitor evolving market conditions (the spot and balancing markets) and the actual financing cost for these and similar investments to assess the extent to which changes alter risk and hence the hurdle rate to inform the setting of future strike prices.**

## Government response

58. DECC aims to ensure its evidence base is up-to-date and robust. There is significant uncertainty around the cost of financing projects now and in the future. Therefore, DECC has commissioned NERA to undertake independent analysis to review existing evidence (primarily consultation responses, analyst reports and interviews with the finance community) on financing costs for renewable electricity generation under the CfDs. The NERA report will be published alongside the EMR Delivery Plan<sup>15</sup>. Further, DECC recognises the importance of having the most current information and has recently consulted on, amongst other things, using powers in section 13 (Information and advice) of the Energy Act 2013 to create an obligation on CfD generators ("a generator who is party to a CfD") to provide the System Operator with certain information, including build, capital and operational costs of CfD plant.

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<sup>14</sup> <http://www.shell.com/global/future-energy/scenarios/40-years.html>

<sup>15</sup> <https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan>

## Panel's comment

59. DECC has continued to consult and commission reports on the evolving costs of, and market conditions facing, renewables, but considerable uncertainties remain on such issues as the balancing regime and its costs and the methodology and level of transmission charges that will be levied on intermittent generation in different locations. We note that DECC's *EMR Consultation on Proposals for Implementation* proposes (para 772) that it will provide Annual Updates that may include "Updated analysis to reflect new information from the market, for example, on technology costs or key assumptions such as fossil fuel prices projections".<sup>16</sup> "It is not our current intention to use each Annual Update to publish strike prices for the period beyond that which a particular Delivery Plan relates to, although Government may choose to use individual Annual Updates to indicate future strike prices or to provide other updates about the way the CfD budget, within the Levy Control Framework, will be used."

60. Later, and even more helpfully, at 785: "The Government's view therefore is that the System Operator needs to be given the "right tools for the job", for which it will be held accountable by Ofgem (see the following section). The Government therefore considers it appropriate to create, using the powers in clause 13 (Information and advice) of the Energy Bill<sup>17</sup>, an obligation on CfD generators ("a generator who is party to a CfD") to provide the System Operator with certain information, including build, capital and operational costs of CfD plant.

61. At 786: "The Government is mindful that CfD generators may be cautious about such information provisions, owing to potential conflicts of interest between the System Operator in its commercial role and its role as EMR Delivery Body. The Government is confident, however, that any potential conflicts can be managed and that information will be strictly safeguarded. The following section sets out how we intend to implement the mitigation measures. We consider these provisions, along with the potential to use regulation for the protection of confidential or sensitive information and the measures to address conflicts of interest that were announced in April (and which will be

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<sup>16</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/255254/emr\\_consultation\\_implementation\\_proposals.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/255254/emr_consultation_implementation_proposals.pdf)

<sup>17</sup> The Energy Bill 2012 received Royal Assent on 18 December 2013, becoming the Energy Act 2013.

implemented using our licence modification powers in the Energy Bill) will be satisfactory in these circumstances. We welcome industry's views on this issue (see consultation questions).”

62. If this information includes the costs of finance, it should be possible to determine the return to equity, which, with the other cost information, will be relevant to resetting the strike prices for subsequent period. Of course, to the extent that the Government accepts the need for an early move to market mechanisms for allocating contracts, the role of strike prices will change to that of ceiling prices, and it will be less important to ensure they are set correctly.

**Recommendation 8: DECC should continue to monitor support conditions in other EU countries to learn what knowledge and evidence can be transferred to understand how they achieve more capacity at lower cost.**

### **Government response**

63. DECC has recently published a report by Frontier Economics into support levels for onshore wind in the UK compared to other European regimes<sup>18</sup>. DECC has commissioned NERA to undertake independent analysis to review existing evidence (primarily consultation responses, analyst reports and interviews with the finance community) on financing costs for renewable electricity generation under the CfDs. This report included an international benchmarking exercise, which looks at the proposed rates of return under the CfDs in the UK against those under different incentive schemes in other countries. As noted above, the NERA report will be published alongside the EMR Delivery Plan.

### **Panel's comment**

64. We are reassured that DECC recognises the importance of seeking evidence from other jurisdictions and has commissioned reports by Frontier and NERA to that end.

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<sup>18</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/205620/international\\_support\\_onshore\\_wind\\_frontier.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/205620/international_support_onshore_wind_frontier.pdf)

We note that UK costs appear high, particularly when compared with Germany (for a number of reasons, of which the Weighted Average Cost of Capital is arguably the most important, although construction costs also appear higher than on the Continent). Not all comparator countries were cheaper: capital costs are also high in Ireland, and financing costs are high in Poland. We also note that other countries appear to be more successful in securing public debt funding of the kind that the Green Investment Bank might supply, that local authorities appear more willing to undertake equity stakes in on-shore wind and so secure the potentially very significant returns (at least based on those offered in the UK) for local communities, and that there is considerably less uncertainty about balancing costs and grid charges (often set at zero for on-shore wind) in many jurisdictions. Of course such costs remain part of the costs of supporting renewables but the additional risk cost associated with managing these activities is largely avoided by the choices that other jurisdictions have made.

## Commentary on National Grid's December 2013 Analytical Report

65. NG's December Analytical Report (which we first saw on 6 December 2013, shortly before finalising our report), is very similar in structure and content to July's issue. Our principal observations are as follows. Although the DDM helps to inform the setting of strike prices themselves, our view still remains that strike prices are one of the pivotal inputs as they determine how much supply is called forth from each technology's supply curve. The key outputs of the DDM modelling are the wholesale prices, generation mix, total emissions and total system costs (which includes costs of supporting deployment of low carbon generations).
66. The report presents nine scenarios, mainly testing the impact of technology cost sensitivity, fossil fuel prices, electricity demand and impacts of increased reliance on offshore or biomass conversion.
67. There is not a lot of variation in the generation capacity mix in 2020 between these scenarios: only offshore wind varies significantly (with about 7GW between the highest and lowest deployment); onshore wind and biomass vary by 2GW, while other

technologies see just hundreds of MWs. This excludes CCGTs which effectively act as the balancing item, with some 10GW difference between the high and low cases. Our view is that this underestimates the uncertainties regarding onshore wind and solar. The 1GW annual cap on new commissioning of large solar now looks low, given the recent high level of inquiry and the fact that several EU countries achieved 2-3 times this. It was not clear whether further amounts above this limit would be open to competitive tendering. We note that the Government is considering an earlier move to competitive allocation for mature technologies, which will offer greater clarity certainty over deployment levels.

68. The main driver of uncertainty regarding outturn wholesale prices and the LCF costs is seen to be fuel prices, which is to be expected given the level of uncertainty of gas and coal price and their high correlation to wholesale prices. We suspect that variations in the level of the carbon price support (CPS) would also have a significant impact, although this is not reported here. Variations in electricity demand – at least in the range tested (a delta of 11% in 2020) – show little material impact on wholesale power prices and LCF costs – though a big impact on CCGT capacity required. Again this is to be expected if the wholesale price is set by marginal fossil plant and the marginal plant does not change much in response to anticipated demand changes.<sup>19</sup> The main impact is to move the share of renewables.

69. As in the July report, NG/DECC test the impact of much greater reliance on offshore wind. (new nuclear and CCS cannot contribute any significant amount by 2020). This high offshore wind case requires much higher strike prices (after the first delivery plan period), than a lower wind case to bring forth the extra capacity (+7GW) and its impact is to increase LCF costs and lower wholesale prices (because of the increased supply of zero variable cost energy on the system). A high biomass conversion case is also tested, with 3.6GW installed versus 1.7GW in the other cases, but its impact is not material in the scheme of sensitivities shown.

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<sup>19</sup> The DDM assumes that investors predict future demand and hence the average wholesale prices earned during the hours that their fossil plant will operate, so lower demand and higher renewables setting low prices in some hours would be met by less gas investment, requiring a higher price in the hours it runs, and leading to a relatively unchanged average wholesale price.

70. Variation in LCF costs would have been seen if investors' hurdle rates had been explicitly tested given the considerable uncertainty regarding these – as we comment on, but these were held constant across all scenarios, although the sensitivities on capex provide a proxy for variation in hurdle rates. The same would apply to a lesser extent to PPA discounts for non-vertically integrated utilities.

71. The DDM is a powerful simulation model, and although it was not designed to find the choice between ROCs and CfDs, nor to estimate the LCF costs in the event that it is breached requiring a system of market allocation and hence lower strike prices, the model can be operated by manual iteration to achieve in large part the desired goal. Without knowing how (and for what range of technologies) such market-based allocation solutions would work (whether, for example, they would be site specific to take account of transmission capacity and wind resources) it is difficult to predict what the split in update between the RO and CfDs would be. Although this is a deficiency in the analysis here, it only promises to be a significant one, if there is no competitive process for allocation of CfD awards, beyond 'first come first served'. As argued elsewhere, an early introduction of a competitive process reduces the need to get the strike prices right, and should protect the LCF and carbon targets.

72. As before, it is disappointing that the LCF outturns are not compared to current (2013/14) level in the analysis. We acknowledge that such comparisons are likely to be made in DECC's own delivery plan document, although we have not seen a draft of this at the time of writing this report.

## The Role of the Rebanding Review in setting strike prices

73. The guiding principle behind setting the CfD strike prices was that they should be set at a comparable level to that provided by the Renewables Obligation scheme taking into account the differences between the two support schemes. Given that Contracts for Difference will be offered alongside the Renewables Obligation for generation commissioning before the end of 2016/17, setting strike prices that are less attractive than the Renewables Obligation during this period would cause developers to adopt the Renewables Obligation instead, leaving no demand for support with CfDs. Since

the premise of EMR is that the CfD should be a more cost-effective instrument, this would be an inefficient outcome for incentivising low-carbon deployment. Conversely, setting strike prices that are more attractive than Renewables Obligation support could result in developers favouring the CfD, but delivering less value for money than could have been achieved.

74. This has the effect of linking the CfDs (and their cost) to the current RO prices, which were re-set for the period 2013-17 in July 2012. When modelling investor behaviour, the DDM (and the earlier rebanding review) assumed that investors expected wholesale electricity prices to remain constant in real terms from 5 years after commissioning any new project. This is an important assumption as while it is essentially irrelevant what assumptions investors make about wholesale prices under a CfD, as they are insulated by design from the wholesale price level, that is not the case with the RO scheme, where developers experience the effect of changing wholesale prices. Future expectations of wholesale prices are therefore material in comparing the two instruments and in this context we note that the Carbon Price Floor is projected to rise to £(2012)75/tonne CO<sub>2</sub> by 2030<sup>20</sup>.

75. In setting the strike prices, the key elements are the technology costs and performance characteristics. Some of these (capex, connection costs, opex including maintenance, lifetime, capacity factor) will be the same whether the developer chooses to apply for ROCs or a CfD. The main difference is the cost of financing the investment and the required returns to investors under the two schemes. That explains why the hurdle rate is such a central element in the EMR, and why we discuss it at length below.

76. In our July report we expressed concern that that the hurdle rates used in the modelling (and published by DECC alongside the draft Delivery Plan) may prove higher than necessary to induce the required supply of investment once the EMR has bedded down and investors gained familiarity with the new contracts. As a result

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<sup>20</sup> NG EMR Analytical Report December 2013: <https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan>



DECC commissioned NERA to review the existing evidence (including consultation responses, analyst reports and interviews with the finance community) on the change in hurdle rates between the RO and CfDs. NERA were asked to develop hurdle rate reductions using this evidence, which considers differences in the risks developers face between the RO and CfDs. This approach was to ensure consistency with the current RO regime and led to a modest reduction in the hurdle rate and hence the strike price for on-shore wind.

77. DECC also consulted extensively on the hurdle rate for the rebanding review and earlier had commissioned a report from ARUP, as well as drawing on the 2011 report from Oxera commissioned by the Committee on Climate Change.<sup>21</sup> We therefore accept that DECC has made the appropriate use of the evidence available at the time of setting the strike prices. However, it is also clear from reading the caveats in these reports that there remains considerable uncertainty on what the future financial terms might be for CfDs, once the market has become familiar with these new instruments. In consequence we consider the matter both sufficiently important and uncertain to require further scrutiny, as it should guide the kind of information to collect in setting future strike prices.

## The Hurdle Rate

### Calculating Hurdle Rates

78. The aim of the EMR is to reduce risk and hence lower the cost of finance, as measured by the hurdle rate used in appraising potential investments. When setting the strike prices, DECC needs to determine the hurdle rate that developers will use in making investment decisions in projects that would receive CfDs.

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<sup>21</sup> Oxera (2011) *Discount rates for low-carbon and renewable generation technologies*, at <http://www.oxera.com/Oxera/media/Oxera/downloads/reports/Oxera-report-on-low-carbon-discount-rates.pdf?ext=.pdf>. This report does not examine the hurdle rates for feed-in tariffs or CfDs.

79. The required hurdle rate can be determined in two ways – top-down or bottom up. The first way, which is relevant for setting strike prices in the period to 2017, is to determine the value of the hurdle rate for CfDs that would make the project as attractive, but no more so, than if funded under the RO scheme, taking account of the different risk characteristics of the two support mechanisms. This is not as simple as it might seem, as it may depend on the source of finance and the hedging options open to different potential developers and their funders.
80. The second way, which will become increasingly important as the RO Scheme is phased out, is to build up the Weighted Average Cost of Capital (WACC) from its component parts, following the same methodology most clearly set out by regulators determining the WACC for price controls.<sup>22</sup> For mature technologies, that would start with the risk-free rate looking forward, the debt premium, the equity risk premium, the beta (which measures the extent to which the project returns are correlated with those of the stock market) and the comfortable level of gearing. The resulting WACC is the return to achieve from investments, and should be comparable to the hurdle rate. In the case of immature technologies with little objective information available about the nature of the risks, this approach is less suitable and the hurdle rate required will be more subjective, as recognised clearly in the Oxera report for the Committee on Climate Change cited above.
81. In both cases the developer will be examining the way in which the investment is financed, and that will depend on how the additional investment adds to or reduces the risk facing the investor, and the extent to which it would be prudent to finance the investment with additional debt.
82. The key difference between the two schemes is that CfDs remove market (price) risk and leave just volume risk, which is uncorrelated with the stock market, so for a stand-alone investor the beta on revenue flows will be zero. That leaves construction cost risk as the remaining market-sensitive cost element – a booming economy is one in

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<sup>22</sup> See e.g. <https://www.ofgem.gov.uk/ofgem-publications/53852/europe-economics-final-report-011210.pdf>

which real investment costs are likely higher<sup>23</sup>, so the capital element would have a positive beta that should be identifiable from past data. However, once the project has reached the Final Investment Decision, these capital and related costs will be better known and hence no longer relevant to the cost of finance (subject to some remaining uncertainty in outturn capex and IDC post FID (for which either contingencies or a higher risk premium on debt and equity are allowed for by developers or investors).

83. Cost-based approaches that determine the required level of support start from the capital cost of the project and the WACC. Countries such as Germany, which pay a fixed price for power, typically have considerably lower values for the WACC than those used in setting the CfD strike prices, as NERA's report, which provides international comparisons, demonstrates<sup>24</sup>. Thus NERA's table in Appendix F (p. 114) shows that Germany's WACC for on-shore wind is 4.8-6% real, considerably lower than assumed for the EMR. For Denmark, where on-shore wind is riskier than the EMR's CfDs, nominal rates of 7-10% (i.e. real rates of 5-8%) are reported (but from a limited sample).

84. In order to secure comparability between the RO Scheme and CfDs, DECC commissioned NERA to estimate pragmatically by how much the hurdle rate should be reduced for CfDs compared with the RO, drawing on existing evidence including information provided through responses to the consultation. The NERA report provides evidence (largely from existing developers and financiers experienced with the RO regime) on what reduction in hurdle rates is justified by the lower risks of CfDs.

85. When making international comparisons, NERA (Appendix F) observed that "the German discount rates are consistently estimated at 200bps or more below the UK CfD estimates across a range of studies." NERA also cautions that this is partly explained by the sourcing of a significant share of investment in renewables that comes from "municipal or domestic investors which have lower return requirements." They also note that "the CAPM plausibility check that we carried out shows betas for

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<sup>23</sup> The prices of equipment such as turbines and PV panels are quite sensitive to supply and demand, and vary considerably over the cycle.

<sup>24</sup> Please note as described later in this section, there are many reasons for this.

solar and to an extent onshore wind that look low compared to the asset betas that commercial investors have been able to accept in other low risk investments.”

86. NERA’s assessment of the evidence was that “While this may suggest that DECC’s proposed hurdle rates are comparatively generous, there are a number of factors that need to be taken into account when comparing rates across countries as follows:

- German studies explicitly account for lower return requirements of municipal / retail investors and preferential debt rates, while in Sweden there may have been a spill over effect from the state guarantee even if debt terms are required to be at arms’ length;
- Germany, Sweden and to a slightly lesser extent Denmark have mature / established system of FiTs/certificates....”

87. While these are good reasons for caution, it is notable that CfDs are endeavouring to replicate the benefits of FiTs and to tap other financial sources, for which municipal and retail investors may be a more appropriate model.

88. The difficulty in determining a comparable hurdle rate is that it will likely depend on the source of finance and who manages the sale of the renewable electricity. While certain types of investor (see para 94 below) are likely to attribute lower value to CfDs than new investors, these investors are unlikely to be the marginal investors in the future, and the CfD has been designed to attract other types of finance (i.e. pension fund and sovereign wealth funds). Added to this investors will take account of the significant differences in risks between developing a commercial energy generation project, operating an OFTO and internal investment in improving a regulated asset. While there are differences in the nature of the risks involved in constructing on-shore wind farms and large PV arrays and operating an OFTO (for which the revealed hurdle rate have been quite low), these should not be exaggerated, as many companies now have extensive experience in constructing on-shore wind farms and large PV arrays, while off-shore subsea links have had a frequently troubled history of failures<sup>25</sup>.

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<sup>25</sup> The Moyle subsea interconnector from Ireland to Scotland is a recent example.

89. In the past vertically integrated utilities were probably responsible directly (through ownership) or indirectly (through Power Purchase Agreements, (PPAs)) for the bulk of on-shore wind investment. As such the ROs fit nicely into their portfolio as it gives them upside exposure to electricity wholesale prices to counteract the problems of selling downstream to customers. That is, when wholesale prices rise, the cost of supplying final customers on agreed contract prices rises and retailing profits fall. As profits from wind farms holding ROCs also increase when wholesale prices rise, this downstream adverse impact is offset by these increased upstream profits (as well as the converse). Note that an upstream benefit is less likely with fossil generation as the main reason wholesale prices rise is that fuel costs rise, with no guarantee that spark spreads and hence generator profits will rise with the wholesale price.

90. A closely related point is that the incumbent generators are vulnerable to carbon price increases, and if the Government remains committed to the Carbon Price Floor, then the post 2020 carbon price would become very high, and would make existing fossil generation less profitable, particularly as the share of renewables increases. Incumbents would therefore value the hedge of the upside to carbon price increases that the RO Scheme offers, and for that reason are arguing for comparable (and very high) returns from the CfD if they are to be as attractive to these investors. Fig 1, overleaf, shows the nature of this upside

## Support to Wind under the ROC Scheme (real prices)

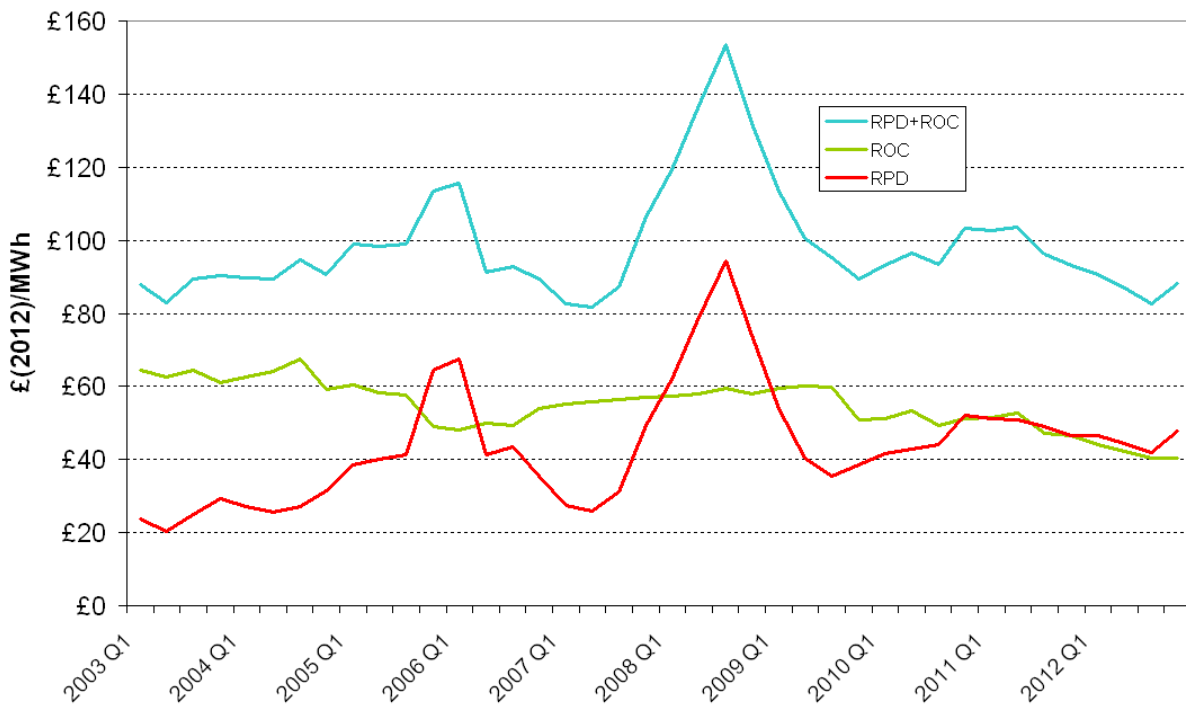


Fig 1 1-year centred moving average of real Reference Price Data (RPD) and ROC prices and the revenue per MWh from on-shore wind (Sources: APX, Ofgem).

### Modelling the RO vs. CfD scheme and the role of Beta

91. For these investors, the strike prices for CfDs are intended to be as attractive as ROCs, and the DDM takes as its assumption that the hurdle rates for the CfDs will deliver this parity, based on the evidence they have assembled. It therefore assumes that renewable plant commissioned in 2015/16 will almost all be under the RO scheme, but that from 2016/17 all new plants will be under CfDs. The exact division between these two forms of support is hard to model, and so DECC accepts this as a reasonable assumption that will not materially affect support costs, the LCF and the wholesale prices before 2020.

92. We comment further on the means by which the choice may be influenced by various factors below, and on whether it is material for assessing support costs. We recognise that any comparison between the probable rewards from ROCs together with

electricity prices and Contracts for Difference is uncertain because in the latter, the electricity price is hedged whereas it is not in the former.

93. It is relatively simple to calculate the implied return to equity given illustrative assumptions about the gearing, and the illustrative assumptions on the real interest on debt provided that the assumptions are accurate and precise. Thus NERA estimates that for existing on-shore wind projects financed under the RO scheme, debt is “already quite high at 70-80 – even 85 percent for a good wind site” (p. 22), and that under a CfD “that debt size might at best increase by 3-4 percent”. On that basis the return to equity is indeed slightly lower for CfDs as a result of the higher gearing, and very sensitive to the level of gearing when that is as high as suggested.

94. With regard to the source of investment funds, we note that a central concern motivating the EMR is that the balance sheets of the incumbents are stressed, and their ability to finance more than a small fraction of new generation investment is limited. EMR thus aims to attract new sources of finance (e.g. banks, financial institutions, pension and sovereign wealth funds, etc.). Especially for pension and sovereign wealth funds, the attraction of indexed revenues and a reduction of the kind of volatility seen in Fig 1. will be important, and for these investors the CfD route with a return based on the regulated utility model may be more attractive. Moreover, such investors need to be attracted away from other global investment opportunities that may have characteristics similar to Contracts for Difference. It is therefore insufficient to only consider a ROC minus approach from the standpoint of current investors in determining the hurdle rate, and both approaches are important.

95. A key determinant of the WACC is the correlation of the returns of the project with those of the market as a whole (captured by the value of beta). Wind farms holding ROCs receive a fairly stable (in real terms) stream of ROC payments in addition to the wholesale price per MWh produced, and the sum is very volatile as shown in Fig 1. The total revenue over the year will depend on the variability of output and of the wholesale price. As wind output is only very weakly correlated with price (and as wind penetration increases may become negatively correlated) their revenues are positively

correlated with wholesale prices which are likely positively correlated with the stock market, giving rise to a positive beta.

96. As quoted above, the NERA Report (p. 114) noted that “betas for solar and to an extent onshore wind that look low”, presumably inferring that they should have been higher, rather than that they were in fact low for good reasons. NERA (p.104) reports a beta for a wind company is 0.55, which is comparable to those of electricity companies’ betas.<sup>26</sup> In contrast, the output of a wind farm under a CfD enjoys a fixed real payment per MWh produced and the only source of variability is output variability, which is completely uncorrelated with the stock market. Consequently it is easier to diversify this risk and its cost is comparably lower than that of those holding ROCs but enjoying no compensating hedge in the retail electricity market.

97. Elsewhere, in looking at UK water utilities, they note that “In this case, further stabilisation of revenues by eliminating volume risk coincided with a reduction in beta of as much as 0.25” (NERA, p. 32). The importance of the role of beta is of massive significance when it comes to setting the strike price of capital-intensive projects such as renewables. This is substantiated in the NERA Report at p31 which compares the real WACCs for merchant and contracted energy companies where the range of differences is 78 to 299 basis points.

98. If we consider new sources of investment funds, particularly from insurance, pension and sovereign wealth funds and the kinds of investors who have been so active in the OFTO auctions (see KPMG report for further details<sup>27</sup>), then we consider they may have a stronger preference for CfDs compared to ROCs. We recognise this is speculative as we are looking ahead to new sources of funds, not already active in the UK market, and for which direct evidence is therefore sparse.

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<sup>26</sup> Smithers & Co (2004, at <https://www.ofgem.gov.uk/ofgem-publications/46357/6593-beta-estimates-ofgem-final.pdf> ) have estimated the CAPM beta for a number of UK based power companies for Ofgem.

To summarise their findings, for Scottish Power their value is 0.6 from the late 1990s up to 2004 with fair confidence, while for SSE over that period it is 0.4. Stern (2013) at [http://pages.stern.nyu.edu/~ADAMODAR/New\\_Home\\_Page/datafile/Betas.html](http://pages.stern.nyu.edu/~ADAMODAR/New_Home_Page/datafile/Betas.html) accessed 5/12/13) gives the results for 101 mainly US power companies (excluding electricity utilities) for which the unlevered beta was 0.58 correcting for cash.

<sup>27</sup> <https://www.ofgem.gov.uk/ofgem-publications/79347/ofto-aninvestorperspective.pdf>



99. This may reflect a number of factors including uncertainty over future gas prices and a lack of bankability of the Carbon Price Floor. In addition the investment case in stand-alone wind generators owned by pension and sovereign wealth funds, who do not benefit from vertical integration and a mix of generation plant, would be more focussed on wholesale electricity price risk and its correlation with the stock market (i.e. its beta). They are likely to particularly value the low revenue risk and low betas that CfD backed projects should be able to achieve. Their appetite for buying up equity in and/or ownership of regulated infrastructure and the low level of long term real interest rates, further supports this view.

100. Therefore, to the extent that institutional investors are confident that the contractual protections of the CfDs are at least as good as ROCs, and that the construction risks are modest (as they should be for on-shore, if not off-shore wind and certainly for solar PV and biomass conversions), we think it is plausible that they may prefer CfDs even at a considerably lower WACC. We are aware that some of the respondents to the consultation appear not to recognise that the ROC support is included in the LCF, and once this is understood there is little advantage in choosing ROCs over CfDs, and the fact that the latter are written in private law makes them less susceptible to regulatory change.

101. In summary, it is plausible that CfDs could result in a relatively low WACC compared with ROCs. This would be the case if strike prices were based on a bottom up CAPM approach to estimating WACCs, assuming that insurance, pension and sovereign wealth funds and similar investors will be the marginal source of finance. In this case, these investors will have a stronger preference for CfDs over ROCs than incumbent generators, even if the return is significantly lower.

102. We are not fully persuaded that the WACC adopted by DECC will be appropriate when setting future strike prices and recommend that they continue to monitor actual financial arrangements carefully as the market develops.

## State Aids, the co-existence of the RO scheme and CfDs and tender auctions

103. The EU State Aid Guidelines for Energy are under revision<sup>28</sup>, and Reuters reported on 5 November 2013 in a somewhat over-dramatic headline that “EU Commission seeks to crack down on costly energy subsidies.”<sup>29</sup> The news report stresses that governments must avoid unannounced and retroactive changes that would harm investors (which is a highly significant qualification in the context of changing the Renewables Obligation in respect of those forms of generation which would have received its support).
104. The current guidelines (EC, 2008)<sup>30</sup> set out the tests that any aid must meet in para 16 and in particular (16) 2)c): “is the aid measure proportional, namely could the same change in behaviour be obtained with less aid?” This test is general to all issues of market intervention which may have the capacity to distort competition, but the March 2013 *Consultation Paper on Environmental and Energy Aid Guidelines*<sup>31</sup> goes further in suggesting additional guidelines for mature renewable electricity technologies: “Such technologies are likely to include, for example, in many instances onshore wind energy, photovoltaic, biomass and small hydro power.” (para 59) The suggestion is that such mature technologies should compete for State aid, and para (60) explicitly refers to tender and auction mechanisms.
105. We understand that DG COMP are likely to indicate that any new support mechanism such as CfDs should meet the test of proportionality and cost effectiveness, and that mature technologies should be subject to market testing. DG COMP will shortly be consulting on the revised Environment and Energy Aid guidelines. In our July Report we stressed the importance of moving to a market-

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<sup>28</sup> At the time of going to publication the European Commission published its Draft Guidelines on environmental and energy State aid for 2014-2020:

[http://ec.europa.eu/competition/consultations/2013\\_state\\_aid\\_environment/index\\_en.html](http://ec.europa.eu/competition/consultations/2013_state_aid_environment/index_en.html)

<sup>29</sup> At <http://uk.reuters.com/article/2013/11/05/eu-energy-stateaid-guidelines-idUKL5N0IP3LE20131105> accessed 3 Dec 2013

<sup>30</sup> EC (2008) *Community Guidelines On State Aid For Environmental Protection* (2008/C 82/01)

<sup>31</sup> Published 11 Mar 2013 and available at

[http://ec.europa.eu/competition/state\\_aid/legislation/environmental\\_aid\\_issues\\_paper\\_en.pdf](http://ec.europa.eu/competition/state_aid/legislation/environmental_aid_issues_paper_en.pdf) access 3 Dec 2013

driven solution, and that is likely to be the intent of the forthcoming revised State Aid guidelines.

106. In particular, tender auctions for mature technologies would have the overwhelming advantage that the market would signal the least cost (lowest strike price) solution, avoiding the need for the Government setting a strike price by administrative means. There would remain merit in keeping the published strike prices as they may be needed for immature technologies for some time. Tender auctions can be quite flexible in their design, for example allowing bidders to offer different contract lengths or to take account of local conditions such as the wind resource, the need to compensate local communities, and differential grid and connection charges.

107. If the EC requires mature technologies to be market tested as proof that the aid is proportional, and provided this would not be considered a retrospective act damaging to investor confidence, then there may be implications for support for new capacity through the RO regime during transition to CfDs in 2017, which would need to be carefully considered.

108. Of course, if all mature renewables were to move to market allocations as quickly as possible and the issue of transition from the RO scheme could be accelerated, then our concerns over setting the strike prices would be allayed, and we would take comfort from National Grid's conclusions that if some of the strike prices remained as ceilings, then the targets could be met without breaching the LCF.

109. We note that the Government is aware of the need to move to market testing, and in a Statement on 4th December the Secretary of State noted that "Given the approach set out in the recent DG Energy guidance, it is expected that the new state aid guidelines will require the UK to move to competition for more established technologies. The Government will confirm its approach and details of how this will operate through the Delivery Plan and engagement with stakeholders early in 2014."<sup>32</sup>

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<sup>32</sup> At <https://www.gov.uk/government/speeches/electricity-market-reform-update-investment-in-renewables>

## Possible consequences of setting incorrect strike prices

110. The hurdle rates are provided to National Grid and fed as assumptions into the DDM. As noted above, given the differences in the assumed investor required hurdle rates between ROs and CfDs that are input to the DDM, investment under the RO and under CfDs is assumed to be equally attractive to investors. Up to 2015-16 the DDM assumes that almost all renewable investment is financed under the RO scheme, but thereafter it is entirely financed by CfDs. As CfDs require (or should require) less public support than ROs, the financial implications of this assumption are potentially material.
111. As a back-of-the-envelope estimate, if CfDs have only a 1% lower hurdle rate,<sup>33</sup> and if 6 GW of on-shore wind and 6 GW of off-shore wind are built under the CfDs and that they cost £1.5 bn/GW on-shore and £2.8bn/GW off-shore, then the total capex would be £25.8 bn. Therefore, the annual cost of financing these would build up to be £258 million less under CfDs than if they were all under the RO. As the total new build renewables is about 24 GW, the 12 GW wind is only about half the total, so the difference in annual interest cost could be twice as high (depending on the costs of other technologies) or some £500 million per year in 2020. The average cost between now and 2020 might be half that, and the total undiscounted extra cost over the period to 2020 could be as much as £3 billion if the CfDs are not taken up as assumed. However, as we have argued that if anything the strike prices are likely to be more attractive (to the likely new sources of finance) than ROs, this risk may be considered small.
112. The other possibility is that the CfDs are so much more attractive than the ROs that there will be a rush to secure them, and if there are limits set by technology (e.g. if all “mature” technologies are covered by a single pot), that limit might be reached earlier, in which case the allocation will be made by some kind of competitive

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<sup>33</sup> On-shore wind has a 1.2% lower hurdle rate and off-shore wind has 1.9% lower, so this is a conservative estimate.

process. In one way this would be the most desirable outcome, as it would allow renewables to be secured at lower cost, it would meet the EC's concern over State aids, and it would reveal information about costs and returns that would be useful for setting future strike (or ceiling) prices. If the limit also applied to applications for ROC financed project, this could be a satisfactory way of accelerating the transition to the CfD approach, particularly as presumably once the limit had been reached it would almost necessarily imply that market allocation would be used from thereon (otherwise there would be complex gaming of delaying applications until the start of the next year).

## Update to the Panel's View of the Analytical Approach

113. As mentioned elsewhere in this and the previous report, and subject to certain reservations mentioned below, in our opinion, the DDM is a suitable modelling tool to assess the impact of inputted strike prices.
114. The process by which the DDM runs are carried out appear to us to be well managed and controlled in terms of the instructions given by DECC to NG which start from a constant reference or basis case and use documented instructions to explore precisely defined variants. Inputs and outputs are clearly documented and relatively accessible to allow ease of interpretation for the current purpose.
115. The reservations we have regarding the suitability of the DDM have remained largely unchanged and although we note that the DDM is not used to set strike prices, as these are an output resulting from other assumptions; the DDM, although designed for stochastic use, in practice cannot be used efficiently except for point values and sensitivities rather than the full aggregation of uncertainty. The DDM therefore provides single point outputs (rather than probability distributions) and therefore does not analyse uncertainty adequately. Further, the DDM cannot model

the choice between ROCs and CfDs, which is likely to be influenced by the actual evolution of wholesale prices and hence dependent on fossil fuel and carbon prices, whose variability is not captured by choosing the non-stochastic mode.

116. We note that neither the National Grid Analytical Report nor the DDM contemplates the consequences of a possible requirement by the EU Third Package to implement the Target Electricity Model by 2014. We understand that in DECC's view, it is not yet clear how or when the Target Electricity Model will be implemented and consequently the scenarios that arise from this have not been modelled. Among other requirements, that will require the System Operator to define price zones which are sufficiently frequently congested to justify a separate zonal price (effectively where the cost of re-dispatch offsets the benefit of greater market liquidity). This would most likely have the effect of creating at least two zones in GB divided by the Cheviot boundary creating separate price zones in Scotland and England.

117. It may be that congestion is eliminated once the Western Bootstrap is commissioned, and by its design, the prices in the two defined zones would only diverge if congestion occurred. Normally, as Scotland is an export zone, when prices diverged the Scottish price would be lower. DECC have assured us that when there is further reliable clarity on movement to the Target Electricity Model, further analysis will be carried out to assess the impact on LCF spend and the choices of CfD or RO.

118. One immediate consequence of two price zones is that it would require clarity about the reference price in the CfD. We note that DECC has addressed this issue within an annex in the Contracts for Difference where they say that where market splitting occurs<sup>34</sup> there will be a trigger event to review the reference price. We accept that it is not possible to entirely predict the impact of splitting on the market, DECC accepts that any required changes to the reference price would be considered in line with a set of principles. DECC has, however, allowed that in the case of market splitting they may allow more than one reference price, and one of the principles relates to the market into which a generator is selling its power.

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<sup>34</sup> That is, different prices emerging in zones as a result of congestion.

119. It will also be necessary to rerun the DDM to check what might be the implications of zonal pricing (market splitting) on the LCF and wholesale prices in each zone. This might require a redesign of the DDM to allow for two price zones.

## Conflicts of Interest

120. We have identified no conflicts of interest in addition to those identified in our previous report.

## Additional Recommendations

121. As the strike prices have already been published we have no recommendations on setting these prices. The Government will continue to monitor delivery and performance, and will need to prepare for the transition of the RO Scheme, as well as for market testing of more mature renewable technologies in anticipation of either pressures from DG COMP or potential breaches of the LCF. We note that the Government considers it appropriate to create, using the powers in section 13 (Information and advice) of the Energy Act 2013, an obligation on CfD generators (“a generator who is party to a CfD”) to provide the System Operator with certain information, including build, capital and operational costs of CfD plant.
122. We therefore closely questioned DECC as to whether the Government should also place an obligation on RO generators as well as CfD generators to provide the System Operator with information about the build, capital and operational costs of renewable plant, together with details of financial arrangements, including the amounts of debt and debt-like instruments with their interest rates (and whether indexed or nominal), the share of equity, and the details of any PPAs or other off-take

arrangements, as well as full details of any re-financing. On balance, we concluded that obtaining this information through legislative change for major, mature technologies, which we understand will be allocated CfDs on a competitive basis in the relatively near future anyway, would not be the most desirable route for a range of reasons, and that encouraging the industry to act in a responsible manner by volunteering, rather than withholding, information would be preferable. How this should be achieved, however, is a matter for Government and not for this PTE.

123. We further recommend that the Weighted Average Cost of Capital is reviewed in the light of unresolved concerns that we have not had the time or means to resolve prior to the publication of this report. The new recommendations above should greatly facilitate this task.

124. We recommend that the consequences of implementing the Target Electricity Model with the possible price splitting between England and Scotland be further examined, to see what might be the implications for the choices between ROCs and CfDs and possible implications on the Levy Control Framework.

## Conclusions

125. In our July Report we considered that National Grid's analytical approach, as commissioned by DECC, and its reliance on the Dynamic Dispatch Model (DDM) was a valid one for assessing the impacts of different technology cost assumptions and market scenarios on different policy parameters (e.g. a percentage of renewable generation, a Reliability Standard, Emission Intensities and the Levy Control Framework). This is largely assured by specifying build-rate limits and ensuring that strike prices are sufficient to induce investors profitably to invest, given their assumed hurdle rates.



126. The approach is relevant for the purposes of establishing the first stages of the Electricity Market Reform programme. This should enable DECC to collect the information to facilitate the transition to a more cost-reflective and ultimately market-driven solution. A more competitive market revealing itself in future strike prices determined at any auction should address the many risks (investor appetite, hurdle rates, pace and cost of technology learning curves, fuel price uncertainty) inherent in this complex market which no model can realistically fully portray.
127. Further probing of National Grid's analytical approach broadly supports this earlier finding, although we would wish to stress again that setting the hurdle rates and the CfD strike prices are separate from the DDM and are fed into the DDM as assumptions. We remain concerned that the bulk of effort appears to have been devoted to running (non-stochastic) scenarios through the DDM primarily as a check that the targets can be met within the LCF, rather than exploring more thoroughly ways in which the strike prices might be set at lower levels while still attracting finance.
128. Here the setting of future ROC prices and volumes will be important, as will considering how to move more rapidly to market determined strike prices, as likely to be required by DG COMP under the revised State aid guidelines expected shortly after this report was completed. Even if such a transition is delayed, we repeat our earlier recommendation that full financial and cost details of all supported projects be collected and used as a basis of more informed future analysis of the strike prices that would be needed to ensure an adequate but not excessive return to developers.
129. That is not to say that running the DDM is not a very useful exercise. It can model the difference in cost between policy choices and the vulnerability of the LCF to these choices. It can also indicate the vulnerability of the LCF to variables such as a fall in the assumed future gas price.

130. Finally, this Panel wishes to take this opportunity to thank DECC and National Grid for their ongoing support since our appointment in February 2013. We also wish to express our sincere thanks to the DECC secretariat for their tireless efforts and expeditious assistance. Without their positive engagement and commitment to this process we would not have been able to fulfil our role as an independent Panel of Technical Experts.

## Next Steps

131. The role of the current Panel of Technical Experts will conclude following the publication of the EMR Final Delivery Plan in December 2013. We would like to record our thanks to the support that the DECC team and National Grid provided during a period in which they were also under very considerable time pressure to deliver on their own commitments. DECC has clearly been very responsive to the recommendations made in the July report, and patient in explaining the constraints under which the EMR delivery has had to operate. We trust our comments will be accepted as constructive comments to what is a continuing delivery undertaking.

132. A new EMR Panel of Technical Experts will be recruited by DECC in early 2014. The role of the new Panel will be defined as part of their Terms of Reference, which will be published upon their appointment. While such a Panel cannot comment on the policy choices, it can comment on whether these policies are based on the best available evidence and analysis. We would like to express our support for the concept of an independent Panel of Technical Experts, which we hope causes DECC to ask further questions and improve their analyses ultimately leading to greater public understanding and recognition of the challenge of balancing the objectives of security, sustainability and affordability and which will contribute to investor confidence and public trust in the processes and commitment behind these vital schemes.