A cost benefit analysis of the potential introduction of competitively appointed transmission operators

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Executive Summary

Ofgem is proposing to introduce competition into the delivery of certain onshore transmission projects, namely those that are new, separable, and high in value. As part of its consultation in this respect, Ofgem has published its high-level impact assessment of the proposals. Frontier Economics has been commissioned by National Grid to undertake its own comprehensive cost-benefit analysis (CBA) of the proposals for onshore transmission assets, including both the early and late tendering models. This independent, expert report summarises our view of the Ofgem analysis and our own findings.

Ofgem's assessment of their proposals

Ofgem is contemplating the creation of two models for Competitively Appointed Transmission Owners (CATOs): a Late and Early model. These vary according to whether the CATO is appointed before or after detailed design and consenting work has been undertaken. Neither model has yet been fully specified by Ofgem, but there is sufficient detail to gain a good understanding of what is intended.

Ofgem has published an Impact Assessment (IA) of their proposed reforms. We believe their analysis is overly simplistic, and overestimates the benefit of reform.

Firstly, it conflates two effects arising from the introduction of CATOs:

- the competition effect, i.e. the potential costs and benefits that arise from introducing competition; and
- the regulatory effect, i.e. the potential costs and benefits of making changing to the regulatory arrangements for transmission.

Ofgem's assessment does not isolate these two effects. It may be that most of the benefits identified by Ofgem arise from the changes to the regulatory arrangements that are deemed necessary to make the CATO vehicle attractive to investors, not from competition.

Secondly, Ofgem draws heavily on the OFTO experience in their analysis. While there is valuable evidence from OFTO tenders, Ofgem has not accounted sufficiently for important differences between the CATO and OFTO models. For example, Ofgem focuses on financing cost savings from the OFTO model without taking account of the fact that CATOs are likely to bear far higher risks than the OFTOs, in particular construction risk. These differences make it unlikely that CATOs would reveal financing benefits in line with OFTOs.

Thirdly, Ofgem appears not to have considered important potential costs arising from the CATO model. For example, Ofgem has not considered, or has at least underplayed, the potential increase in the risk of delay or default under the CATO model, and has not taken account of the potential disoptimisation in

overall operation of the transmission grid from creating a world where the SO interfaces with potentially many new CATOs, in addition to all existing TOs.

Our approach to cost benefit analysis

Ofgem's proposed reforms relate to the introduction of competition. They could equally have proposed amended regulatory arrangements for non-competitively appointed TOs. These are two independent decisions. We therefore isolate and appraise the competition effect alone. We defined four alternative scenarios for future project delivery to be used in our analysis:

- Ofgem's two CATO models (late and early);
- National Grid project specific scenario, where infrastructure is delivered by National Grid alone, under a CATO-like remuneration model; and
- a continuation of RIIO-T1 arrangements.

We then compare, qualitatively and quantitatively:

- The late CATO model with the National Grid project specific scenario, to identify the competition effect (CBA1).
- Early and late CATO models, to identify the difference between the two competitive models proposed by Ofgem (CBA2).

Our findings

There are material administrative/process costs associated with the late CATO model, relative to the National Grid project specific scenario, arising from the need to create the legislative/regulatory arrangements to support CATOs and in the running of each project tender process. These costs alone could outweigh the benefits of competition for smaller projects.

There are a wide range of further costs and risks created by CATOs, including:

- interface costs, i.e. the costs borne by SO and other stakeholders in working with a set of new CATO entities;
- dis-optimisation costs, should the creation of CATOs result in inflexibility in the operation and optimisation by the SO;
- lost synergies in construction or operation of assets, arising from lost scale and diversity of projects;
- potential cost of imperfect asset stewardship, should the CATO arrangements fail to provide sufficiently complete incentives;
- cost/risk of delay of commissioning, should CATOs lack capability or resources to deal with the range of project eventualities;

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- cost/risk of initiating unrequired work, as a result of contracting inflexibilities with CATOs; and
- cost/risk of bidder default.

The benefits of competition are more limited in scope, though still material.

- While competition is unlikely to drive down debt costs (National Grid should be able to access debt markets just as cheaply and efficiently as a CATO provided it was doing so against a similarly specified regulatory construct) competition could reveal a lower cost of equity.

- Similarly, competition could lower construction and operating costs, as Ofgem assumes. There is likely to be scope for efficiencies arising from direct costs incurred by National Grid, though beyond this the majority of investment costs are typically subcontracted, limiting further benefits.

Our analysis suggests the late CATO model is likely to be more beneficial for larger projects, where the potential savings are large enough to offset (largely) fixed administrative costs. We find the late CATO model is only net beneficial for projects over approximately £260m. However, many of the potential costs/risks associated with the late CATO model are very difficult to quantify and so are not included directly in the quantitative CBA. Our indicative analysis of some of these costs/risks suggests they are likely to be material, and that the actual minimum efficient scale for CATOs is therefore higher still. For example, based on an illustrative estimation we find that disoptimisation across the SO-TO interface arising from £1bn of CATO build could create costs of £2.5m per annum, with a present value of approximately £35m.

Our initial conclusion should be tested in particular against the potential for CATOs to create a higher cost/risk of delay. For large scale projects connecting strategically important generating assets (e.g. new nuclear plants), the cost of delay to the delivery of transmission could be very large, and could increase the real (or perceived) cost of financing large scale generation investments. Illustratively, a one year delay on transmission build to a new nuclear plant could cost the developer £1.5bn, and an increase in developer cost of equity of only 4bps might be sufficient to remove benefits of competition in transmission build.

This suggests that Ofgem should consider carefully the nature of large projects to assess the risk of delay. For particularly strategically important transmission works, stakeholders who may have significant value at risk should be consulted.

Comparing the Early and Late CATO models, we find that early tendering could deliver cost reducing innovation, but at the cost of weaker pressure on actual build costs. The risk of commencing unnecessary work is clearly also greater in the early CATO model. The early model is likely to make most sense where material innovation gains are plausible, and the need case for the investment is

relatively certain, which may only be a small subset of the potentially separable projects.

Executive Summary

1 Introduction

Ofgem is proposing to introduce competition to certain onshore transmission projects, namely those that are new, separable, and high in value. Ofgem has set out some proposals for how the new tendering arrangements would work[1], although a number of elements of the regime (e.g. the choice between early and late tendering, issues around transfer of existing assets etc.) remain to be defined.

Ofgem has also carried out a very high level cost benefit analysis of the proposed changes[2]. In doing so, Ofgem has recognised the difficulty in quantifying each individual element of a CBA. Rather, Ofgem has quantified a number of the costs associated with competitive tendering, and then sought to demonstrate that there could credibly exist benefits which are at least of this magnitude. In particular, in relation to the latter, Ofgem has relied upon:

- a cost benefit analysis of the OFTO regime carried out by CEPA/BDO[3], which places some broad ranges around net benefit; and
- more qualitative analyses from other systems (e.g. Argentina, Texas, Brazil, Chile).

Frontier Economics has undertaken a more comprehensive CBA of the proposals for onshore competition, including both early and late tendering models. This independent, expert report summarises our findings.

The remainder of this report is made up of the following sections.

- In section 2, we **present a critique of the CBA undertaken by Ofgem**, as set out in its Integrated Transmission Planning and Regulation project.
- In Section 3 we **define the factuals and counterfactuals that we have developed to support this cost benefit analysis**. We set out four possible models for the delivery of large, separable transmission projects.
- In Section 4, we then **describe the three cost benefit analyses** that could be produced by comparing the factuals and counterfactuals described in Section 3.
- In Section 5 we describe the results of our **qualitative cost benefit analyses** for two of these three cost benefit analyses.

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1 Extending competition in electricity transmission: arrangements to introduce onshore tenders, Ofgem, October 2015

2 Integrated Transmission Planning and Regulation (ITPR) project: Impact assessment, March 2015

3 Evaluation of OFTO Tender Round 1 Benefits, May 2014

- In Section 6 we present an indicative, **quantitative cost benefit analyses**, drawing on publicly available information on the potential costs and benefits.

- Section 7 provides our **summary conclusions and policy recommendations**.

- Annexe 1 provides more **detail on each of the factuals and counterfactuals** analysed in Section 3.

- Annexe 2 presents a brief discussion of the properties of **other infrastructure delivery schemes**, where there may be parallels with CATOs. We discuss the Thames Tideway Tunnel (TTT), the Gas To The West competition in Northern Ireland (GTTW) and the Offshore Transmission Operator scheme (OFTO)

2 Critique of Ofgem's CATO CBA

Summary of key points

- In its impact assessment, Ofgem uses the standard regulatory framework for monopoly TOs as the counterfactual. By doing so its assessment conflates the benefits associated with changes to the regulatory regime (i.e. the differences between CATO and RIIO) and benefits associated with the introduction of competition. Many of the benefits identified by Ofgem may be achievable absent competition.

- Ofgem's analysis does not make it clear whether it is the early or late tender CATO which is being assessed. This is clearly important as the two different approaches offer different potential mixes of costs and benefits.

- Ofgem assumes that competition will inevitably lead to greater cost efficiency than incumbent TOs. This may not necessarily be the case, as incumbent TOs already put construction projects out to competitive tender and therefore bring competitive pressure in to many elements of the overall cost of infrastructure delivery.

- Ofgem states that innovation would be triggered by the introduction of competition and could result in lower costs and better value for customers. However, some areas of innovation could be achieved by incumbent TOs. Other areas of innovation may not necessarily be driven by competition, but by changes in the regulatory regime instead.

- While it is possible that competition will result in financial innovation, it is not clear that the experience cited by Ofgem from the OFTO regime provides relevant precedent for CATOs. OFTOs (at least all OFTOs created hitherto under the Generator Build OFTO model) have borne no construction risk, whereas we anticipate that CATOs would face substantial (full) construction risk. Similarly we anticipate that CATOs will face residual value risk at the end of their envisaged 25 years term, whereas OFTOs do not. Hence it does not necessarily follow that similar financing approaches can or would be adopted under both models.

- Ofgem's assumed bid costs are associated with an OFTO process which involves taking ownership of assets which have already been built. The bid costs relating to a process which involves taking on a design developed by a third party and then committing to its construction will involve higher bid/process costs than simply taking ownership of existing assets.

2.1 Introduction

Ofgem states in its impact assessment of the proposal to introduce competitive tendering for onshore transmission that it believes competitive pressure will drive innovation and expenditure savings and that these will outweigh the potential costs of the process.

To support this view, Ofgem presents a high level cost-benefit assessment, setting out its view of the key incremental costs and benefits likely to emerge from competition. It then seeks to quantify some of the aspects of cost, and consider (based on experience from the OFTO and other international tendering regimes) whether it is credible to assume that benefits would outweigh these costs.

Below, we consider the qualitative arguments made by Ofgem and review its quantitative assessments.

2.2 General comments

Ofgem does not make clear, through its impact assessment, whether it is the early or late tender CATO which is being assessed. This is clearly important, as the two different approaches offer very different potential mixes of costs and benefits. For example:

- an early CATO tender would appear likely to result in more possibility for tenderers to involve themselves in design innovation and potentially provide them with more levers through which to reduce total lifetime cost of the project; and
- a late CATO model will involve tendering a more tightly defined project, and therefore may involve a greater transfer of risk to the CATO as there are fewer uncertainties which CATOs are not well placed to manage.

The absence of clarity in this area makes it difficult to interpret some of Ofgem's arguments and assess how relevant the evidence is in supporting its qualitative assessment.

2.3 Ofgem's qualitative assessment of benefits

Ofgem cites a number of benefits in its impact assessment:

- capital and operating cost savings;
- innovation (with the areas for innovation being a function of the tender model chosen);
- diversifying sources of capital and labour;

- achieving lower financing costs; and
- enabling investment in low carbon generation.

Some of these areas of benefit are not true benefits to the final customer. In particular, it is difficult to see how "innovation" and "diversifying sources of capital and labour" are real benefits to customers. Customers ultimately care about the cost and quality of the energy market outcomes achieved. If innovation results in lower capital investment, lower financing costs or lower operating costs then it has a customer benefit. However, these benefits are already listed separately. Similarly for the benefit ascribed to diversifying sources of capital and labour.

Ofgem's description of the benefits resulting from enabling investment in low carbon generation also appears to indicate double counting. Ofgem states that this benefit relates to the likelihood that "*cost savings driven by innovation and the competitive process will lower transmission charges and make investment in low carbon generation more economically viable*". TNUoS charges will ultimately be driven by capital costs, operating costs and financing costs, and so on the face of it this benefit simply double counts those benefits.

We turn now to specific comments in relation to the detail of Ofgem's benefit assessment.

2.3.1 Capex and opex

Ofgem states that:

> *"competitive tendering will place downward pressure on capital and operating expenditure. In regulating the incumbent TOs we have to estimate the efficient cost of constructing and operating new projects, based on the funding requests submitted to us by TOs….Parties competing to be appointed the successful bidder are likely to put forward lower costs than an incumbent TO estimating the costs of constructing and operating a particular asset under a traditional price control approach"*

Ofgem recognises that incumbent TOs put construction projects out to competitive tender, and that therefore there might be a limit to the scope of costs which are not exposed to competition under a traditional price control approach. However, it states that:

> *"We consider that opening overall project development to competition will create scope for further efficiencies, such as through encouraging innovative and more cost-efficient procurement, risk management, project management and operations and maintenance strategies"*

Ofgem does not consider the likelihood that incentive regulation over time has and will continue to incentivise and reveal cost efficiencies in relation to each of

these cost categories. Rather, Ofgem asserts that competition will inevitably lead to greater cost efficiency both in an immediate and a dynamic sense.

The only evidence which Ofgem points to in this area is the CEPA / BDO study on the impact of the OFTO regime, which Ofgem states "*showed that offshore TOs (OFTOs) achieved significantly lower costs when compared to a counterfactual in which incumbent TOs operated the offshore transmission systems as part of the onshore price control*".

This evidence is of only limited relevance in relation to Ofgem's theory that efficiencies may come from "*cost-efficient procurement, risk management, project management and operations and maintenance strategies*". The OFTO regime involves the transfer of assets which have already been built (at least all existing OFTOs have been created under the Generator Build model where the OFTO plays no part in construction). Hence, it would appear that the only relevance of the OFTO evidence might be in relation to operation and maintenance strategies. In relation to these activities, CEPA and BDO note that OFTOs largely subcontract out operational and maintenance (O&M) work, with the risks associated with these activities also passed through to the O&M contractor. Unless Ofgem is suggesting that the procurement and/or contract management of subcontractors would not be replicated, it is difficult to see how any cost reductions in this area could not be achieved by the existing TOs.

2.3.2 Innovation

Ofgem states that "*competitive pressure and the involvement of new parties is likely to drive innovation*". Ofgem notes that such innovation can result in lower costs and better value for consumers on an individual project, and across the industry as new innovations are adopted by others.

Ofgem talks about innovation in relation to "*technology, design, supply chain management, the raising of finance and operations processes*". Not all of these potential areas for innovation are necessarily relevant for the CATO regime being proposed by Ofgem. Innovation in some of these areas:

- could be achieved anyway by the incumbent TO tendering for build – for example, technological innovations are more likely to originate with equipment manufacturers[4];
- could be achieved anyway by the incumbent TO tendering for operations and maintenance support in the same way as potential CATOs do;

[4] Ofgem appears to argue that the award to TC Ormonde OFTO Ltd of innovation funding in relation to an offshore cable repair vessel and universal cable joint demonstrates that the competitive OFTO regime stimulates technology innovation. However, innovation funding is available to any TO. It is not clear that there is any causal link between the competitive award of the OFTO licence and the award of innovation funding.

- are really likely only with an early CATO model, which is not that immediately being proposed by Ofgem – for example, design innovation is likely to be relatively low with a late CATO tender; and
- may not be driven by competition – for example, innovation in financing may be observable in the OFTO regime[5] but it may be the case that innovating financing would emerge if a project specific incentive regulatory regime existed for the incumbent TO.

2.3.3 New sources of labour

Ofgem states that "*opening up investment opportunities to new parties allows different sources of labour and capital to enter the ind*ustry".

It is not clear how competition would allow access to different sources of labour. The labour required can be split into three categories:

- labour to procure and project manage construction;
- labour to undertake construction; and
- labour to operate and maintain assets post construction.

Resources in the first and third of these categories are (currently) employed by the incumbent TOs, and would under a competitive regime be employed by CATOs. It is not obvious that the incumbent TOs are foreclosed from labour markets which are open to CATOs. Indeed, if CATOs are smaller, project specific organisations, they may be less able to access some labour markets either because of the reduced breadth of career opportunities offered or because of the fixed costs of accessing these (e.g. international) markets. In addition, it is possible that since there might be more companies acting in the same labour market, the cost of labour may increase (even if the demand for labour remains constant).

Resources in the second category are currently employed by the contractors to incumbent TOs. It is not clear that the set of contractors for CATOs would be different to those available to the current TOs. It is therefore again difficult to see how competition would facilitate access to new sources of labour. As noted above, it is possible that the increase in the number of companies acting in the same markets may increase the cost of labour.

2.3.4 More efficient financing

Ofgem states that they would "*expect bidders in a competitive process to put forward financing solutions that provide value to consumers. The experience of the offshore transmission*

[5] Ofgem notes that the Greater Gabbard OFTO was the first UK project to use innovative European Investment Bank (EIB) project bond credit enhancement (PBCE) product

regime is that bidders have been able to draw finance from a range of new sources and consumers face a cost of capital that is ultimately comparable to incumbent TOs".

Ofgem believes this would have benefits for individual projects and for the wider sector, as it would "*increase the number of data sources we can use to benchmark the cost submissions of TOs and other transmission developers when deciding on the allowed revenue*"

The financing structures and financial instruments which have been used by OFTO bidders are indeed different to those which are used by the incumbent TOs. However, it is not clear that:

- this can definitively be linked to the competitive element of the OFTO regime; or
- this implies a similar variety of structures and instruments could be expected to be used by CATO bidders.

The OFTO regulatory regime is very different to that under which the incumbent TOs build and operate assets. Not least, OFTOs have a contract for a fixed 20 year revenue stream against which they can secure finance (rather than an 8 yearly price control). This in itself will lead to a very different structure of finance. The debt issued by OFTO vehicles tends to back to back the term of the revenue stream[6]. Ofgem does not differentiate between innovations driven by the different regulatory structure and those driven by competition. It is credible (indeed likely) that a significant number of the innovations observed in OFTO financing come from the former.

Neither is it clear that the innovations seen through the OFTO tenders will be relevant to the CATO regime. Bidders for OFTO assets bear no construction risk, and so have tended to use highly leveraged structures, with gearing levels around 80-85%[7]. This compares, for example, to the Thames Tideway Tunnel project (which was procured competitively by Ofwat) in which the winning bidder proposed gearing levels of around 57%[8], with debt initially being provided by commercial lenders on a 10 year basis, with refinancing during the course of construction.

While it is clearly credible in theory that competition will result in financial innovation, it is not clear that the experience cited by Ofgem from the OFTO regime provides a relevant precedent on which an evidence-based policy judgement can be made.

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6 Robin Rigg, Gunfleet Sands 1&2, Walney 1, and Greater Gabbard all issued debt with 19 year tenor. Barrow issue debt with a 17.5 year tenor, for a licence term of 18.5 years.

7 CEPA / BDO impact assessment

8 Bazalgette Tunnel Limited indicates that they will invest c. £2.8bn, of which c. £1.6bn will be debt funded (CEPA briefing note on Thames Tideway Tunnel)

2.4 Costs

The scope of costs which Ofgem considers in relation to the regime is very narrow. It considers:

- Ofgem set-up and tender costs;
- bidder costs;
- interface costs; and
- duplicated SO development costs.

Ofgem also considers risk of delay and of building unnecessary assets.

It would seem likely that there are further categories of cost which Ofgem should have considered as part of the assessment. We set out our views in later sections of this report.

We turn now to specific comments in relation to the detail of Ofgem's cost assessment.

2.4.1 Bidder costs

Ofgem cites an estimate of bidder costs from round 1 OFTO projects of £35m over nine projects. These bid costs are associated with a process which involves taking ownership of assets which have already been built. It is likely that the bid costs relating to a project which involves taking on a design developed by a third party and the committing to its construction will involve higher costs than taking ownership of existing assets. Ofgem does not appear to give any consideration as to whether this is the case.

Ofgem notes that there may be some offsetting of costs in that some work does not need to be undertaken by the incumbent TOs. It notes that there may be "*some limited duplication of functions, but we do not think these are likely to be significant*". Ofgem does not appear to consider the potential for increased SO costs relating to the need to facilitate an open and competitive dataroom process around their design, and the need to respond to questions and answer from a potentially wide field of bidders.

2.4.2 Risk of building unnecessary assets

Ofgem notes that the introduction of a tender process carries with it a risk around the flexibility of build projects, and in particular that "*we could run a tender for a project and then, based on external factors such as a changing generation mix, decide that the project is no longer in the interests of consumers and is not needed. In this case there would be costs associated with the aborted tender.*"

Ofgem does not appear to associate any costs with their proposed mitigation of "*careful design of the project development and tender processes*". In reality, it would appear likely that this would need to involve:

- some form of break clauses in contracts at pre-defined points; and
- a pre-defined approach to remunerating bidders for costs incurred to that point in time if the build does not go ahead.

It seems likely that this will result in incremental cost in one or more of:

- Ofgem's definition and running of tenders;
- bidders preparation of tenders; and
- Ofgem / bidder negotiations when and if projects are halted prior to completion.

2.5 Cost benefit evaluation

Ofgem presents a number of scenarios for potential costs of the CATO regime. These costs vary according to the potential number and size of projects to be tendered. Ofgem's cost scenarios are shown in **Figure 1**.

Figure 1. Ofgem's scenarios for required benefits

Scenario	One Project £500m[19]	Two Projects £1bn	Three Projects £1.5bn	Four Projects £2bn
Set up cost	£3m	£3m	£3m	£3m
Ofgem tender costs	£5m	£10m	£15m	£20m
Bidder costs	£10m	£20m	£30m	£40m
Total costs[20]	£18m	£33m	£48m	£63m
Minimum savings (as a percentage of asset value) required so that benefits outweigh costs	3.6%	3.3%	3.2%	3.15%

Source: Ofgem (2015) Integrated Transmission Planning and Regulation (ITPR) project: final conclusions, Impact Assessment – Supporting document, Figure 1, p. 18

Having considered these cost scenarios, Ofgem considers whether there is evidence to suggest that the benefits of the CATO regime would outweigh these.

Its principal source of evidence is the OFTO regime. Ofgem states that its analysis shows a significant benefit from OFTOs in the first tender round: "*when compared with the most relevant counterfactual for this LA – delivery by monopoly TOs under a price control – the cost savings were estimated to be approximately 14% of the total expected revenue stream*"

It is difficult to see how this datapoint can be considered as strictly relevant to the potential benefits of competition through the CATO regime. In particular:

- the value represents a comparison against a monopoly price control counterfactual – and hence conflates benefits associated with a different regulatory regime and benefits associated with competition;
- the value represents a comparison for assets which are already built, and hence a very different form of tender compared to both the late and early proposed CATO tender model; and
- the value is based on the commercial structures used by OFTOs, which are likely to be very different to those proposed by CATOs who will have to bear construction risk, potentially consenting risk and also residual value risk.

Ofgem acknowledges that "*competitive tendering for new, separable and high value onshore assets is likely to use a different tender model with additional challenges*" but argues that "*there may also be greater scope for competition to yield innovation and efficiencies in the development and construction stages, and we believe that similar or additional benefits are likely to be captured.*" However, Ofgem presents no evidence to support this belief.

Ofgem cites a number of other pieces of potential evidence in support of competitive tendering. We describe and comment on this evidence in Table 1. This additional evidence appears rather anecdotal, and it is not clear how it may be relied upon at present given that there is insufficient documenting of factual/counterfactual in each case, in particular no assessment of the effectiveness of the arrangements that may have preceded the use of competition.

Table 1. Assessment of additional Ofgem evidence

Jurisdiction	Evidence	Comment
Texas (c. 2010)	Seven projects were allocated to incumbents and eight to new entrants. 3,600 miles of new transmission lines were delivered over three years	▫ No clear evidence that new entrant bids superior ▫ No evidence on financial benefits ▫ No discussion of effectiveness of regulatory counterfactual
Argentina (1993-2003)	Over two thirds of winning bids below specified maximum. The incumbent won less than one fifth of tenders. Projects saw a significant expansion of the transmission system, with significant capex and opex cost reductions (roughly halved over first five years).	▫ Evidence of cost reductions, though given timing of tenders, not clear if this is the result of competition or "early stage" improvements in sector efficiency ▫ Some evidence that incumbent bids less cost reflective ▫ No discussion of effectiveness of regulatory counterfactual
Brazil (1999-2008)	High volume of bidders, good equipment price discovery, downward trend in revenue per km	▫ No evidence on link between competition and cost per km (as distinct from general improvements in sector efficiency) ▫ No discussion of effectiveness of regulatory counterfactual
Chile (2011)	Eight projects awarded to a range of new entrants. Auctions useful in terms of cost discovery. Winning bids consistently undershooting the maximum acceptable bid thresholds.	▫ No evidence on link between competition and cost ▫ No discussion of effectiveness of regulatory counterfactual

Source: Frontier Economics. The examples are in Ofgem (2015) Integrated Transmission Planning and Regulation (ITPR) project: final conclusions, Impact Assessment – Supporting document, Figure 2, p. 19

3 Factuals and counterfactuals

Summary of key points

Ofgem's Impact Assessment conflates the benefits of modifying the regulatory arrangements for CATOs relative to the incumbent RIIO model, with the benefits that may result from competition.

We have developed a framework that allows these effects to be separated, by developing the following four alternative policy options for future onshore transmission project delivery. These four options support the cost-benefit analyses that follow.

- Late CATO – this follows closely the model identified by Ofgem.
- Early CATO – this also follows closely the model identified by Ofgem.
- National Grid project specific – this matches as closely as possible the Late CATO model, but with no element of competition.
- RIIO-T1 – infrastructure delivery under the existing arrangements.

3.1 Introduction

In order to undertake a CBA, it is necessary to formulate precisely a factual (the state of the world after the change which is being assessed) and the counterfactuals (the state of the world absent the change). In this section we describe four possible infrastructure delivery models for large, separable onshore transmission projects, which we use as factuals and counterfactuals in our CBAs.

3.2 Options

Below we provide a brief description of four alternative policy options for future onshore transmission project delivery. These are:

- Late CATO;
- Early CATO;
- A new model where NG delivers infrastructure under revised regulatory arrangements; and
- RIIO-T1.

More detail on the defining elements of these policy options is provided in Annexe 1.

The first two options reflect possible implementations of the CATO model, in which the works are competitively tendered. These build on the Early and Late CATO models put forward by Ofgem in its recent consultation[9]. Where Ofgem is yet to make a clear decision on certain aspects of each model, we have made an assumption in order to facilitate our work. Where we consider that these assumptions are particularly critical to the CBA, we provide a discussion of the impact of each assumption on our results.

The third and fourth options describe scenarios in which there is no tendering of contracts and the work is managed/delivered by National Grid. The RIIO option describes the current regulatory arrangements. The 'project-specific remuneration' option describes the situation in which specific, separable transmission projects are remunerated as under the late CATO model, but the work itself is not tendered. Instead, a fixed project-specific revenue stream is agreed between Ofgem and National Grid ahead of construction and operation.

3.2.1 Late CATO

We have sought to follow closely the model identified by Ofgem in its latest report. We highlight three elements of the model we appraise in particular, which are:

- we assume that Late CATOs are exposed in full to construction risk (subject only to some tightly prescribed reopeners for extreme circumstances);
- we assume however that tenders occur at a relatively late stage of bid preparation, enabling subcontract negotiations to be largely complete and reflected in bids; and
- we assume that CATOs have 20/45^{ths} of their value undepreciated at the conclusion of their tender revenue stream, and that this value is potentially at risk should due diligence reveal inappropriate asset stewardship.

The first and third elements of this are important, as they create risks that may limit access to very low debt financing in the context of a highly geared structure, and may also mitigate investors willingness to "bid" low values for required return on equity.

9 Extending competition in electricity transmission: arrangements to introduce onshore tenders, Ofgem, October 2015

3.2.2 Early CATO

Under the Early CATO model, we again follow closely Ofgem where possible. We assume, loosely speaking, that the intention is for the early model to follow the late model but with an additional pre-development phase. We therefore make similar assumptions in respect of construction risk and treatment of residual value at project end.

3.2.3 NG project specific

In developing this model we have sought to establish a case that matches as closely as possible the late CATO model, but with no element of competition. The costs of establishing and running competitive processes are therefore eliminated, but so too are the potential benefits of competition.

The NG only model therefore assumes that infrastructure would be delivered under a model where NG is:

- in receipt of a 25 year fixed revenue stream with highly limited scope for regulatory review;
- raises project specific debt;
- negotiates a cost of equity appropriate to the model;
- submits a costing to Ofgem for negotiation and approval, and does so at a late stage on an open book basis; and
- faces the same risk around residual value at the end of the revenue stream, in the event of poor stewardship.

As we describe in Section 4 below, the intention of developing this model is to allow the effects of competition alone to be quantified.

We note that while this particular option is NG specific, the findings of how this option compares to others will have read across to options including incumbent TOs elsewhere.

3.2.4 RIIO-T1

The final case is to assume infrastructure delivery under the existing RIIO-T1 arrangements. We assume that the elements of the regulatory model are familiar to the reader.

4 Selected CBAs

Summary of key points

- We have identified two effects that would arise from the introduction of CATOs:
  - a competition effect; and
  - a regulatory effect (resulting from the contemplated changes to the regulatory model for CATOs versus the incumbent RIIO model).
- It is important not to conflate these two issues in any assessment of the CATO model. We have therefore designed three separate CBAs to allow us to disentangle these two effects.
  - CBA 1 compares the Late CATO model with the National Grid project specific counterfactual to isolate the completion effect of the CATO model.
  - CBA 2 compares the Early CATO model with the Late CATO model to identify the difference between the two CATO models.
  - CBA 3 compares the National Grid project specific scenario with a counterfactual of National Grid under RIIO-T1.
- Our assessment will focus on CBA1 and CBA2, as we believe that the competition effect is at the heart of the proposed reforms.

4.1 Introduction

In this section we discuss our choice of CBAs to take forward for further analysis. Our choice of which CBAs to focus on is driven by an important observation we have on the Ofgem CBA. Ofgem's CBA conflates two effects that would arise from the introduction of CATOs.

- **Competition effect**: CATOs would create competition for certain costs incurred in the delivery of transmission projects, where such competition is

presently limited[10] or does not exist at all. It seems reasonable to presume that competition will act as a superior discipline to the cost of infrastructure provision than regulation. Benefits are therefore likely to result, albeit that they may be offset by the transaction costs borne in delivering competition.

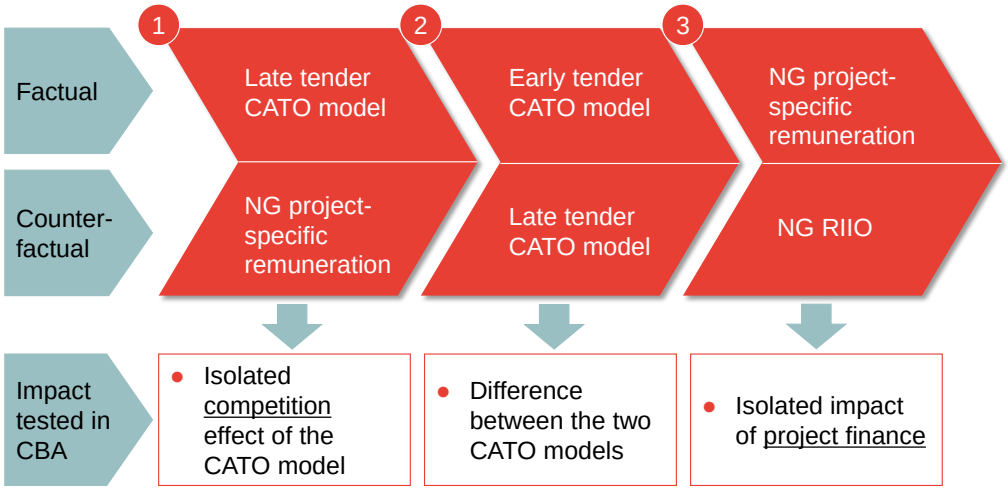
- **Regulatory effect**: in order to make the concept of CATOs attractive to infrastructure investors, Ofgem also contemplates making material changes to the structure and form of regulation (compared to the RIIO model) that it would apply to CATOs, whether under the early or late model. Certain of these regulatory changes are intended to reduce the risks borne by the infrastructure provider (transferring them to the customer) and may therefore reduce costs.

In our view it is critical to separate out these two effects, in order to understand better which of the two is most responsible for the creation of potential savings and hence what policy conclusion is appropriate. This follows because adding competition to the process creates a series of new costs that are otherwise avoided if there is a monopoly provider (as we expand on in subsequent sections). If the main driver of savings is not competition, but the redesign of regulatory arrangements, the present conclusion – that CATOs have the potential to provide savings to customers – may need to be re-examined, as while expected infrastructure costs may appear to be reduced, this could be at the cost of a risk transfer to customers. If this is viewed as desirable, an approach that allows for regulatory redesign absent competition may produce greater savings.

We have therefore identified three comparisons between factuals and counterfactuals that we think are most relevant to the current policy discussion (see Figure 2).

10 The prevailing model, where NG is responsible for the delivery of all onshore transmission projects, does already embody some element of competition, as most large projects are sub-contracted to third parties to deliver, with the successful bidder winning a competition.

Figure 2. Combinations of factuals and counterfactuals



Source: Frontier

Taken together, these three separate CBAs allow us to disentangle the competition effect from the regulatory effect. We are also able to investigate the merits of the late and early CATO models.

- **CBA 1** above compares the late tender model for CATOs with the counterfactual that NG receives comparable project-specific remuneration. This CBA allows us to isolate the costs and benefits of introducing competition alone via a late tender CATO model.

- **CBA 2** compares the late tender model to the early tender model. This comparison allows us to isolate the differences in cost and benefits between the two CATO models. When combined with the information from CBA 1, we should also be able to compare the factual "early tender model" with the counterfactual that NG receives project-specific remuneration.

- **CBA 3** compares project-specific remuneration for NGET to the RIIO regime. This CBA would allow us to isolate the effects of project-specific remuneration for a regulated TSO. We believe that this effect is not at the heart of the proposed reforms by Ofgem and, as such have not included this in our work.

The following two sections of this report provide qualitative and quantitative versions of CBA 1 and CBA 2.

5 Qualitative CBAs

Summary of key points

- CBA 1 compares the late CATO model with the National Grid project specific counterfactual to isolate the competition effect arising from the CATO model.
- We find areas where the late CATO model would give rise to additional costs versus a National Grid project specific counterfactual. However, the late CATO model does give rise to benefits through lower financing and investment costs. Both costs and benefits are likely to change depending on the scale of the specific project contemplated.
- It is not therefore possible to demonstrate qualitatively that one approach is unambiguously superior to the other in all circumstances.
- In respect of the potential costs of introducing late CATOs:
  - There will be one-off set up costs incurred in establishing the CATOs regime.
  - There will be further costs incurred in running each late CATO tender process, with duplication of bidder costs.
  - There will be additional transaction costs in maintaining additional interfaces between many TOs and the SO and a risk around communication barriers and/or imperfect incentives leadings to coordination failures.
  - There may be a loss in scale/scope efficiencies under the late CATO model, relative to the National Grid counterfactual.
  - It is not clear whether the CATO model may increase the risk of delayed delivery of infrastructure. However a CATO may be less well equipped to manage the consequences of any delay.
  - There is a risk that a tender process is initiated for a project that is found to be unnecessary in future, resulting in process/duplication costs with no benefit.
  - There is a risk around potential CATO default/failure.
- In respect of the potential benefits of introducing late CATOs, we find:
  - There is no reason why a late CATO should generate a lower cost of

debt than or a different level of gearing than the National Grid counterfactual.

- However it is possible that the presence of competition may mean that CATOs are willing to offer and accept a lower cost of equity.
- Competition may also result in lower investment and operating costs, although we note that large elements of infrastructure delivery are already exposed to competitive pressure and would continue to be under our counterfactual.

- CBA 2 compares the early CATO model with the late CATO model.
- We find that the early CATO model would give rise to higher process/bidder costs and increased risks, relative to the late CATO model. However, the early model may create the opportunity for more material benefits from innovation, provided that the relevant network circumstances facilitated innovative approaches.
- It is not therefore possible to demonstrate qualitatively that one approach is unambiguously superior to the other in all circumstances.
  - Early CATO bids would be more involved and less prone to mechanistic appraisal than late CATO bids, owing to the need to assess the quality and credibility of proposed pre-development activities. There would be additional costs for bidders and Ofgem.
  - Successful bidders under the early CATO model would be exposed to greater risk than under the late CATO model, as they would be bound to fixed pre-development budgets and would need to lock down aspects of construction cost far in advance of works commencing. This increased risk is likely to increase financing costs.
  - The early CATO model removes the pressure of competition at an early stage, leaving open the scope for later one-on-one negotiations that may increase construction/operating costs relative to the late model.
  - The risk of project delay is likely to increase under the early CATO model.
  - There is increased risk of initiating unrequired work, with the management of resulting costs limited by contract break clauses.
  - These costs may be offset but substantial innovation. But only a subset of projects may lend themselves to such material innovation.

Qualitative CBAs

5.1 Introduction

In this section we present qualitative results for CBA 1, and CBA 2, as defined in Section 4. We adopt the following approach:

- for each CBA, we identify a list of potential costs and benefits, based on the defined cases set out in Section 3 and previous experience of infrastructure delivery models;
- for each we then discuss the processes and practices that would feed into each cost/benefit item, in order to understand whether the factual or counterfactual case is likely to perform better, and if so under what circumstances; and
- we then alight on a judgement as to whether factual or counterfactual is "better" or "worse", or "similar".

A summary of the results is provided in tabular form at the start of each section.

Clearly a qualitative CBA of this kind cannot provide definitive results, only an indication of likely performance. However, we consider the process, in particular the discussion of how each delivery model might actually work in practice, has yielded important insights into their potential future effectiveness. Given the limited available data that exists to quantify costs and benefits, we consider that the qualitative CBAs play an important role in our overall assessment of the options.

The remainder of this section addresses each CBA in turn.

5.2 Qualitative assessment of CBA 1

In this CBA we consider the performance of the Late CATO model against an alternative model where NG delivers the infrastructure under project-specific regulation. We have identified a range of potential costs and benefits when these two cases are compared against one another. These results of our assessment are summarised in **Table 2**.

Table 2. Qualitative assessment of CBA 1 (Late CATO vs NG only delivery model)

Category	Assessment of performance of Late CATO versus NG only model
Costs	
One-off set up costs	>
Variable tender costs	>
Bidder costs	>
Interface costs	>
Dis-optimisation cost between CATO and SO	>
Lost synergies in construction or operation of assets	≥
Cost for transferring asset to TO (at start or end of CATO license)	>
Cost of imperfect asset stewardship	≥
Cost (risk) of delay of commissioning	>
Costs (risk) of initiating unrequired work	≥
Costs (risk) of bidder default	>
Benefits	
Lower financing costs (due to competition/innovation	>
Lower investment costs (due to competition/innovation)	>
Lower operating costs (due to competition/innovation)	>

Source: Frontier Economics

We find a range of potential areas where the late CATO would give rise to additional costs versus an NG only delivery model. However, the late CATO model does create three areas of benefit, meaning that it is not possible to demonstrate that one approach is unambiguously superior to the other, but that it will depend on project specific characteristics. It is these characteristics that

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determine the relative size of costs and benefits. In the following subsection we explain our findings in detail.

5.2.1 Assessment of factual and counterfactual

One off set up costs

A variety of parties will incur one off set up costs in implementing the late CATO model. Ofgem and DECC will incur one-off costs in setting up the regulatory and legislative regime that underpins any subsequent tendering process. There may be further one off costs incurred by other stakeholders. For example, the SO will likely incur further set up costs, e.g. from the need for it to establish clearer ring fencing between SO and TO in order to facilitate a competitive bidding process. Potential bidders may incur costs readying themselves to participate in CATO processes.

Ofgem's IA only considers its own costs and estimates these at £2-3m, based on the assumption that Ofgem will be able to build on the existing systems and processes put in place for the OFTO regime. Since this ignores the costs that others will bear, it is an underestimate.

These set up costs would be very largely avoided in the counterfactual case where NG alone delivers the infrastructure under a revised regulatory model. NGET's existing license can likely be used, and Ofgem has prior regulatory experience of similar arrangements from the Strategic Wider Works (SWW) process. No revisions to legislation would be needed. This model could therefore rely on the institutional and legislative arrangements already in place for regulating NG.

The NG only model outperforms the late CATO model on this cost item.

Variable tender costs

There will be further costs incurred in running each subsequent late CATO tender process. Here we discuss Ofgem costs. Bidder costs are addressed in the next subsection.

Ofgem will incur costs in running each tender processes (staffing, IT, external expert advice). Experience from the OFTO regime suggests these costs are ≈1% tendered asset value[11] (because some cost elements are fixed, the share will tend to be higher for smaller assets).

However, evidence from the OFTO processes will be an underestimate of future CATO process costs. All OFTOs have been appointed under the Generator Build model, where bidders compete to own and operate an already constructed

11 Ofgem (2015) Integrated Transmission Planning and Regulation (ITPR) project: final conclusions, Impact Assessment – Supporting document, para 3.18

asset. Since these assets are already built, bids are relatively straightforward to assess. There is more limited back and forth with bidders, and less complexity in terms of evaluating risks and liabilities, than would be the case under the CATO model where it would be necessary for Ofgem to appraise more detailed proposals for the delivery of a new/replacement asset.

Under the NG only model, we anticipate fewer costs. This model would most likely operate under a late review (open book) model, with NG providing tender-backed prices to support a proposed regulatory allowance. Ofgem's costs would be reduced under this model, with such scrutiny requiring some increment over business as usual.

The NG only model outperforms the late CATO model on this cost item.

For completeness, we also note that it is likely that the SO would incur additional costs in supporting each tender process under the late CATO model, owing to a requirement to answer questions from bidders (and also potentially in scrutinising bids for compliance with requirements).

Bidder costs

Bidders will incur costs preparing bids for late CATO projects. Consequently, there will be an element of wasteful duplication as multiple parties undertake due diligence and project development costs.

The CEPA/BDO report on the costs and benefits of OFTOs[12] estimated bidder costs for **successful bidders only** of £35m over the nine projects in offshore tender round 1 (just under £4m per OFTO). Since each OFTO project was competed for by multiple bidders, the total costs incurred by participating parties will be higher, albeit that losing bidders may have faced lower costs than winning bidders as they exit the process at an earlier stage.

We consider that bidder costs will be higher for late CATO bidders than under the OFTO regime. As noted above, under the OFTO model hitherto, all competitions have been for already constructed assets, such that bidders need only consider financing arrangements, ongoing operations and maintenance and due diligence. In contrast, CATO bidders must factor into their bid the full suite of construction planning activities, including lining up contracts for delivery and assessing wider project and risk management concerns at the bid stage.

Over time, companies will also need to recoup the cost of unsuccessful bids. Consequently, in submitting bids it will be necessary for bidders to include sufficient margin to cover the costs incurred in making unsuccessful bids.

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12 CEPA/BDO 'Conclusions of Consultation on the Evaluation of OFTO Tender Round 1 Benefits', 19 September 2014, p12

Under the counterfactual case, NG would incur similar costs in a negotiation process with Ofgem, but there would be no duplication of costs among multiple bidders. Similarly, any duplication of costs between SO and CATO bidders would be eliminated.

Should further bid costs be incurred subsequent to the initial competition process (or after NG build under the NG build model) owing to the need to deliver incremental capacity on the asset (e.g. following the request for connection to the new asset), we anticipate that similar costs would be incurred under either model, as Ofgem would in either case need to agree cost allowances with a single party (either CATO or NG).

In summary, owing to the duplication of bid costs under the late CATO model, the NG only model outperforms the late CATO model on this cost item.

Interface costs

The late CATO model introduces additional interfaces between an increased number of TOs, the SO, Ofgem (and possibly the DNOs depending on the nature of the CATO projects). These extend throughout the operation of the CATO. There will be set up and ongoing costs incurred in creating and maintaining these interfaces, e.g. setting up, monitoring and coordinating contracts and/or service agreements between an increased number of parties.

Ofgem acknowledges that there will be additional costs from interfaces under the late CATO model, but considers these to be incremental (rather than a shift change) given that multiple TOs and OFTOs already exist.

In contrast, under the NG only delivery model, there would not be any material interface/duplication costs within NG. In particular there is no further TO-SO contracting necessary.

The NG only model outperforms the late CATO model on this cost item.

Disoptimisation costs between CATO and SO

In addition to the transaction costs of maintaining additional interfaces, there is a risk that the operation of the transmission system may be less efficient due to communication barriers and/or imperfect incentives leading to certain failures of coordination.

Where National Grid is both SO and TO in respect of a given group of assets it is subject to a collection of incentives spanning both businesses that encourages it to co-optimise its actions. Where National Grid is SO and another party is TO, there is evidence of coordination failure. A range of activities that National Grid, acting as TO, is willing to undertake are not observed (or observed far less frequently) from other TOs. National Grid has shared with us an internal working paper that highlights three areas:

- greater willingness on the part of National Grid as TO to estimate and use operationally higher transmission asset capability figures;
- greater willingness on the part of National Grid to measure and make use of real time data in respect of asset capability; and
- increased flexibility on the part of National Grid in respect of the scheduling of asset maintenance.

National Grid has identified a range of recent actions that it has taken for which it can find no comparable/similar actions taken by other TOs. There is, therefore, already a disoptimisation cost arising from ineffective SO-TO interfaces/incentives. Creating a new wave of CATOs is highly likely to add further costs.

We anticipate that CATOs would bring greater disoptimisation problems than would an OFTO. By their nature, OFTOs operate at the periphery of the transmission grid and their actions will have only limited (if any) consequences for the wider transmission system. CATOs, on the other hand, will more likely operate assets that more integrated within the main transmission system, where cross system coordination (or failure to so coordinate) will have a more material effect.

No such disoptimisation costs should arise under the NG only delivery model. Any externalities that the project imposes on the wider grid, or vice versa, will very largely be internalised within National Grid owing to common ownership, as they are at present when National Grid performs both roles.

The NG only model outperforms the late CATO model on this cost item.

Construction/operation synergies

NG currently has access to scale/scope efficiencies that arise from its role in managing a large portfolio of transmission projects. Resource can to an extent be flexibly reallocated among projects in response to changing infrastructure requirements or project developments (for example between reinforcement and maintenance projects). This allows NG to maintain a relatively smooth overall profile of work delivered, which should permit it to maximise the utilisation of a minimum number of persons, in respect of both direct work on the assets, and indirect work overseeing such delivery. Internally, NG can schedule work to keep delivery managers fully engaged. NG can also contract externally for asset delivery across a portfolio of assets, helping to give contractors a stable average workload and lower costs.

Dividing projects among CATOs would mean these efficiencies would not be realised, unless there is some additional mechanism for strong coordination. With only a small number of CATO projects, this may be achievable, although it would rely on a high willingness to co-ordinate among CATOs, and potentially

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for CATOs to bear some risk associated with ceding resources to others for periods of time. As the number of CATO projects and CATO operators increases, it becomes more likely that this effect could be material.

We anticipate no such loss of synergies arising under the NG only delivery model.

If one assumes a small number of CATOs and strong coordination, then both models may perform similarly on this item. As more CATOs are considered and coordination becomes less perfect we would assume that the NG only model would then outperform the late CATO model.

Asset transfer at beginning/end of CATO period

At the end of the envisaged 25-year revenue stream costs will be incurred (by the CATO and the TO) in supporting the transfer of the asset back to the TO. Costs will arise in respect of technical due diligence on the asset and legal fees, and potentially in arranging the operational handover of the asset. Further costs may be incurred in arranging the transfer of wayleaves. Where the CATO takes over an existing asset, similar costs may also be incurred in the original transfer of the asset from the TO to the CATO (some of which may form part of bidder costs discussed above, but some of which may be incremental).

The final asset transfer also exposes the CATO to risk that it fails to recover the expected asset value (due to failure to maintain the asset to the required standard), but this is discussed and covered separately under Financing Cost Benefits below.

Under the NG only model, there may be some small legal/operational costs associated with transferring assets from the 'project-specific remuneration' arrangements back to NG's RAB. But since this is an internal transfer within the same entity, we anticipate lower costs being incurred under this model.

The NG only model outperforms the late CATO model on this cost item.

Costs of imperfect asset stewardship

Ofgem appears to contemplate an availability incentive being imposed on CATOs, which would resemble that already in place for OFTOs. However, the late CATO model would not otherwise inherently incentivise the CATO to optimally maintain the asset over its full operational life. It may therefore be possible for the CATO to curtail inefficiently maintenance activity during/towards the end of the CATO period, thereby saving up a stock of maintenance that would need to be delivered subsequently by NG post transfer back, while not leading to any material availability concerns at the time. Failure to complete routine maintenance over time may reduce the expected operational lifetime of the asset, or may give rise to increased cost in remedying any problems.

Lack of a full incentive to maintain the asset optimally may be mitigated by scrutiny of the asset at transfer back to the TO. We would expect that the TO would perform due diligence on the asset, which is likely to include an assessment of the actual maintenance undertaken compared to the CATO's stated policy and against industry best practice. A physical assessment of the assets may also take place to determine the current condition of the assets, what remedial works may need to take place to ensure the assets functions effectively for the remaining 20 years, and the cost of those additional works. Given this assessment is likely to take place, it is possible that the residual value at transfer is deemed by Ofgem to be less than the remaining regulatory value.

Under the alternative NG only delivery model, if we presume a similar set of regulatory arrangements, then NG may potentially face similar incentives to minimise inefficiently operational costs. However, unlike the CATO, NG would not be able to walk away from the asset at the end of the CATO term, as the asset would still be its responsibility, as it would be merged back into the main business. NG may then contemplate being unable to recover any inefficient maintenance costs that arose owing to its failure to maintain the asset under the project specific arrangements. More generally, NG would have incentives to preserve its reputation with Ofgem, as it has more to lose from creating the impression with Ofgem that it may "game" holes in regulatory arrangements.

On this cost item, it may be that the NG only model and the late CATO model perform similarly well, although there may be arguments to suggest that the NG only model could be slightly superior.

Cost/risk of delay in commissioning

There are two aspects to consider in appraising the cost/risk of delay. Whether the introduction of CATOs:

- increases the likelihood of delay; and
- if so, whether CATOs are less well able to deal with the consequences of any delay that did arise.

The delivery of large scale transmission infrastructure requires a strong set of project management skills to coordinate many activities and supply chain elements. There is also a need to handle local stakeholders with tact and care, in order to ensure that operations are not disrupted.

Organisations familiar with this will build up a level of experience and competence in undertaking such tasks. However these skills may be relatively scarce. There is the prospect that CATOs may have weaker skills in this area than NG, increasing the risk of project delay relative to counterfactual of NG delivery.

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The likelihood of CATOs increasing the frequency of delay does of course depend on the identity of those bidders. We recognise that many prospective CATOs are likely to have significant experience of project delivery, as they will be entities from which NG currently procures delivery. However, it seems reasonable to presume that no CATO would have access to the resources that NG could deploy in the event a large scale project was running behind schedule. NG therefore appears better placed than most (if not all) potential CATOs to manage risks effectively and reduce the probability of delay.

Delay in the delivery of infrastructure can give rise to large costs, e.g. in the form of prolonged congestion management costs incurred by the SO. Where a failure to deliver has a direct impact on specific customers (e.g. in respect of connection or local enabling works) there is a risk of litigation.

In the event of a delay occurring, connecting customers would no doubt prefer to deal with a party with very considerable resources, both in terms of being able to commit those resources rapidly to address the delay (as discussed above), and in terms of having the capacity to pay potentially sizeable damages where appropriate. Developers of large scale generation projects that may be served directly by a CATO might perceive increased risk for their project versus a counterfactual where they are instead served by NG.

While it is difficult to say definitively how material the increase in risk may be, it is important to note that the implications of delay of a major transmission project may be very significant for particular projects. We therefore consider that a model based on NG only infrastructure delivery is likely to be superior to a CATO model, owing to NG's increased ability to manage the likelihood of delay, and also their ability to manage the consequences of delay should one occur.

Cost/risk of initiating unnecessary projects

In respect of reinforcement investments to manage congestion on the main transmission grid, NG's view of where to add new capacity and in what quantum evolves as information on future generation and demand is revealed. There is material uncertainty over what new generation projects may be brought forward in future, and in respect of the evolution of demand, which is dependent on wider economic performance, the speed of take up of low carbon technologies (such as electric vehicles and heat pumps) and the scope for increased penetration of DG. While aggregate forecasts of future generation and demand can be regarded as reasonably accurate, transmission planning can be far more volatile as the precise location of each can significantly affect flows and hence necessary reinforcements.

NG manages this uncertainty using its Network Development Policy (NDP), which sets out how it will assess the case for adding new transmission capacity at a given point in time through a least regrets framework. A planning and

assessment exercise is conducted annually, and at each iteration different projects may be identified as necessary.

This context creates a risk that a process is initiated to run a competition to appoint a CATO for some project that is presently considered necessary, only for that project to be found unnecessary in a future NDP iteration. Depending on the timing of any change in view on a project, a range of costs might be incurred. If the project is cancelled relatively early, then there may be some administrative costs (on the part of Ofgem, the SO, and bidders) incurred in preparing for a competition that then does not proceed. In this situation the administrative costs would be a sunk cost for Ofgem and there may in addition be a need to compensate all registered bidders. If work on a project has begun, then Ofgem would need to ensure that there was sufficient contractual flexibility to cancel the project if that was optimal (noting that if part of the cost of the project has been sunk then it may then be optimal to complete works).

The NG only delivery model would avoid some of these costs. Where projects were cancelled before construction had begun, there would be some preparatory work undertaken by NG that would be written off (although such incurred cost may have value if the project is reignited). But the NG model would outperform the CATO model however, as it avoids the duplication of effort that would be present in the CATO model with multiple bidders. Where a project is cancelled later in the process, after works had commenced, we envisage that there would be greater scope for flexibility in the treatment of those sunk costs from a negotiation with NG, than would be the case with a CATO that may exist only to deliver the cancelled asset and where contractual structures may place some rigidity on cancellation/break clauses.

Based on this discussion, we consider that the NG only model would outperform the late CATO model in respect of both avoided administrative costs, and in flexibility to handle later cancellation.

Cost/risk of bidder default

Under the CATO model, there is a risk that the winning bidder may subsequently prove unable or unwilling to deliver the project for the offered revenue stream. The recent experience of Carlton Power, which was awarded a capacity contract in respect of its Trafford project in the 2014 capacity market auction only for it to subsequently reveal that it has been unable (as of yet) to secure financial backing to proceed, is a timely reminder of the potential for such events to occur.

Although this risk will clearly be considered when awarding contracts, it is likely that the project-based nature of funding under the CATO model means that any given project will be less robust to unforeseen events, and therefore more likely to default, than a counterfactual in which NG delivers the infrastructure.

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In the event of CATO default prior to construction commencing, there would be a need to incur additional costs in finding another provider. The available options are that NG is asked to adopt the project, or that a new competition would be run to find another CATO, or that negotiations are reopened with the second placed bidder in the original CATO project. In any of these cases, there would be a further round of administrative costs and inevitable duplication.

In the event of CATO default post construction, we presume that Ofgem would run an OFTO style competition to identify a new owner and operator of the asset. Again, a further round of administrative costs would be incurred, albeit at a later stage (with a lower present value) and in respect of a simpler process than is necessary for an as yet unconstructed asset.

Default during construction would be likely to be the most costly case, as there may be significant difficulties in identifying rapidly who should take forward the project and in securing the delivery of the remainder of the construction programme at reasonable cost, in particular as the status of any contracts between the failed CATO and the subcontractor may be unclear.

We also note that default would give rise to the potential for delay in commissioning. While we have already covered the risk of CATOs giving rise to a higher probability of delay, the risk of delay arising from default is an additional facet of that risk.

Based on this discussion, we consider that the NG only model would outperform the late CATO model.

Lower financing costs

The introduction of competition into the provision of onshore transmission has the potential to reduce financing costs. CATOs may be:

- willing to accept a lower return on equity than the level that is embodied in wider regulatory settlements such as RIIO-T1; and
- able to access and pass through lower debt financing costs than the debt allowance embodied in RIIO-T1.

CATOs may also support a higher level of gearing which in the presence of corporate taxes may reduce the overall cost of financing any given project (although as gearing becomes very high these savings should be weighed against the risk of possible financial distress/failure).

Ofgem's IA drew out just these comparisons and noted the low financing costs that have been achieved through, for example, the OFTO competitions.

However, for our purposes, further thought is needed. Here, we are not comparing Late CATO with RIIO-T1, but with a model where NG delivers the

infrastructure through a late CATO-like set of revised regulatory arrangements. Several important consequences flow from this.

- **Cost of Debt**: under our counterfactual, we contemplate that NG's debt financing would not be compensated using the RIIO roller mechanism, but would instead be project specific. Consequently, we see no reason to suppose that the CATO model would deliver savings in respect of the cost of debt, versus our counterfactual. NG will be accessing the same debt markets at the same time as the prospective CATO and we see no reason to believe a higher coupon would be necessary to support fund raising by NG. [13]

- **Gearing**: for similar reasons to those given in respect of the cost of debt, we see no reason why there should be material differences in the level of gearing that may be achieved between a CATO and NG under the factual and counterfactual cases.

- **Cost of equity:** this appears to be the only area where the late CATO model may create a real financing saving relative to the counterfactual (NG project specific scenario). It may be the case that the pressure of competition would create CATOs willing to accept lower equity returns than NG under the project specific scenario. However, one should be cautious in estimating the quantum of this saving for three reasons.

  - Again we stress, the comparison we make is not between late CATO and RIIO-T1. In both the factual and counterfactual in CBA1, regulatory arrangements are modified to make the proposition more palatable to investors. In our view, certain aspects of the regime (25 year revenue term, minimal scope for regulatory review within term etc) will have the effect of reducing risk to the infrastructure provider, relative to RIIO-T1. Any quantum of reduction arising from this

[13] We further observe that the belief that CATOs and certain other forms of infrastructure delivery arrangements bring financing savings may be transitory. These structures, which make a project new and stand alone, facilitate financing in a capital market where debt costs are presently very low. The low cost of debt that can presently be accessed is then sometimes compared with the cost of debt of a long lived infrastructure businesses with a lengthy history of raising debt, and which inevitably have a significant proportion of the debt on their books at the higher coupons that were necessary to attract investors in the past. Such comparisons contrast a spot debt rate with an average debt rate and presently find the spot rate lower. But by definition, owing to the use of an average over time in the RIIO model, any resulting savings must simply be a matter of timing, and there will be a time in the future when the spot rate is higher than the average. Under such circumstances, CATOs (and other similar structures) may then appear to provide rather poor value for money, as they will be financed by what appears to be high cost debt. Ofgem does not appear to have considered this point.

redesign should appear in both the late CATO and NG only delivery model and should form no part of CBA1.

- It is tempting to compare the financing costs revealed through the OFTO process with those offered under RIIO-T1 and then conclude that a similar quantum of saving will arise here in CBA1. However, we consider that this is very unlikely to be the case. In part this is because, again, OFTOs have been structured to reduce risk and increase investor appetite versus the RIIO-T1 model. As above, we should ignore this regulatory change effect in CBA1. But additionally, and importantly, OFTOs bear no construction risk at all[14], whereas we have presumed that CATOs will be fully exposed to construction risk. Given this potentially material risk that will be borne by CATOs, it is not reasonable to presume that the incremental equity savings in CBA1, to the extent that there are any, will be as large as those revealed by comparing OFTOs to RIIO-T1.
- Similarly, we note that OFTOs have no residual value at risk at the end of their 20 year term. In contrast, Ofgem contemplates (and we assess here) a late CATO model where approximately twenty forty-fifths of the project value are dependent on a yet to be specified transfer procedure at term end, with scope for some disallowance[15]. Investors would need to factor this risk into their offers, reducing the prospect of CATO financial offers matching OFTO financial offers further. (We do note however that this effect does not influence CBA1, as it is present for both NG and the late CATO model, but it would affect any assessment of late CATO versus RIIO-T1.)

- **Tax**: A CATO may potentially be more innovative/aggressive in creating tax savings, but if we presume that customers and tax payers are the same set of individuals for our purposes, then tax savings are simply transfers, not genuine savings. We do not quantify any tax benefits, nor do we include them in either our qualitative or quantitative CBAs.

Given the analysis above, we consider that the late CATO model should outperform the NG only delivery model in respect of financing costs, but only through its ability to drive incremental reductions in the cost of equity. We also note that the quantum of financing reduction revealed by OFTOs, when compared to the RIIO-T1 model, is irrelevant for considering the quantum of

14 At least all existing OFTOs have borne no construction risk as they have been tendered under the Generator Build model.

15 If one does not contemplate risk of disallowance, then one must instead reappraise the risk of poor asset stewardship under the Late CATO model. We assume the prospect of poor stewardship would be unacceptable for the great majority of stakeholders.

savings that the late CATO model might generate, versus either RIIO-T1 and/or the late CATO model.

Lower investment costs

We anticipate that exposing construction costs to competition in the late CATO model would produce savings relative to a counterfactual where NG is the only provider of infrastructure.

- In a competitive process bidders may be better incentivised to seek out lower cost delivery solutions. The extent of such savings from innovation may be rather limited in the late CATO model however (certainly when compared to the early CATO model) as it is contemplated that the solution design and consenting process will already have been completed prior to the appointment of the CATO. Innovation savings would need to be in respect of the approach to delivering the well specified asset and may not be material in an area where the technology is mature.

- CATOs may have a stronger incentive to run a tighter/better specified tenders for subcontractors. While NG already tenders out a significant proportion of large scale delivery work, and thereby does (and would) secure some benefits from competition, a competitive process may drive some further incremental savings on that element of cost.

- CATOs may have leaner/more efficient overhead costs.

- CATOs may be more willing to reveal any available cost savings in their bids in order to increase their likelihood of winning.

Countering that, it may be that NG is able to extract a better deal from subcontractors than would a CATO, as it may exercise some monopsony power in the market, owing to the portfolio of work that it may let to subcontractors. This effect may mitigate in part the benefits of competition, but we consider it unlikely that it would be sufficient to dominate them.

The late CATO model should therefore outperform the counterfactual where NG only delivers the infrastructure on this item. The quantum of this outperformance will depend on the size of the project and one's view of the proportionate saving that competition may drive.

Lower operating costs

For similar reasons to those set out above in respect of investment costs, we anticipate that CATOs should deliver lower expected operating costs than would be achieved under the NG only counterfactual. CATOs will be strongly incentivised to make sure operating costs are as low as possible. Competitive

pressure will encourage these to proactively be offered to consumers at the bid stage.

While NG would have incentives to minimise operational costs in order to maximise returns, the lack of a competitive threat may make it less willing to identify and offer up prospective savings to consumers at the negotiating stage.

However, NG may benefit from economies of scale in delivering low-cost operations, since the fixed costs of maintenance operations can be divided across its large portfolio of assets. It may therefore have a natural advantage that may partially offset the benefits of competition.

Nevertheless, we conclude that the late CATO model outperforms the NG only model on this cost item.

5.3 Qualitative assessment of CBA 2

In this CBA we consider the performance of the Early CATO model against the alternative late CATO model. We have identified a range of potential costs and benefits when these two cases are compared against one another. These are summarised in **Table 3**.

Table 3. Qualitative assessment of CBA 2 (Early CATO vs Late CATO)

Category	Assessment of performance of Early CATO versus Late CATO
Costs	
Higher Ofgem tender costs	**>**
Higher bidder costs	**>**
Higher financing costs	**>**
Greater cost (risk) of delay in commissioning	**>**
Higher costs (risk) of initiating unrequired work	**>**
Benefits	
Lower investment costs	**Case dependent**
Lower operating costs	**Case dependent**
Lower interface costs	**≥**

Source: Frontier Economics

We generally find that the early CATO model would give rise to higher costs and increased risks relative to the late CATO model. However, the early model may, under certain circumstances, create the opportunity for more material benefits from innovation. Again, as with CBA 1, it is ambiguous as to which of these models should be preferred, with the answer depending on the specific circumstances.

5.3.1 Assessment of factual and counterfactual

Higher Ofgem tender costs

We consider that the early CATO tender process will likely be more involved and less mechanical than the late CATO process. Under the early model there would be a need to assess the quality of the proposed pre-development activities (where the quality of one bid relative to another may be rather difficult to determine) the feasibility of potentially numerous proposed construction options and the plausibility of the indicative costs provided. This would make this process more costly. The early model will also entail additional costs when the construction and operation revenue stream is negotiated relative to the late CATO model.

Qualitative CBAs

Although the late model also entails costs, bid assessment will be more straightforward. The tender/negotiation process also ends with the award of contract, helping to limit future negotiation costs.

The late CATO model is likely to outperform the early CATO model on this item.

Higher bidder costs

For similar reasons to those set out just above, we anticipate slightly higher bidder costs under the early model versus the late model, given the multiple stages through which the successful bidder would need to pass. One might argue that early model bids may be simpler than late model bids, as they would mostly focus on establishing the credentials of the bidder to undertake the relevant range of predevelopment tasks. This possible reduction in costs would however be greatly reduced by the envisaged requirement for the bidder to offer at least some binding commitments on costs (e.g. fixed unit costs).

On balance therefore, we anticipate higher bidder costs under the early CATO model.

Higher financing costs

Under the early CATO model, we anticipate that the successful bidder would be exposed to greater risk than under the late CATO model. There would be risks associated with the risk of cost overruns during the pre-development stage, which will not easily be backed off to third party contractors, to which the bidder would be fully exposed. And there would be the need to commit to locking down elements of the cost of the project (e.g. unit costs) very far in advance of construction commencing. Bidders could choose to reflect all these uncertainties by adding contingencies to their cost bids, but may also be less willing to bring forward a low cost of equity as we speculate they may do under the late CATO model.

Furthermore, under the early CATO model, since construction costs and revenues aren't locked down completely at the tender stage, we presume that debt could only be raised long after the tender stage had been completed. At that stage, the selected CATO may have weaker incentives to drive all possible efficiencies in its debt raising. As open competition has been removed from this stage of the process under the early model, it is possible that higher financing costs may result.

On balance therefore, we anticipate higher financing costs under the early CATO model.

Cost/risk of delay in commissioning

The early model passes a number of additional activities from NG to the CATO, such as network solution design and consenting. Potential CATOs are likely to be less familiar with at least some of activities than with the construction and operational tasks that are common to both models (and to numerous other infrastructure projects). This adds a new potential source of risk to the project's timing, in the event that the selected CATO is found to lack the skills/experience to meet project milestones.

Under the late CATO model, the handover between NG and the CATO occurs later in the design process, when additional design work, surveying and consenting work has already been done. This implies the need for a more comprehensive handover, which could add to the risk of delays. However, this risk seems far less material than the risk of failing to obtain timely consent, where NG's prior experience should be a significant advantage.

The need to negotiate the final revenue stream once pre-development work is complete also creates a potential new source of delays, in the event one or other party feels that its position can be improved by delay.

The same incentive to ensure timely delivery applies in both models (namely that construction and operation revenue is only available on completion). However, early CATOs will receive pre-construction revenues, whereas late CATOs receive nothing until completion.

However, a CATO could theoretically use the early design flexibility given in the early model to develop an innovative proposal that could be delivered sooner than had been anticipated by the SO and/or one that better mitigates timing risk.

On balance, we conclude that the risk of delay is greater under the early CATO model, in particular given the increased risk of delay emerging during the consenting process, although there may be some special cases where significant design innovation is possible where this would not hold.

Cost/risk of initiating unnecessary projects

Under the early CATO model Ofgem will offer a formal contract for the delivery of an asset at a far earlier stage than it would under the late model (potentially as much as 10 years ahead of commissioning). Given the prevailing uncertainty/volatility over future reinforcement, as described above in Section 5.2.1, this must imply a greater risk of being locked into (some component of) the cost of pre-development/construction of an asset that is later found not to be required. We assume that Ofgem would seek to negotiate reasonable break clauses in any early CATO contract in order to mitigate this risk, but since perfect flexibility is not be achievable, some run-on excess costs may be unavoidable.

Qualitative CBAs

Innovation under the early CATO model may develop solutions that prove more flexible (i.e. sink less cost early) but it is not clear how this could be specifically encouraged and it could certainly not be guaranteed.

On balance, we conclude that there is a greater risk of initiating unnecessary work under the early model, and the potential for higher cost should a project be cancelled.

Lower investment costs

The early model provides scope to select from a wide range of bidders that may offer many different design solutions. Depending on whether the project lends itself naturally to such innovation, there is greater scope to develop innovative solutions that may reduce investment costs under the early model. However, if the engineering circumstances are such that there is little scope for innovation (i.e. all suitably qualified electrical engineers would agree on a highly similar solution), then this potential benefit could be small.

The early model also exposes the first stages of the build development process to competitive pressure, and this should encourage bidders to achieve savings on these elements of the work, relative to the late model where these activities are delivered under a standard regulatory framework by the SO, and to pass those savings through to customers in their bids.

However, under the early model build costs aren't fully locked down at the point the contract is awarded under the early model. This means that competitive pressure can't be as effectively applied in controlling these costs under the early model as under the late model (where competitive pressure is heavily focused on the build stage). Instead, bidders would be incentivised to offer low indicative costs and promises of innovation at the bid stage and then negotiate these cost estimates upwards after the competitive threat is removed.

As under the NG project-specific model, the CATO's incentives to share any efficiencies with consumers, or to drive a hard bargain that might subsequently be used against them in negotiation, are weaker than under the late model.

In our view it is not possible to say unambiguously whether the innovation effect created by the early model (plus possible savings from more efficient pre-development) would dominate the disbenefit of having weaker competitive pressure focused on the bid stage. Results will vary from case to case. Projects to be delivered on parts of the network where significant innovation is possible may be delivered at lower cost under the early model. Whereas projects where material innovation is unlikely may be better delivered under the late model.

Lower operating costs

Our analysis of the potential costs and benefits of the early/late CATO models with respect to operating costs precisely mirrors the discussion of investment

costs. The relevant question is whether innovation may offset the weakening of competition under the early model, with the answer likely to be project dependent.

Lower interface costs

Under the early CATO model, the transfer of responsibilities to the CATO occurs earlier in the build process, when less detailed design and consenting work has been done. This would potentially require fewer and less costly interfaces at this stage of the development than under the late model.

Under the late model there is no potential for multiple CATOs designing solutions on different projects that may interact with one another, since all early solution design is overseen by NG. Before solution design starts, it may be hard for Ofgem to identify the risk of cross-project impacts (e.g. bidding up procurement costs)

If there are to be few CATOs, then performance may be similar across the early and late models. As one imagines a world with more CATOs, it seems more likely that the early model will outperform as it reduces the number of parties requiring an interface with the SO.

6 Quantitative CBAs

Summary of key points

- We have undertaken a quantitative analysis of CBA 1 and CBA 2.
- The two CBAs also depend on a number of assumptions. We have set out the basis on which we have made assumptions and in certain cases sought to provide a range.
- Not all of the areas identified in Section 5 lend themselves readily to quantification. We have documented clearly which elements are included and which are not.
- The results from CBA1 indicate that the late CATO model does not have positive net benefits when compared to the National Grid counterfactual, unless the size of the asset to be built is greater than £260m.
- Unless projects are of this or greater scale, the benefits of lower investment and financing cost are insufficient to offset the fixed costs running a competitive process.
- Since there are a number of other areas where the late CATO model may also bring incremental costs that have not been directly quantified, the actual minimum efficient scale for the late CATO model to be preferred is likely to be higher still.
- In CBA2 we considered two scenarios:
  - In scenario A we assumed that the asset value in the early model is 2% higher than in the late model. This represents a case where the loss of competitive pressure on the build phase is not offset by innovation.
  - In scenario B we have assumed that the asset value in the early model is 5% lower than in the late model, representing a case where more material innovation was possible and achieved.
- The results show that, as one would anticipate, the early CATO model only has net benefits over the late CATO model in scenarios where there is more scope for innovation in design.

6.1 Introduction

In this section we describe the approach we have taken and present the results of the quantitative CBAs. For each CBA, we:

- summarise the results for a range of potential asset values[16] for CATO assets;
- provide a list of the costs and benefits that have been included in the analysis; and
- set out the data sources and assumptions that have been used to estimate the value of these costs and benefits.

Where possible we have based the estimates of costs and benefits on data sources from other studies, or actual figures from relevant regimes. However, in some cases we have had to make assumptions around the likely size of these factors. While in some cases there is relatively little hard evidence on which to base assumptions, we have nevertheless made assumptions on the likely drivers of cost and benefits where we believe this can be done with a degree of certainty over the broad magnitude.

For some costs and benefits we do not consider it appropriate to include quantitative estimates in the CBA, as we do not have sufficient information even to form high level estimates. In these cases, we have undertaken some analysis to estimate an approximate scale, but have not included the values in the CBA. Rather, we have used these estimates to indicate the importance of these factors in relation to the conclusions which might be drawn from the quantitative CBAs.

In line with our qualitative CBAs, we have carried out two quantitative CBAs. We discuss each in turn.

6.2 Quantitative assessment of CBA 1

The table below provides the results for CBA 1 for three potential asset values. The columns highlight the scale of the late CATO asset value.

16 As discussed in Section 5, the absolute amount of saving that may be derived from the introduction of competition is likely to depend on the size of the asset. By examining a range of asset values it is possible to gain insights into the minimum efficient scale necessary for the variable benefits of competition to outweigh the largely fixed costs.

Table 4. Summary quantitative results of CBA 1

Net present value (£m)	£100m late CATO asset value	£250m late CATO asset value	£500m late CATO asset value
CBA 1	-13	-1	19

Source: Frontier Economics

The results indicate that the late CATO model does not have positive net benefits when compared to the National Grid project specific counterfactual, unless the size of the asset to be built is greater than £260m.[17] However, as we describe the analysis underpinning this finding, it will become clear that these results require careful interpretation before conclusions can be drawn.

In the remainder of this section, we set out the estimates of costs and benefits that lead to this result, and the assumptions that underpin them. The costs are summarised in **Table 5** and the potential benefits in **Table 6.** An inspection of **Table 5** reveals that there are a number of costs not quantified. Our assessment of the minimum efficient scale of the Late CATO model is therefore likely to be underestimated.

17 While this analysis has been based on using a National Grid specific counterfactual, the findings could largely be read across to cases where the incumbent TOs is not National Grid, i.e. we anticipate finding similar results had we been asked to consider Late CATO versus a Scottish Power specific delivery option.

Table 5. Late CATO incremental costs[18]

Cost item	£100m late CATO asset value	£250m late CATO asset value	£500m late CATO asset value
Administrative costs	£20m	£21m	£22m
Interface costs	Not quantified		
Initiating unrequired work	Not quantified		
Lost synergies in construction and operation	Assumed to be £0m		
Disoptimisation costs	Outline assessment made off model		
Cost/risk of delay	Outline assessment made off model		
Cost of transferring assets to TO	£0.4m	£0.4m	£0.4m
Cost of bidder default	£0.5m	£0.5m	£0.6m

Source: Frontier Economics analysis

- **Ofgem costs.** We have assumed that there will be costs associated with setting up the regime, and also on-going costs in running tenders. This is in-line with the approach that Ofgem adopted in its Impact Assessment. We also note that there are likely to be set-up costs incurred by DECC and the SO, but we have not accounted for these costs in the quantitative CBAs.
  - *Set-up costs.* We have assumed a value of £3m for the Ofgem set-up costs. This is based on the Ofgem estimate of its tender costs.[19] We have further assumed that there would be six tenders in total, and that the total costs of £3m should be spread out over those six tenders.

18 This table shows present value terms.

19 Ofgem (2015), Integrated Transmission Planning and Regulation (ITPR) project: final conclusions; Impact Assessment, para 3.17

- *Tender costs.* We have assumed that tenders costs will be 1% of the asset value, up to a maximum of £5m. Ofgem assumed that tender costs would be 1% of the asset value in its Impact Assessment.
- *Counterfactual.* We subtract the administrative costs related to negotiations between Ofgem and National Grid in the counterfactual world of 0.5% of the asset value.

- **Bidder costs.** The National Audit Office (NAO) published the combined administrative costs for the first four OFTO tenders[20], which included successful bidder costs and Ofgem's costs. The value of these combined costs was £7.1m - £7.9m. Since the asset value in these four cases varied from £33.6m to £105.4m we can conclude that a large proportion of the costs are fixed. As such, we consider that it would be most appropriate to set bidder costs as an absolute figure, rather than as a proportion of the asset value. We have assumed that £4m of the total NAO figures were the OFTO bidder costs, based on the information in the NAO report.[21] We have then assumed that the CATO bidder costs will be approximately 25% higher than the OFTO bidder costs, since CATO bidders will not just be bidding to take on an existing asset (often with existing maintenance and support contracts) but will need to construct a more complex bid including detailed constructing plans back-to-back with contract offers. We also note that the NAO figures do not include the bidder costs for unsuccessful bidders. These are a genuine welfare cost to society that should be accounted for. We have assumed a long term average of four bidders in the process, all with the same cost (i.e. 125% of £4m).

- **Interface costs.** As described above, we anticipate there being increased costs in maintaining additional interfaces between SO and more TOs. However, in the time available it has not been possible to develop a robust basis on which to estimate this cost. In this exercise, there is no incremental cost included for this item.

- **Cost of initiating unrequired work:** To the extent that there are incremental costs associated with initiating unrequired work in the late CATO model (where a CATO process is launched and then cancelled as the NDP no longer supports the project), relative to the counterfactual, this

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20 National Audit Office (2012), Offshore electricity transmission: a new model for delivering infrastructure

21 The National Audit Office (p. 26) presents the total administrative costs split by licensee and generator. We have assumed that the Ofgem costs, which are included in these totals, are split equally between the licensee and the generator, meaning that the licensee's bidder costs are assumed to be approximately £4m.

could impact the interpretation of the break-even point. Our analysis focuses on what the break-even point would need to be for individual projects that do proceed. To offset the incremental costs of projects that do not proceed (and therefore do not generate any benefits), the average value of the projects that do proceed would need to be higher than the £250m identified in our analysis, to ensure that the overall portfolio of projects using the late CATO model (included those that don't proceed) is net beneficial. We have not quantified the likelihood and effect of a project being initiated and then cancelled, but note that discussions with National Grid suggest that the outcome of each NDP planning iteration is relatively volatile, suggesting that this approach may underestimate costs associated with CATOs.

- **Lost synergies in construction and operation.** We make the conservative assumption that there are no lost synergies in construction and operation, as a result of an idealised tendering process which facilitates perfect co-ordination between CATOs and the TO. We then assume that this ensures that construction and maintenance providers are able to optimise their workload and that this benefit is passed through to asset owners. While this is unlikely to be the case in practice, it is otherwise difficult to derive an estimate of the potential cost.

- **Dis-optimisation cost between CATO and SO.** The costs of potential disoptimisation are difficult to quantify. However, National Grid has shared with us an internal working paper that has sought to estimate the effects of failure to optimise across the SO-TO boundary in respect of network operations in Scotland. We have chosen not to embody this work directly into our CBA, but have instead provided an illustrative off model calculation, which is presented later in this section.

- **Cost/risk of delay:** again, we have developed a framework for considering the cost/risk of delay, but have chosen to present this analysis off model.

- **Cost of transferring the asset to the SO.** We have assumed that this cost relates principally to legal and technical due diligence on the assets. This is a similar activity to that undertaken by OFTO bidders today, although the technical due diligence required in relation to what will then be significantly older assets may be greater. We therefore assume that this cost will equate to around 20% of the CATO assumed bidder costs (i.e. 20% of 125% of £4m). This cost is included in the analysis after the 25 year revenue stream ends.

- **Cost of bidder default.** One way of assessing the cost of a bidder defaulting would be to assume that another tender would need to be held to select a new entity to take on the asset (this could also proxy for the cost of

negotiations with NG to incorporate the assets into the RAB). We have assumed that the risk of the bidder defaulting is 5%, that this happens post construction (the lowest cost of the three default options explored in Section 4), and that a tender analogous to an OFTO tender would be held. The central and bidder tender costs may be in the order of £19m[22]. The expected value of this cost is therefore £1m. We have included this expected cost at the mid-point of the CBA time horizon (i.e. year 15, as there are 29 years after the first year in which the tender is carried out before the asset is transferred to the TO).

Table 6. Late CATO incremental benefits[23]

Benefit	£100m late CATO asset value	£250m late CATO asset value	£500m late CATO asset value
Lower financing costs	£5m	£11m	£23m
Lower investment costs	£2m	£6m	£12m
Lower operating costs	£1m	£4m	£7m

Source: Frontier Economics analysis

- **Lower asset value.** We have assumed that the cost of assets is lower under the CATO model than under the NG project specific regime. We assume that there is a small potential reduction in contractor costs (which are likely to be subject to competitive tendering in both the counterfactual and factual) and a larger reduction in overhead costs (although overhead costs will not be a large proportion of total build costs). Overall we therefore assume that the capital investment in the counterfactual scenario (NG only delivery) is 5% higher than in the late CATO model. To reflect the impact of higher capital investment on customers, we model the implied depreciation associated with capital costs over the 25 year revenue stream, with the residual value accounted for at the end of the revenue stream.

- **Lower financing costs.** For the reasons set out in Section 4, we have assumed that the cost of debt and level of gearing for a Late CATO would

22 This is based on set-up costs of £0.5m (as in the late CATO model), tender costs that are calculated as 1% of the asset value, and bidder costs based on OFTO licensees (i.e. £4m per bidder, and assuming four bidders). The value of £19m is based on an asset value of £250m.

23 This table shows the savings for assets worth £250m and in present value terms.

be the same as that achieved by National Grid in a project specific financing regime. However, we consider that competition in tendering may result in a lower cost of equity being revealed than Ofgem would determine in a bilateral negotiation with NG under the NG only counterfactual. It is clearly difficult, however, to estimate the potential size of this reduction.

In order to make progress in that direction, we have first considered the potential upper and lower bounds.

- It is possible (although perhaps unlikely) that the introduction of competition has no impact, as NG may have the same required cost of equity for any given project as a CATO, and Ofgem may be effective in securing that value for customers. This would, however, require us to contemplate a perfectly effective regulatory revelation process. So while the "in principle" lower bound is 0 bps, we have adopted instead a lower bound of 50 bps.

- To inform a judgement on the potential upper bound, we have considered the range of parameter estimates found in regulatory practice across Europe (note, not in the parameters finally chosen by any given regulatory office, but in respect of the potential range that informs a final judgement). Previous client work has identified a spread of 250 bps between the lowest cost of equity and the highest derived from the spread of parameter values, based on a notional gearing level of 60% for electricity transmission. This difference in potential cost of equity may provide some indication of the maximum potential quantum of saving. Both the high and the low estimate derived are attempts on the part of regulatory offices to infer the "true" cost of equity, which is what any potential investor would seek to do in bidding for a CATO. And the spread of 250 bps is indicative of the range of views that might emerge, between the most "aggressive" and the most "conservative" assumptions. However, while a possible upper bound is therefore 250 bps, to adopt this number would require us to contemplate a wholly ineffective form of regulatory negotiation between Ofgem and NG under our counterfactual. It would also require us to believe that Ofgem's judgements in respect of equity returns are at the top end of conceivable European practice. Neither of these assumptions is reasonable. Just as it seems unreasonable to contemplate an entirely effective regulator, so it seems unreasonable to contemplate one that is both entirely ineffective and setting estimates at the most generous end of possible practice. . We therefore moderate the upper end of range of potential equity savings from 250 bps to 200 bps. In the light of the discussion above, we note that 200 bps may still be regarded as unlikely to be realised in practice (and results in the central estimate of the range equalling a substantial 125 bps), but proceeding with this estimate allows

us to quantify a wide range of possible outcomes, which is not unhelpful in an exercise of this nature.

The table below illustrates the effect of this range of assumptions on the quantum of financing benefit. We show results for the upper and lower bound, and the mid-point of 125 bps (which is the value we have used in our various summary tables).

Table 7. Range in estimated benefits from lower financing costs[24]

Reduction in the cost of equity (bps)	£100m late CATO asset value	£250m late CATO asset value	£500m late CATO asset value
50	£2.7m	£6.8m	£13.5m
125	£4.6m	£11.4m	£22.8m
200	£6.4m	£16.0m	£32.1m

Source: Frontier Economics analysis

This shows that the estimated benefit from lower financing costs ranges from £6.8m to £16.0m, with a central estimate of £11.4m for a project with an asset value of £250m.

For completeness, we note that it is necessary to estimate not only the difference in financing cost between the counterfactual and factual, but also the level of WACC that would apply in the NG only case. This is because we have assumed that the Late CATO model generates lower build costs. Even if we applied the same rate of required return in the factual and counterfactual case, lower build costs would result in a financing cost saving related to the level of the WACC. To illustrate the size of savings, we have assumed that the WACC (vanilla, real) determined for NG under the project specific regime is 50 basis points lower than the RIIO-T1 Ofgem determination, using the real, vanilla WACC.[25] We made this reduction to illustrate the reduction in debt costs that would arise under the counterfactual where, NG would raise project specific finance in present debt markets.

We assume gearing of 60% for the project for the first two years of operation, given its significant construction risk, and 80% for the remainder

24 This table shows present values.

25 Using a vanilla WACC is appropriate as it embodies the post-tax cost of equity, tax benefits are excluded from our analysis as discussed in Section 4 above.

of the 25 years (the lower risk operational phase) and hence calculate the effect of this lower cost of equity on WACC at different stages of the project. We model finance costs throughout the 25 years of the revenue stream. To illustrate this change in gearing, the table below shows the components of the WACC in the late CATO model, based on our central estimate of a 125 bps reduction in post-tax equity returns. For the avoidance of doubt, none of these estimates should be regarded as fully formed and well-justified assessments of the WACCs that may result from the different infrastructure delivery models tested here, but as indicative assumptions developed to aid appraisal of the potential effects of each model.

Table 8. Components of WACC in late CATO

Component	First two years of operation	Remainder of operation
Cost of debt (real)	1.44%	1.44%
Gearing	60%	80%
Cost of equity (post-tax, real)	5.75%	5.75%
WACC (vanilla, real)	3.16%	2.30%

Source: Frontier Economics

- **Lower opex.** We have assumed that opex is 2% of the asset value. This is based on figures from the OFTO regime that are published in the NAO report.[26] We therefore model the difference in opex between the late CATO and NG project specific regimes as a function of the assumed difference in capex.

These incremental costs and benefits were used to calculate the net present value of the late CATO model relative to the counterfactual. In this calculation, the following further assumptions have also been made.

- The construction period is assumed to be three years long.
- The discount rate used is 3.5%, in line with the discount rate used in the Green Book.

26 Para. 3.17

6.2.1 Other non-quantified factors

There are two factors which we have not quantified in this CBA, but for which some assessment of the scale of impact is possible.

Cost/risk of delay

The first relates to the **cost/risk of delay of commissioning**, as discussed in Section 4. The cost of delayed commissioning is difficult to estimate generically. It will be highly project specific. For example, delay to some projects may simply result in higher congestion, and hence a need to run more expensive generation at a resource cost to society. In other cases, delay may result in a failure to connect a single large generator, with that party suffering a large and direct loss in consequence. The consequences of variation in delivery time may be highly asymmetric in such cases: delivery ahead of time may not yield significant benefits if the generator is not also ready to commission, but late delivery may result in substantial harm. We note that, consistent with this risk, offshore wind developers have preferred to construct their own transmission infrastructure in parallel with windfarm build rather than pursue an OFTO Build development model.

Given the case-by-case nature of the potential costs of delay, we have not included a quantification of this item directly in our main CBA results. But below we explore the potential consequences of this important cost item.

We have considered the potential effect of a one-year delay in completing the works necessary to connect a nuclear plant with an assumed asset value of £1bn. We have estimated the cost of such an outcome in two ways:

- By assuming that the costs of running nuclear generation were avoided, but instead that an average efficiency CCGT ran instead[27]. We assume a 3.2 GW nuclear plant running at an 80% load factor with short run marginal costs around £10/MWh is replaced by a gas plant with an SRMC of around £28/MWh. The resulting cost to society would be of the order of £400m per year of delay.
- Alternatively, we consider the loss incurred by the developers of the nuclear plant in the event of a one-year delay. For illustration, we value the loss on the basis of the publicly available information on the Hinkley C CFD strike price (£92.5 per MWh), less the avoided cost of running the station. We also account for the fact that the presumed loss

[27] In reality, different plants would run at different hours of the day to replace the lost nuclear energy. However, we have chosen a mid-range efficiency CCGT to represent the "average" plant which might replace the nuclear energy. In some (low demand, high wind) hours a more efficient CCGT might replace it, and in other (high demand, low wind) hours an older CCGT, a reciprocating engine or even demand response might be used.

in year one would be offset by the receipt of a future year of CFD revenue (i.e. we assume that the start date for the CFD shifts back a year and so does the end date). On this basis, we find the private loss of the developer to be of the order of £1.5bn. Since it is probable that customers would need to compensate the developer accordingly, we consider this to be the most appropriate sum to consider when assessing the risk of delay.

The potential cost of a delay in respect of a large, strategically important generating asset is clearly material, potentially very large indeed. But to proceed to include this item in the model, we would need to speculate as to the increase in likelihood of such a delay occurring that would arise from having a CATO deliver the transmission works rather than NG, which is clearly far from straightforward. Rather than attempt this, we have instead derived the break even increase in likelihood, i.e. the increase in likelihood of delay that would be necessary in order to offset entirely the potential benefits.

- In this example, we have assumed that the cost of the transmission works to support the nuclear plant is £1bn.
- When an asset value of this size is entered into our CBA model, we find net benefits, absent the cost of possible delay of £63m.
- The breakeven increase in likelihood of a one-year delay occurring can then be derived as 4%, based on the private loss of the developer.

For particularly large transmission projects, where major works are required and where local opposition to the development may be more likely, a relatively low increment in probability such as this is of potential concern.

An alternative way to analyse this problem is to consider the possibility that the perception/reality of increased risk of delay may raise the required return on equity of the developer, which, based on a presumption of an open book style process would then translate into an increase in customer bills. Given an assumed £18bn build cost for a new nuclear plant, only a modest effect may be necessary to eliminate the perceived benefits.

- Indicatively, we assume generating plant build costs of £18bn, a depreciation lifetime of 40 years and low gearing (30%).
- We calculate return on equity cash streams consistent with this model and then identify the uplift in required return on equity necessary to eliminate the identified benefits (absent risk of delay) of £63m.

- Based on these assumptions, an increase of slightly less than 4bps in the average project lifetime required return on equity would be necessary to eliminate the benefit of the CATO model.

This analysis suggests that particularly large/strategic transmission investments, where the CATO model may in principle deliver benefits, should be considered carefully to assess the likelihood of delay. Ofgem should also consider carefully the capacity of potential CATOs to deal with "shocks" to planned construction, relative to the capacity of NG. Stakeholder views as to the suitability of certain projects for the deployment of a CATO model, particularly those of the developers of large projects, should be sought.

Cost of disoptimisation, SO-TO

We have described above (in Section 5.2.1) how there is evidence to suggest that CATOs may reduce the overall efficiency with which the transmission grid is operated, owing to the inflexibility created across the SO-TO boundary when the same party is not on both sides, and when incentives for cooperation are imperfect. While it is clearly challenging to quantify the scale of the monetary impact of this disoptimisation, we set out below an indicative calculation in order to provide a feel for the potential cost.

- National Grid's internal working paper has identified a range of actions offered/undertaken by National Grid TO, which bring overall cost reductions when TO-SO is considered jointly. The cost savings resulting from these actions was estimated to be approximately £50m per annum.

- Over the period of analysis, none of the actions offered by National Grid TO were also offered by any other TO.

- This indicates that incremental annual savings of circa £50m may be possible across National Grid's E&W assets from close cooperation across the SO-TO boundary.

- The benefits may be eroded if certain E&W assets are no longer owned by National Grid, but a CATO.

- We assume that the benefits of optimisation arise evenly across the asset base, and that the gross asset value provides a measure of the contribution of any given asset to the total.

- Indicatively, we assume the £50m derives from an asset with net value of £10bn, and gross value of circa £20bn (applying a scaling factor of 2, thereby implying that the National Grid assets are 50% depreciated).

- Using a sample CATO project of size £1bn, these assumptions suggest that optimisation benefits of £1bn *divided by* £20bn *multiplied by* £50m, which is equal to £2.5mn, may be lost per annum.

- This would have a present value, over the envisaged 25 year lifetime of a CATO, of circa £35m.

While this analysis is clearly highly indicative, it does reveal that the costs of disoptimisation across the SO-TO boundary may be material when compared to the scale of benefits (and other costs) identified above. Further and more detailed analysis is needed to ensure that this can inform any final decision taken by Ofgem. If the CATO model is implemented, then this suggests that it may be inappropriate to apply it to assets that are particularly integral to the efficient operation of the main transmission grid.

6.3 Quantitative assessment of CBA 2

The table below provides the results for CBA 2 for three potential counterfactual asset values. The columns highlight the scale of the asset value. We have compared the early and late CATO models under two scenarios. In scenario A we assume that the nature of the project is such that there is little scope for design in innovation. We have modelled this by setting the asset value 2% higher than it is in the late model in this scenario. In scenario B, we assume that the scope for design innovation is greater. We have modelled this by setting the asset value 5% lower than in the late model.

Table 9. Summary quantitative results of CBA 2

Net present value (£m)	£100m late CATO asset value	£250m late CATO asset value	£500m late CATO asset value
Scenario A	-4	-8	-16
Scenario B	3	9	19

Source: Frontier Economics

These results show, as one would anticipate, that the early CATO model only has positive net benefits over the late model in scenarios where there is more significant scope for innovation in design.

In the remainder of this section, we set out the estimates of costs and benefits that lead to this result, and the assumptions that underpin them.

Table 10. Early CATO incremental costs[28]

Cost	£100m late CATO asset value	£250m late CATO asset value	£500m late CATO asset value
Administrative costs – scenario A	£0.8m	£2m	£4m
Administrative costs – scenario B	£0.6m	£2m	£4m
Pre-development costs[29] – scenario A	-£0.4m	-£1m	-£2m
Pre-development costs - scenario B	-£1m	-£3m	-£6m
Financing costs – scenario A	£1m	£3m	£6m
Financing costs – scenario B	-£0.3m	-£0.8m	-£2m

Source: Frontier Economics analysis

- **Ofgem costs.** We have assumed that the Ofgem set-up costs and tender costs in the early CATO model are twice as high as that in the late CATO model. This is because the tender process will be more complex, and in particular there will be more onus on Ofgem scrutinising the range of design and consenting options which are proposed and selecting the option which is better value for customers. Compared to a process involving assessing the approach to delivering a known design, it is likely to include more evaluation effort. We therefore show incremental costs of £3m for an asset value of £250m.

28 This table shows the savings in present value terms.

29 Pre-development costs are assumed to be lower proportion of the asset value in the early CATO model, so this is shown as a cost saving. The saving is greater in scenario B, as the asset value is lower in the early CATO model in that scenario, so the assumed pre-development costs are even lower in absolute terms.

- **Bidder costs.** We assume that the bidder costs will be the same as in the late CATO model. While it could be argued that the bid is more complex as a result of the less defined requirement, it is also the case that bidders are likely to be committing firmly to a smaller quantum of spend, and to less well defined build timelines for the major spend.

- **Pre-development costs.** We have assumed that competition brings about lower costs for pre-development work as well as the potential, in some projects, for a more innovative design. There are also likely to be differences in the way that these costs are accounted for. In the late model, the costs will be incurred by the SO and then are likely to be capitalised through the RAB. However, in the early model a RAB will not have been established when these costs are incurred. As a result it is likely that these costs would be funded by staged payments.

  For appraisal purposes we have assumed that there will be five years of flat expenditure on pre-development work, in both models. We assume pre-development costs in the late CATO counterfactual (undertaken by the SO) will be 15% of the asset value. In contrast, we assume that pre-development costs in the early CATO model are 95% of those in the late model of the asset value. We assume this difference in value also reflects the incremental Ofgem costs in regulating pre-development costs under the late CATO model. We recognise that this approach is not wholly realistic but consider that it provides a reasonable estimate of the quantum of the saving.

  We also note that working capital will be incurred during the pre-development work. We consider that this effect is captured in the assumption that the pre-development costs in the early model are 95% of those in the late model.

- **Financing costs.** For the reasons set out in Section 4, we have assumed that the cost of debt for the early CATO would be the same as that available in the late CATO model. However, there are two reasons why we consider that the cost of equity is likely to be higher under the early CATO model than under the late CATO model:

  - the early model creates additional risk and uncertainty; and
  - construction and operation revenues aren't locked down in the early tender process, which means that less competitive pressure on financing costs will be exerted in the early CATO model.

  To reflect this in the appraisal, we have made a less material reduction (relative to the NG only delivery model used as the counterfactual in CBA 1) in the cost of equity in the early model, than we have in the late model. To put it another way, we have used a higher cost of equity (40 bps higher)

under the early CATO model than we have in the late CATO. We assume gearing of 60% for the project for the first two years of operation, given its significant construction risk, and 80% for the remainder of the 25 years. We have modelled finance costs as being recovered throughout the 25 years of the revenue stream.

Table 11. Early CATO - incremental benefits[30]

Benefit	£100m late CATO asset value	£250m late CATO asset value	£500m late CATO asset value
Capital investment – scenario A	-£0.8m	-£2m	-£4m
Capital investment – scenario B	£2m	£5m	£10m
Opex – scenario A	-£0.5m	-£1m	-£2m
Opex – scenario B	£1m	£3m	£6m

Source: Frontier Economics analysis

- **Capital investment.** We consider two effects in relation to capital investment. The first is that the early CATO model provides for less competitive tension in relation to build costs than the late CATO model. This is because it will not be possible for bidders to commit firmly to a price for the build of an asset which has not yet been designed and consented. Hence, the degree of commitment may be lower, related for example to unit costs (although there may be variations in asset types post-consenting that mean that even this level of commitment is not possible), potentially weakening the extent to which the benefits of competition are felt on construction costs under the early CATO model. The second is that the early CATO model provides for more innovation in design, which could in turn reduce capital costs in the bid phase. Therefore in scenario A (little scope for innovation), we assume that the impact of the loss of competitive tension is greater than the benefit from innovation. As a result we assume

30 This table shows the savings in present value terms. There are cost savings (i.e. benefits) in scenario B as the asset value is assumed to be 5% lower than that in the late CATO model. But these costs are higher in scenario A as the asset value is assumed to be 2% higher than in the late CATO model.

an asset value 2% higher than the late CATO model. In contrast, in scenario B (higher scope for innovation) we assume that the asset value is 5% lower than the late CATO model, as a result of benefits from design innovation outweighing the loss of competitive tension.

- **Opex.** As in CBA 1, we have assumed that opex is 2% of the asset value. As a result, any differences in the asset value will also result in differences in opex.

The costs and benefits were used to calculate the net present value of the early CATO model relative to the counterfactual. In this calculation, the following further assumptions have also been made.

- The pre-development phase is assumed to last five years and the construction period is assumed to be three years long.

- The discount rate used is 3.5%, which is based on the discount rate used in the Green Book.

6.3.1 Other non-quantified factors

As with CBA1, There are a number of factors which we have not quantified in this CBA, but for which some assessment of the scale of impact is possible.

There is again a **higher risk of delay of commissioning.** If anything, since skillsets associated with the management of transmission design, planning and consenting processes are arguably scarcer than those associated with the efficient management of construction processes, the risk to delay of commissioning is greater under an early CATO model.

Similarly, there is also arguably a greater likelihood of incurring a **cost of initiating unrequired work**.

7 Conclusions

While we recognise the uncertainty that attaches to our attempts to appraise the CATO models put forward by Ofgem, we consider that our qualitative and quantitative CBAs, taken together, do provide a reasonable basis on which to draw some initial conclusions. Our initial conclusions are set out below.

- **Ofgem's assessment of the case for CATOs is overly simplistic.**
  - **Its assessment conflates benefits that stem from the introduction of competition with benefits due to changes in the regulatory regime.**
    - Regulatory benefits, which may provide access to lower cost finance, could be realised without the associated costs of introducing competition and should be considered independently.
    - The approach adopted in this report allows the two changes created by the CATO model – the competition effect and the regulatory effect – to be separated out.
  - **Some of the financing benefits identified and expected by Ofgem are an accident of timing.**
    - Project finance is presently cheaper than the 10-year average debt cost that populates the RIIO-T1 model.
    - But since the RIIO model uses an *average* measure of debt costs, at some point in the future project finance debt costs will be comparatively expensive.
    - At this point some of the perceived savings of the CATO model identified by Ofgem will turn into costs.
  - **Ofgem draws heavily on the OFTO experience without adequately accounting for the differences.**
    - Ofgem appeals in particular to the financing cost savings that have arisen owing to the introduction of the OFTO model. However, it is not clear that CATOs will be capable of delivering similar savings, owing to the higher risk that CATOs bear relative to OFTOs.
      - OFTOs bear no construction risk. CATOs may bear full construction risk.
      - OFTOs don't expose financers to a large asset transfer risk at the end of the revenue stream (they are fully depreciated in the

20 year revenue stream). CATOs will have 20/45 ths of value potentially at risk at the end of their revenue stream.

- OFTOs don't involve nearly the same complexity in relation to structuring and evaluating bids, compared to CATOs.

- **Ofgem has not considered or appears to underplay potentially important potential costs and risks.**
  - Ofgem does not consider increased risk of delay or default under the CATO model. CATOs may entail a greater risk of significant delay or default, particularly when responding to low-frequency, high-impact events, where NG will have a depth of resources and experience that no CATO could match. CATOs might therefore not be a sensible choice for particularly critical work.
  - Ofgem fails to account for dis-optimisation between CATOs and the SO, for example due to split incentives and the increasing challenge of effective coordination, which outline our assessment reveals could be material.
  - CATOs may face weaker incentives for good stewardship.

- **There are material administrative costs associated with the late CATO model that could be largely avoided under the NG only model. There are also potentially material costs arising from loss of coordination and scale/scope efficiencies.**
  - **There are fixed costs to running a tender which might outweigh the potential benefits of competition for smaller projects.**
    - Ofgem, DECC and the SO will incur material costs in establishing the CATO regime.
    - There will also be material costs incurred by bidders in participating in each CATO process.
    - These costs would be greatly reduced under the NG only model.
  - **The late CATO model would divide responsibilities among a greater number of parties and is likely to lead to increased transaction costs and the loss of some coordination and scale efficiencies.**
    - Increasing the number of stakeholders increases coordination costs by requiring the creation of additional new interfaces between parties and the monitoring of those interfaces.

Conclusions

- Unless contracts aimed at ensuring cooperation are complete and perfect, some potential coordination efficiencies (e.g. maintenance scheduling/outage planning) are likely to be lost.
- NG enjoys some scale/scope efficiencies associated with building/operating multiple projects (e.g. the ability to flexibly reallocate resources as requirements change). These efficiencies might be lost when the delivery of projects is broken up between several parties (again, absent rather perfect and complete contracts).
- If only a small number of CATOs is contemplated, then something approaching fully efficient coordination may be possible. But it is difficult to see how this could be achieved as more and more CATOs are contemplated.

- **The benefits of competition, though potentially material, are limited in scope.**
  - **Debt costs are unlikely to be lowered by competition (assuming similar risks) so any benefits will come from cost of equity reductions.**
    - While debt costs will be lower under the CATO model than under RIIO-T1, we consider it reasonable to assume that debt costs would be similar under the late CATO model and the NG only model. Competition, in and of itself, is therefore unlikely to lower debt costs.
    - But competition could reveal a lower cost of equity. Equity costs may also be relatively slightly more important for CATOs given the presence of construction risk, which should imply lower gearing than OFTOs for example, although probably only during the construction phase.
  - **Contractor costs are unlikely to change much (although they may reduce slightly), but NG's direct cost might be competed down.**
    - The majority of large infrastructure costs are typically subcontracted. These costs are (by definition) already tendered by NG, and we envisage would continue to be so under the NG only model. Under this model, Ofgem could (and probably would) request tender-backed bids from NG to prevent contractor costs being inflated under that model. CATOs may conceivably reduce these costs through improved procurement (owing to the pressure they would feel from competition), but we would not envisage a step change in costs between the models as both embody some degree of competitive pressure.

- There is scope for benefits arising from efficiencies in the component of cost incurred directly by NG, e.g. project management, which CATOs may deliver at lower cost. The proportionate saving may be greater than that available in respect of contractor costs, but the overall quantum will be less material.

- **Consequently, the late CATO model is only likely to be preferred for large scale projects, where the quantum of potential saving from competition efficiencies is sufficiently large to offset the administrative and other costs**.
  - Our analysis suggests a breakeven point of approx. £260m.
  - However, we have not quantified a number of areas where the Late CATO model may give rise to incremental costs, suggesting that the breakeven project size is higher still.

- **The assessed potential benefits of competition are higher for larger scale projects, as we assume savings proportionate to asset size. However, larger scale projects are also more likely to be more strategically important and the cost of delay arising in these projects will also be greater.**
  - We have not included the value of these delay costs/risk in our quantitative CBA. But we have estimated the approximate scale of these risks to give an indication of the likely impact.
  - For a nuclear plant requiring £1bn of transmission assets, for example, we have found a "breakeven" increase in delay likelihood of 4%.
  - Alternatively, we have estimated that an increase of slightly less than 4 bps in the average project lifetime required return on equity would be necessary to eliminate the benefit of the CATO model.
  - Should Ofgem pursue a CATO model it will need to consider carefully the nature of large projects to assess their delay risk. For particularly critical transmission works, potentially affected stakeholders, who may have significant value at risk, should also be consulted.

- **Early tendering could deliver cost reducing innovation, but at the cost of weaker competitive pressure on actual build costs when compared to the late CATO model. Early CATO is likely to be the preferred model for only a subset of projects therefore.**
  - The early CATO model provides scope for additional innovation in the solution design.

Conclusions

- However, the proposed process engages competitive pressure at a relatively early stage of the development process and fails to lock down fully construction and operation costs at the time of the tender. This potentially enables the winning bidder to have a second go at inflating these costs later, in a one-on-one negotiation with Ofgem that would mirror a typical regulatory process.
- The early model also carries a higher probability that contractual inflexibilities result in costs when work is started but subsequently proves to be unnecessary.
- Whether the early CATO model is overall preferable to the late CATO model will depend on the scope for innovation gains. The early model is only likely to make sense where innovation is plausible, which may only be a small subset of the potentially separable projects.

Annexe 1: Further detail on factuals and counterfactuals

The tables below set out more detail on the four policy options that were identified in Section 3.

Annexe 1: Further detail on factuals and counterfactuals

Table 12. Defining elements of four policy options

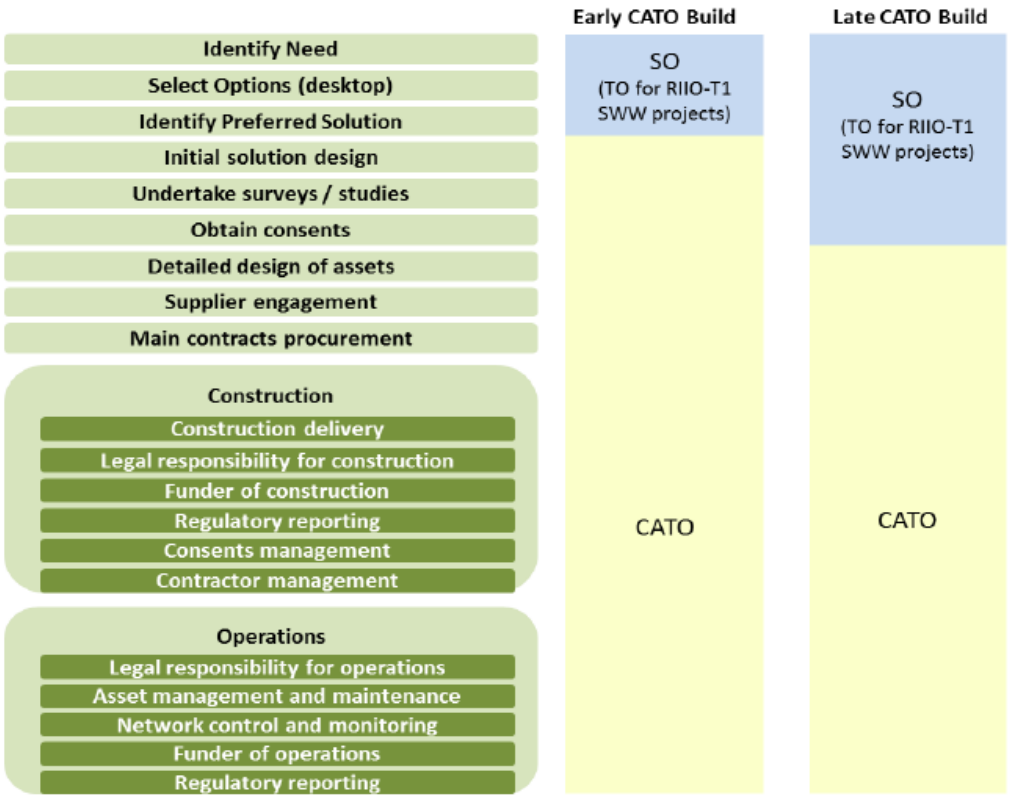
	Competitively Appointed		National Grid	
	Late	**Early**	**Project-specific remuneration**	**RIIO**
Services provided	▫ Late (see **Figure 3**, taken from Ofgem consultation paper)	Late plus: ▫ Initial solution design, ▫ Undertake surveys/studies ▫ Obtain consents Break clause before build	▫ Late (early development always with SO under RIIO)	▫ All
Remuneration framework	▫ Tender revenue stream	▫ First (pre-construction) phase: tendered revenue stream ▫ Second phase: bilaterally negotiated revenue stream	▫ Negotiated revenue stream, based on "open book" view of tendered costs	▫ Building blocks regulation with allowed expenditure set periodically
Determinants of bid/revenue	▫ Capex and Opex ▫ Debt costs ▫ Equity costs	▫ First phase: pre-development costs and risks ▫ Second phase: Capex and Opex, debt costs, equity costs	▫ Capex and Opex (project specific) ▫ Debt costs (specific) ▫ Equity costs (specific)	▫ Regulated return based on parameters set out in regulatory framework
Review	▫ No scheduled review, limited reopeners specified in advance	▫ Review of proposed costs following first phase. ▫ Early bid includes' best indicative cost', fixed unit costs, return on equity and gearing	▫ No scheduled review, limited reopeners specified in advance	▫ Major review every 8 years
Revenue term	▫ 25 years	▫ Staged preliminary funding; 25 years for build and operation	▫ 25 years	▫ 45 years (but 8 year regulatory review)
Cost recovery period	▫ 45-year asset life and cost recovery period ▫ Asset condition requirements at end of revenue term	▫ 45-year asset life and cost recovery period ▫ Asset condition requirements at end of revenue term	▫ 45-year asset life and cost recovery period ▫ Asset condition requirements at end of revenue term	▫ 45-year asset life and cost recovery period

Annexe 1: Further detail on factuals and counterfactuals

	Competitively Appointed		National Grid	
	Late	Early	Project-specific remuneration	RIIO
Refinancing	▫ 50-50 gainshare mechanism for refinancing	▫ 50-50 gainshare mechanism for refinancing	▫ 50-50 gainshare mechanism for refinancing	▫ No gainshare within 8 year review period
New investment	▫ Required to undertake incremental investment up to cap	▫ Required to undertake incremental investment up to cap	▫ Required to undertake incremental investment up to cap	▫ Following regulatory approval, additional investment can be added to RAV
Risk sharing				
Pre-construction cost risk	▫ N/A	▫ Fully borne (limited reopeners)	▫ N/A	▫ Set every 8 years
Construction cost risk	▫ Fully borne (limited reopeners)	▫ Fully borne (following post-tender negotiation and with limited reopeners)	▫ Fully borne (limited reopeners)	▫ Set every 8 years
Inflation	▫ Partial indexation as per bid	▫ Partial indexation as per bid	▫ Partial indexation as per bid	▫ Full RPI indexation
Timing	▫ Revenue stream starts only on completion	▫ Construction and operation stream starts on completion, but pre-construction funding is provided upfront and staged	▫ Revenue stream starts only on completion	▫ Revenue starts with construction
Congestion management	▫ N/A	▫ N/A	▫ SO incentives	▫ SO incentives
Operational performance	▫ Annual availability target with over/underperformance incentives. Penalties capped to 10% of annual revenue.	▫ Annual availability target with over/underperformance incentives. Penalties capped to 10% of annual revenue.	▫ Annual availability target with over/underperformance incentives. Penalties capped to 10% of annual revenue.	▫ Based on energy unserved. Exposure capped to 3% of annual allowed revenue.

Annexe 1: Further detail on factuals and counterfactuals

Figure 3. Services procured under Ofgem's early and late models



Source: Ofgem

Annexe 1: Further detail on factuals and counterfactuals

Annexe 2: Other infrastructure delivery schemes

Thames Tideway Tunnel

The Thames Tideway Tunnel (TTT) is a major new sewer needed to protect the tidal River Thames from pollution. It is a very large infrastructure project, with the scheme expected to cost in excess of £4bn. However, once complete, the project will have very low operational risks (it essentially a tunnel with some pumps). There are however very material construction risks. Construction will begin in 2016 and works are expected to be complete in 2023.

It was decided that the scheme was too large for Thames Water to deliver under standard regulatory arrangements, so separate arrangements have been delivered to oversee its delivery. A competitive process was adopted to identify the party that would build and own the TTT, under modified regulatory arrangements. Bazalgette Tunnel Limited (BTL) was appointed as preferred bidder on 14 August 2015. BTL offered to build and operate the TTT for a WACC (real, vanilla) of 2.497%. According to Ofwat guidance[31] on the project specific licence, the Bid WACC will apply for the period up to and including 31 March 2030. Thereafter, Ofwat has indicated that the project would earn a WACC consistent with Ofwat's standard approach to determining WACC.

The WACC offered by the winning bidder is low by comparison to recent regulatory determinations, but must be considered in the context of the considerable protection from risk (principally construction and regulatory risk) offered by the regulatory arrangements and, in particular, the support package offered by HM Government. Allowed revenues will be based on actual spend. Equity investors will be required to fund at the Bid WACC expenditure up to a pre-identified Threshold Outturn. They have the option to fund expenditure beyond this level, but not the obligation. A detailed agreement is in place to request and secure equity funding from HM Government should build costs exceed expectations[32].

As a consequence of these arrangements, it is reasonable to characterise the construction risk faced by BTL as low. Regulatory risk has also been carefully controlled, with well specified agreements in place to determine the calculation of allowed revenues for at least the period up to 2030.

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31 http://www.ofwat.gov.uk/wp-content/uploads/2015/10/pap_pos20150824baztttlic.pdf

32 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/458822/ttt-contingent-equity-support-agreement.pdf

Gas To The West

In January 2013 the Northern Ireland Executive agreed to award funding to support the extension of the natural gas network in Northern Ireland to five towns in the North West of the province. Following consultation with stakeholders, the Utility Regulator (UR) and the Department of Enterprise Trade and Investment (DETI) decided to create and award two new licences (one high pressure, one low pressure) for the conveyancing of gas to the North West. These licences were awarded through a competitive bidding process. On 11 February 2015 Scotia Gas Networks NI Limited was declared to be the successful bidder for the low pressure licence, and Northern Ireland Energy Holdings Limited was declared to be the successful bidder for the high pressure licence. The overall investment is expected to be of the order of £250m, to construct 200km of pipeline and 500km of gas mains and services. Works are expected to be complete early in 2018.

Bidders did not compete on forecast capex costs (which will be determined by UR and was hard wired into the bid), but primarily on financing costs (WACC, real, pre-tax). Bidders could also enter their own forecast values for Design and Management costs and contingencies, implying competitive pressure on these costs. Bidders were required to bear 35% of construction risk (on "controllable" capex) versus the UR fixed estimate. Additionally, bidders for the low pressure licence also faced an incentive on the volume of connections, thus creating an additional volume risk.

Offshore Transmission Operators

To facilitate investment in offshore wind, the Government and Ofgem have worked together since 2005 to design and implement the regulatory regime for offshore electricity transmission. In March 2007, following a number of prior consultations on different options, Government decided on the overall framework for offshore transmission – a competitive, asset-based regulatory regime.

This was further developed by Government and Ofgem to become an approach whereby multiple parties compete through a tender process to secure licences to build (where appropriate), own and operate offshore transmission assets. This provides the overarching legal and regulatory framework within which investment decisions are taken, and within which policy and regulatory developments occur.

Since the introduction of the 'enduring regime' in early 2012, wind farm developers have had (broadly) two options to construct the offshore transmission asset that will connect their project to the onshore grid.

- to build themselves ('Generator build'); or

- to request an Offshore Transmission Owner (OFTO) to do so ('OFTO build').

If the generators construct the assets themselves (under the 'Generator build' option), then they must transfer the assets to an OFTO post-construction and installation. Regardless then of the party that constructs the assets, an OFTO will ultimately be responsible for the ownership and operation of the assets under long-term licenses. Such licences are obtained through a competitive tender process run by the regulator, Ofgem.

In practice, all existing OFTOs have been developed under the Generator Build model, with bidders competing primarily on the basis of their costs for financing an already existing asset with a known transfer value over a 20 year period. Bidders are exposed to the ongoing availability risk through an availability incentive. Existing OFTOs have therefore faced no construction risk, but only risks associated with owning and operating the network. They are also isolated from any regulatory risk.

Annexe 2: Other infrastructure delivery schemes

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