

Transmission investment for renewable generation

Final proposals

December 2004

288/04

Summary

This document sets out the final proposals for incentive and funding arrangements for transmission investment for renewable generation. It follows an initial proposals paper published in August 2004 and consultation papers published in May 2004 and October 2003.

In response to incentives put in place by the Government substantial volumes of renewable generation plant are now under construction or in planning and it has become clear that investment will be required to reinforce the transmission system, particularly in Scotland and the North of England. No allowance was made for this investment when the transmission price controls were set in 1999 and 2000.

Each of the investment projects put forward by the transmission licensees has been assessed to establish whether it can be justified in terms of reducing the cost of network constraints and transmission losses. This should help ensure that investment is carried out in a timely and efficient manner, which in turn should protect consumers from the costs of stranded assets and lead to charges for generators that are no higher than is necessary. Independent engineering consultants Sinclair Knight Merz (SKM), have assisted with this analysis.

On the basis of this assessment the investment projects put forward by licensees have been classified as follows:

- ◆ Baseline investment – investment projects which appear clearly justified in terms of savings in constraint and other costs. The Beaully to Denny, Sloy, Kendoon and Interconnector reinforcements meet this criteria.
- ◆ Incremental investment – investment projects where there is some uncertainty as to whether they would be justified in terms of savings in constraint and other costs. The reinforcement of the North East of England transmission ring falls into this category.
- ◆ Additional investment – investment projects where there is significant uncertainty and a relatively high probability that the investment could be stranded. The Heysham area reinforcement, Beaully to Keith reinforcement and links to the Scottish Islands fall into this category.

Baseline investment will be funded through the incentive arrangements described in this document. Changes to the analysis made in response to comments on the initial proposals has led to approximately £560 million of investment being categorised as baseline and subject to funding arrangements, compared to approximately £350 million in the initial proposals.

Incremental and additional investment projects can be considered at the next transmission price control review in 2006. Alternately, if power station developers are prepared to commit to suitable longer term charging arrangements then additional investment projects could be added to the baseline.

These final proposals should protect the interests of consumers and allow efficient and timely transmission investment such that renewable generators can access the market in a cost effective fashion, avoiding any undue delays.

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1. Introduction

Purpose

- 1.1. This document sets out the final proposals for the funding of cost effective investment in transmission systems in response to increases in demand from renewable generators. It follows three earlier consultations, including the August 2004 initial proposals¹ to implement an adjustment mechanism to the existing transmission price controls. In reaching these conclusions, Ofgem has taken into account a number of factors, including the analysis of independent engineering consultants Sinclair Knight Merz (SKM) and responses to the August 2004 initial proposals document.
- 1.2. The proposals focus on providing incentives for transmission companies to invest efficiently in response to increased demand from renewable generators for connections to the distribution and transmission networks. They do not seek to provide additional subsidies for renewable generation.

Rationale

- 1.3. Three transmission companies (transmission licensees) operate in Great Britain: the National Grid Company (NGC) which operates in England and Wales; SP Transmission Limited (SPTL) which operates in the South of Scotland and Scottish Hydro Electric Transmission Limited (SHETL) which operates in the North of Scotland.
- 1.4. At the last electricity transmission price control reviews (undertaken in 1999 for SPTL and SHETL and in 2000 for NGC) there was significant uncertainty regarding the likely level and pattern of emerging renewable generation and so it was not practicable to make allowances in the price controls or establish incentive arrangements for any associated investment. Since these price control reviews there has been an increase in the demand for transmission capacity by renewable generators. The increase in renewable generation capacity has arisen

¹ Transmission investment and renewable generation, Ofgem consultation document, 129/03, October 2003
Transmission investment for renewable generation, Ofgem second consultation, 107/04, May 2004
Transmission investment for renewable generation, Ofgem initial proposals, 196/04, August 2004
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in response to obligations placed on electricity suppliers by the Government under the Renewables Obligation Order 2002 and the Renewables Obligation (Scotland) Order 2004 to supply an increasing proportion of electricity from renewable generation or face financial penalties.

- 1.5. A large proportion of the proposed new developments are for wind powered generation in Scotland, connecting to either the distribution or transmission networks. It is likely that significant additional investment in transmission networks will be necessary to allow the efficient connection and operation of these new generating plants.
- 1.6. If the funding of transmission investment is not addressed before the next main price control reviews, the transmission companies may not invest in response to demand. This could delay the connection of new generation to the transmission and distribution networks and/or increase the costs of constraining new or existing generation plant off the system. This would not be in the interests of consumers who would ultimately pay these constraint costs.

Background

Statutory framework

- 1.7. Ofgem is the Office of the Gas and Electricity Markets, which supports the Gas and Electricity Markets Authority (the Authority). The Authority has powers and functions in relation to the regulation of the electricity industry, as set out in the Electricity Act 1989 and the Utilities Act 2000.
- 1.8. The Electricity Act 1989 provides the statutory framework for the licensing regime relating to the generation, transmission, distribution and supply of electricity. The Authority administers this licensing regime and enforces licence conditions.
- 1.9. The Authority's principal objective in carrying out its functions under the Electricity Act is 'to protect the interests of consumers [both existing and future]...wherever appropriate by promoting effective competition....'
- 1.10. The Authority is required to carry out its functions in a manner best calculated to further its principal objective, having regard to the following:

- ◆ the need to secure that all reasonable demands for electricity are met
- ◆ the need to secure that licence holders are able to finance their licensable activities, and
- ◆ the interest of the disabled, chronically sick, those of pensionable age and those with low incomes, and those residing in rural areas.

1.11. Subject to the above, the Authority is also required to carry out its functions in a manner which is best calculated to:

- ◆ promote efficiency and economy on the part of persons authorised by licenses or exemptions to distribute, supply or participate in the transmission of electricity and the efficient use of electricity conveyed by distribution systems
- ◆ protect the public from dangers arising from licensable activities
- ◆ secure a diverse and viable long-term energy supply, and
- ◆ contribute to the achievement of sustainable development.

1.12. The Authority is also required to have regard to the effect on the environment of licensable activities and to any social and environmental guidance issued by the Secretary of State.

1.13. The Energy Act 2004 introduced a further statutory duty for the Authority under which it is required to have regard to the principles of best regulatory practice in carrying out its functions under the Electricity Act 1989. This requires the Authority to consider an approach to regulation that is transparent, accountable, proportionate, consistent, targeted only at cases in which action is needed, and any other principles which appear to the Authority to represent the best regulatory practice.

Price controls

1.14. The transmission and distribution companies' price control arrangements are typically reviewed every five years. At the price control review transmission licensees provide forecasts of capital and operating expenditure over the price

control period, based on expected developments on the network and forecast generation connections, disconnections and demand growth. Ofgem reviews these plans, consults and discusses these forecasts with transmission licensees and then makes proposals. These proposals set out Ofgem's views on the revenues required by each transmission licensee to finance efficient levels of capital and operating expenditure for the next five years. Finally, modifications are made to each company's licence, to specify the amount of revenues the companies are allowed to recover.

- 1.15. As noted in the rationale, when the present price controls were set there was insufficient information available to make allowances for transmission investment for renewable generation. These final proposals will put in place a funding mechanism to address the increased demand for renewable generation.
- 1.16. Price controls provide strong incentives for transmission licensees to reduce costs. There are a number of measures in place at present, including security standards and the monitoring of quality of service performance, designed to ensure that quality of supply is not jeopardised. Over time it will be appropriate to consider the development of a wider range of output measures and incentive arrangements to improve incentives for efficiency and quality.

Initial proposals

- 1.17. The initial proposals noted that Ofgem would consider developing incentives which would:
 - ◆ establish output measures to assist in judging whether capital expenditure is efficient
 - ◆ where appropriate establish output measures as a revenue driver, or as part of an incentive scheme, so that the level of allowed revenue could be adjusted for changes in the specified output
 - ◆ develop incentives that encourage licensees to invest in a timely manner to meet the needs of their customers
 - ◆ provide financial incentives on licenses to minimise any interruptions in supply, and

- ◆ ensure that system users face cost reflective charges and consider whether system users should signal present and future demands through their willingness to pay for access and use of the network.

BETTA

- 1.18. BETTA will introduce new GB wide transmission and trading arrangements. The planned implementation date is 1 April 2005. Adjustments to the transmission licensees' price controls will be made to reflect the new system operator role for NGC and the transmission owner roles for SPTL and SHETL. A new code has been developed to provide co ordination between the System Operator and Transmission licensees.²
- 1.19. Since the transmission infrastructure related to renewable generation spans all three transmission licensees the development of adjustments to the price controls to allow for this expenditure is being coordinated separately from the above price control work. These proposals for transmission investment for renewable generation are additional to any adjustments for BETTA. Measures will be developed to ensure that no double counting of investment takes place between the various strands of work on price controls, in order to ensure that consumers do not pay twice for investment.

² System Operator Transmission Asset Owner code (STC) as implemented in September 2004. The full designation notice can be found at:

http://www.ofgem.gov.uk/temp/ofgem/cache/cmsattach/8559_3_Notice_designating_the_STC.pdf

Offshore wind

- 1.20. The Government has announced that it will introduce a new regulatory regime for offshore transmission and offshore distribution. The Energy Act 2004 contains provisions to allow the Secretary of State to modify the licensing regime for the purposes connected with offshore transmission and offshore distribution.
- 1.21. The development of offshore wind generation is likely to have implications for transmission system investment, although the extent and timing of the demand for additional investment is not yet fully clear. Ofgem and DTI are working on these issues and will consult on these matters in 2005.

Impact assessment

- 1.22. Ofgem's draft impact assessment (IA), published in the August 2004 initial proposals, considered the costs and benefits of the incentive arrangements for transmission investment for renewable generation. The assessment was carried out pursuant to section 5A of the Utilities Act 2000 (as amended by the Sustainable Energy Act 2003).
- 1.23. Appendix 1 of this document updates the estimates of the costs and benefits of the investment projects underlying these proposals. Nevertheless, the broad conclusions of the draft IA remain valid; it is better to act now to encourage efficient investment rather than do nothing until the next price control reviews.

Structure of the document

- 1.24. This document includes the following chapters:
- ◆ Chapter 2 provides an overview of respondents' views to the initial proposals
 - ◆ Chapter 3 explains the methodology which Ofgem has used to assess efficient investment
 - ◆ Chapter 4 sets out the incentive arrangements and adjustment mechanism for the funding of transmission investment for renewable generation

- ◆ Appendix 1 contains an updated impact assessment
- ◆ Appendix 2 sets out Ofgem's conclusions on double counting, security standards, the distributional effects of the final proposals in relation to transmission charges
- ◆ Appendix 3 sets out projections of costs and revenues for the baseline projects
- ◆ Appendix 4 provides information on ROC prices
- ◆ Appendix 5 sets out the licensees' forecasts of connection activity

Way forward

- 1.25. Ofgem intends to consult on the draft licence modifications necessary to implement the proposals for baseline investment in early 2005. Final proposals to modify the transmission licences should follow between February and April 2005 in conjunction with the licence consultations being undertaken for the introduction of. Should a licensee reject the transmission investment for renewable generation licence modification, it would be necessary to consider referring these matters to the Competition Commission for determination.
- 1.26. Subject to consultation the price control adjustment mechanism would be effective in the transmission licences from 1 April 2005.
- 1.27. If you would like to discuss the issues raised in this document please contact Tolani Azeez (020 7901 7043), Ayesha Uvais (020 7901 7307) or Mariusz Hubski (020 7901 7051).

2. Respondents' views

- 2.1. This chapter provides a brief summary of the 20 responses to Ofgem's August 2004 initial proposals document. All non confidential responses are available on Ofgem's website at www.ofgem.gov.uk³.
- 2.2. The August 2004 initial proposals document sought views on any aspect of the initial proposals and in particular on:
- ◆ the estimates of the level of renewable generation likely to connect
 - ◆ the appropriate levels and values of constraint costs
 - ◆ the assessment and classification of investment projects
 - ◆ the review of GB wide transmission security standards
 - ◆ whether it is appropriate to separately identify baseline, incremental and additional investment projects
 - ◆ the incentives associated with each category of investment
 - ◆ whether network capacity is an appropriate output for baseline investment and whether generator connections are an appropriate revenue driver for additional investment
 - ◆ whether the revenue allowances should be calculated for baseline network capacity in terms of assumptions on regulatory depreciation and the cost of capital
 - ◆ whether additional rewards should be provided if transmission licensees are able to provide outputs beyond those envisaged in the baseline, and
 - ◆ whether a process for reviewing investment projects in the future to ensure that, if necessary, they are moved to a different category, is appropriate.

³ Full responses can be located at http://www.ofgem.gov.uk/ofgem/work/index.jsp?section=/areasofwork/monopolypricecontrols&levelids=,1_8008#top8008

- 2.3. Respondents provided views on a number of the issues set out above and in particular on the wind generation capacity factor estimated by SKM, investment in transmission connections for the Scottish Islands, long term charging arrangements and deep connection charges, locational transmission charging, diversity of supply and the Government's targets for renewable energy.
- 2.4. This chapter focuses on the issues most commented on by respondents. The views expressed were broadly associated with the criteria for assessing reinforcement proposals, (such as the constraint cost values and classification of projects), the incentive arrangements for the three categories of investment (including the incentives associated with each investment category, the output measures for baseline and additional capacity, the assumptions on cost of capital for baseline investment and the process for moving investment projects between different categories) and the wind generation capacity factor estimated by SKM.

Assessing reinforcement proposals

August 2004 initial proposals

- 2.5. Ofgem appointed SKM (engineering consultants) to assist in the technical and economic evaluation of the reinforcement proposals put forward by each licensee. The assessment informed the initial proposals set out in the August 2004 initial proposals document.
- 2.6. SKM's analysis compared the capitalised cost of each investment project with the capitalised savings in constraint costs and transmission losses that would be associated with the investment.
- 2.7. For conventional generation SKM proposed that costs should be assessed based on the difference in marginal fuel costs between constrained and replacement generation. However, they noted that constraint costs could also be based on market prices, which SKM estimated as the difference between system buy price and system sell price in the NETA balancing mechanism.
- 2.8. For renewable generation, SKM's proposed value of constraint costs included the Renewable Obligation Certificate (ROC) buy out price and the fuel saving for a conventional replacement generator.

2.9. On the basis of this assessment of the costs and benefits of each project, Ofgem suggested that each of the investment proposals should be categorised as one of the following:

- ◆ **Baseline investment** – for investments where SKM’s analysis indicated that the savings in constraint costs would be greater than investment costs.
- ◆ **Incremental investment** – for investments where constraint costs appeared to be substantial but there was uncertainty as to whether they would be greater than the investment required to relieve the constraints, or where it may be more efficient to delay the project.
- ◆ **Additional investment** – for investments where SKM’s analysis indicated that constraint costs were likely to be lower than investment costs and/or there appeared to be a significant risk of stranded assets.

Respondents’ views

- 2.10. In broad terms transmission licensees said that it would be appropriate to take account of market based indicators in establishing the cost of constraints. Licensees provided detailed information on what they considered were realistic estimates of constraint costs. In general these were significantly higher than the estimates underlying SKM’s analysis.
- 2.11. In particular respondents considered that the value of constraining renewable generation should include the market price for ROCs rather than the buy out price. One respondent considered that this valuation should also take account of exemption from the Climate Change Levy (CCL). It argued that the valuation should reflect the possibility that ROC prices may fall in the future and that the renewable obligations currently provide support until 2027.
- 2.12. A number of respondents said that the cost of constraining conventional generators would be more than the marginal difference in fuel costs of power stations and that generators would seek to recover a contribution to their fixed costs for providing replacement energy.

- 2.13. While the large majority of respondents supported the classification of projects as baseline, incremental and additional, a number of respondents did not agree with the initial allocation of projects within the three classifications. Several respondents considered that using different assumptions for constraint costs, such as market-based prices, would suggest a different classification for certain projects.
- 2.14. A number of respondents expressed concern that the Scottish Islands connection proposals would be treated as additional investment. These respondents considered that this would not promote the development of renewable energy on the Islands and that this could hinder achievement of the Government's renewable energy target. Some of these respondents suggested that the development of renewable energy sources and the necessary transmission reinforcement on the Scottish Islands would be economically viable.
- 2.15. Other respondents expressed concern about the costs of additional transmission investment and the associated risk of stranded assets would lead to higher costs for system users and consumers.

Ofgem's views

- 2.16. In the light of respondents' views supporting the classification of projects between baseline, incremental and additional, Ofgem has retained this approach. These matters are discussed in more detail in chapter 4.
- 2.17. Additionally, there appears to be strength in arguments that projections of constraint costs should be brought more clearly into line with market based indicators of these costs. Chapter 3 deals with these matters along with other changes to the allocation of individual projects to each investment category.
- 2.18. Ofgem notes respondents' concerns that links to the Scottish Islands have been classified as additional investment. It is clear from the relatively large number of wind generation projects, either operating or under construction, that wind generation is economic at suitable onshore locations in Scotland. The situation on the Scottish Islands is more uncertain. While some respondents said their projections indicated that investment would be economic, other respondents expressed concern that transmission investment for renewable generation could lead to stranded assets and additional costs for system users and consumers.

- 2.19. The best approach to resolving these uncertainties would require potential developers of wind generation to make a financial commitment to pay future transmission charges and so leave these projects as additional investment. This should help ensure that only projects that have proper financial backing and are economic would proceed, which would in turn reduce the probability of stranded transmission assets and extra costs for consumers. The detail of these arrangements is discussed in chapter 4.

Incentive arrangements

August 2004 document proposals

- 2.20. The August 2004 initial proposals document proposed the incentive and funding arrangements that could be associated with each category of investment. Ofgem proposed a revenue allowance for baseline investment and a revenue allowance for the recovery of pre-construction costs for incremental capacity.
- 2.21. For additional investment Ofgem suggested two options for funding these proposals to ensure that consumers are protected against the risk of potentially funding stranded assets. It was proposed that either the investment could be funded by a revenue driver based on additional generation connections or commercial arrangements could require the generator(s) to guarantee or underwrite payment of transmission charges in the longer term.

Respondents' views

- 2.22. Transmission licensees suggested that the return and depreciation allowances proposed for the baseline investment should be increased and that the rate of return during construction should be based on the weighted average cost of capital rather than the cost of debt. Licensees also noted that any output measures would need to be carefully defined so that they were matters over which they had control, such as the capacity of the network reinforcement projects.
- 2.23. A number of respondents suggested that the costs of design and pre-construction work for incremental and additional projects should be funded by price control allowances.

- 2.24. Some respondents considered that the additional investment option needed further development and clarity. Others expressed concern that long term charging arrangements would resemble deep connection charges. Transmission licensees rejected an incentive mechanism based on a revenue driver saying that the licensees would be unable to control the level of connections. One respondent considered that the revenue driver could distort incentives for transmission licensees with affiliated generation businesses.

Ofgem's views

- 2.25. The assumptions on the cost of capital and interest during construction have been aligned with those used in extensions to the Scottish Transmission price controls. The allowances for depreciation are consistent with the main price controls. Licensees arguments that shorter depreciation periods would be appropriate, may have some force, but it would be more appropriate to consider these matters at the next price control reviews rather than as part of this project. These matters are discussed in more detail in chapter 4.
- 2.26. As the majority of new projects in the final proposals are now classified as baseline rather than incremental, there seems less of a case for additional allowances for development and pre-construction costs. These matters are discussed further in chapter 4.
- 2.27. Arrangements for long term charging are also discussed in chapter 4. In the light of comments from licensees on revenue drivers, Ofgem has decided not to pursue this option.

Wind generation capacity credit

SKM's report

- 2.28. SKM's analysis included an estimate for the wind generation capacity credit factor of 20 per cent, which relates to the level of wind that can reasonable be relied on to secure demand on the transmission system.

Respondents' views

- 2.29. Some respondents noted SKM's assessment of the capacity credit for wind generation but considered that it did not align with previous studies which suggested an appropriate factor of 60 per cent. Respondents also expressed concern regarding the impact this could have on the classification of investment proposals. Some respondents proposed that a further independent assessment would be appropriate to consider the effect of wind generation on system security.

Ofgem's view

- 2.30. Ofgem considers that it will be appropriate to review the current transmission network security planning and operating standards in light of increased renewable generation and network developments, but does not propose to undertake such work as part of this project.
- 2.31. The concerns over the use of this capacity credit factor for wind generation, appear to be misplaced. It is not used to calculate whether network reinforcement is required to support additional generation. It is used as a supporting check to test whether the flows on the network consistent with the growth in renewable generation are such as require additional investment to support end user demand in Scotland. Therefore, a lower capacity credit factor tends to lead to more investment and not less. Ofgem is content that the 20 per cent factor used by SKM represents a prudent view of wind capability given the information presently available.

3. Assessing efficient investment

Introduction

- 3.1. This chapter sets out Ofgem's assessment of the transmission reinforcement projects that have been put forward by transmission licensees in response to increases in the level of renewable generation in Scotland. It includes:
- ◆ a description of the method for assessing whether it is cost effective and efficient to invest in the transmission system
 - ◆ forecast levels of new generation
 - ◆ a discussion of likely future levels of constraint costs, and
 - ◆ an assessment of each transmission reinforcement project.

Assessing investment

- 3.2. There is growing demand for access to the transmission system from renewable generators. Provided that these generators are willing to pay cost reflective transmission charges then they should be able to the transmission network and receive compensation if network constraints restrict access.
- 3.3. In order to plan its network the transmission company needs to estimate the likely future pattern of flows on the network. These flows on the network will depend (inter alia) on the commercial decisions of existing and any new generators. In establishing whether any new generation is likely to arrive it is appropriate to check that it appears economic to provide network investment with generators paying cost reflective transmission charges. In practice the scope for new generation is also constrained by the need for new stations to obtain planning permission, financing and suitable contractual arrangements with suppliers. Therefore in considering the likely pattern of flows on the transmission system, it is also appropriate to consider how much generation has received planning permission and is under construction.

- 3.4. Once these projections have been made it is appropriate to consider whether any network reinforcement is efficient. In deciding on network reinforcement it is sensible to consider this in terms of minimising the total costs of transmission to system users. These costs include network constraints, investment costs and losses.

Forecast levels of new generation

- 3.5. The Renewable Obligation Orders are creating significant demand for renewable generation and the market has reacted by bringing forward proposals for new renewable plant. A large proportion of these proposed new developments are for wind-powered generation in Scotland.
- 3.6. SKM reviewed the transmission licensees' assumptions and analysis regarding the likely level and location of new connections for renewable generators. These assumptions were largely based on connection activity (such as the capacity of wind generation already connected, the capacity under construction, connection applications and expressions of interest from developers) in each licensee's geographic area.
- 3.7. The August 2004 initial proposals were based on SKM's estimate of about 4 GW of wind generation connecting in Scotland by 2010 and a further 0.5 GW in the North-West of England. These projections are subject to significant uncertainty and SKM suggested a plausible range of +/- 1 GW around their 4.5 GW central estimate.
- 3.8. Ofgem asked the transmission licensees to provide updated details on current connection activity in their areas to ensure that the assessments in this study remain relevant. The aggregate results are shown in Figure 1 and Figure 2 below.

Figure 1: Total of licensees' forecasts of wind generation in Scotland⁴

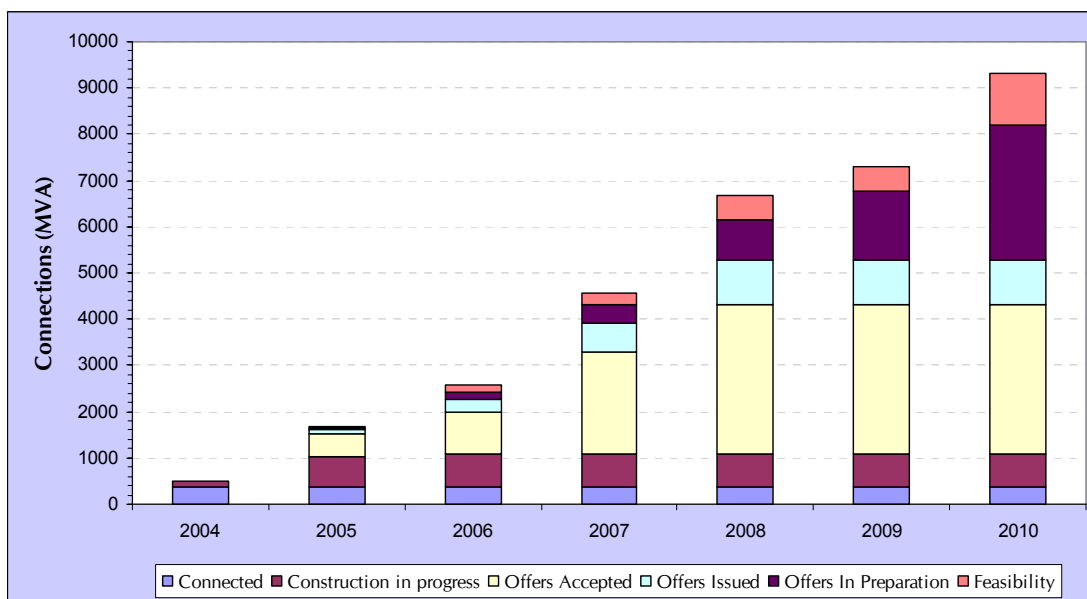
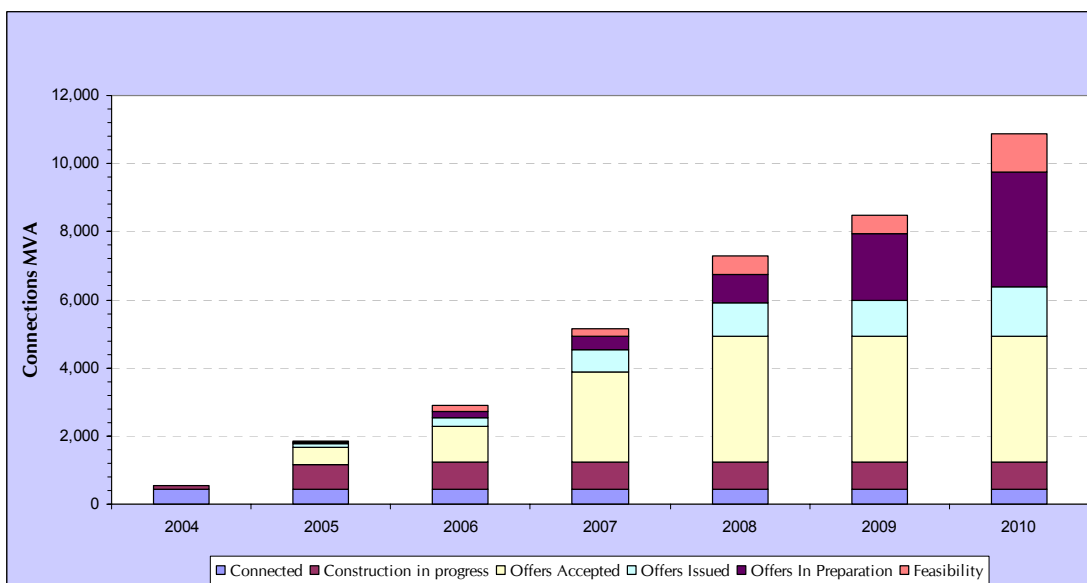


Figure 2: Licensees' forecast connection activity - Scotland and northern England



3.9. As part of initial proposals, the licensees' forecasts totalled to around 7 GW of additional capacity could connect in Scotland by 2010. Of this, SKM assessed that around 4 (± 1) GW would connect by 2010. The revised forecasts by licensees show that in aggregate, connections in Scotland could be up to 9 GW. These revised projections also show that many projects have moved from the *feasibility* and *offers in preparation* stage to *offers issued* or *offers accepted*.

⁴ Additional information in Appendix 5
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- 3.10. In the light of these increases in connection activity, it appears that SKM's higher case projection of 5GW may be feasible by 2010 or shortly afterwards. Nevertheless, downside risks such as difficulties with planning consents remain.
- 3.11. As part of assessing how much wind generation might connect, it is instructive to consider the underlying economics of wind generation given the present level of ROC subsidies. Typical revenue for a wind generator may be around £170/kW, assuming a 30 per cent load factor, £40/MWh for ROCs and £25/MWh for energy. Typical annualised capital costs would be around £85/kW (£650/kW annualised over 15 years at ten per cent), operating costs of around £10-25/kW and cost reflective transmission charges in the range £20/kW to £30/kW. This gives total costs (including a return on capital) of up to £140/kW compared to revenue of £170/kW. On this basis it is clear that given the present level of ROCs that wind generation is economic on mainland Scotland. Provided wind generators can continue to obtain planning consent it is likely that new wind generation projects will continue to be developed.

Constraint costs

- 3.12. Network constraints could increase if new generation connects to the existing transmission system without associated network reinforcement. This would result in increased constraint management costs for the system operator and ultimately consumers.
- 3.13. The costs of upgrading the transmission system should be compared with the annual savings in reduced constraint costs. Respondents to the initial proposals generally supported a market-based approach to evaluating the cost of constraints. There was also agreement that different constraint costs should be used depending on which type of generation would be constrained off the system.
- 3.14. The transmission licensees put forward constraint cost values ranging from £25-85/MWh based on their estimates of likely bids and offers in the balancing mechanism and the opportunity cost of generators willing to be constrained off the system. SKM based their analysis on costs of £1-10/MWh for conventional generators and £45/MWh for renewable generators.

3.15. In deciding on the appropriate value of constraint costs Ofgem has carefully considered the views of respondents, forecasts of the commercial behaviour of generating stations, as well as market based forward prices (although these are typically available only for three years ahead, whereas the analysis of constraint costs matches the 40 year expected assets lives). Under the electricity trading arrangements, NGC addresses system constraints by instructing constrained generators not to generate and replaces this energy by buying it from generators not subject to constraints. The cost of constraining off a generator will depend on its bids into the balancing mechanism and NGC is incentivised to minimise these costs by accepting the lowest bids from available generators. Generally, NGC can buy replacement energy at market-based prices. Projections of a combination of these costs can be used to guide investment decisions.

3.16. This approach suggests the following constraint costs:

- ◆ In broad terms a **renewable generator** eligible for ROCs and subject to a transmission constraint would be expected to cost the system operator the value of the ROC plus replacement generation (i.e. the renewable generator would bid into the balancing mechanism to recover its lost profit and the system operator would need to schedule replacement generation to make up for the shortfall in energy). This translates into £40-45/MWh (the value of the ROC plus the value of the exemption from the climate change levy minus the proportion of these values that tend to be retained by suppliers) plus £25-30/MWh (an estimate of the cost of replacement generation) to give a range **£65-75/MWh**. After 2027 it is assumed that ROCs fall away and are replaced by a scheme which funds the social cost of carbon (estimated at £7/MWh), giving a range **£32-37/MWh**.
- ◆ **Other renewable generators** would cost in the range **£25-33/MWh** depending on their entitlement to subsidy, as above it is assumed that this increases to **£32-37/MWh** after 2027. Plant in this category would for example include a number of larger hydro stations that are not eligible for ROCs (built pre 1990) and renewable stations built under the Non Fossil Fuel Obligation arrangements.

- ◆ constraint costs for **conventional generators** are based on estimates of the costs of providing the additional generation capacity that is required when generation is subject to transmission constraints. A conventional generator subject to a constraint typically saves fuel costs and should reflect this in its bid into the balancing mechanism, the system operator also needs to schedule replacement energy, giving a net cost to the system operator that would relate to the cost of providing additional capacity. This is broadly equivalent to the difference between forward fuel and electricity prices (for gas this is called the spark spread and for coal the dark spread) with forward prices presently giving a range of **£10-15/MWh**.

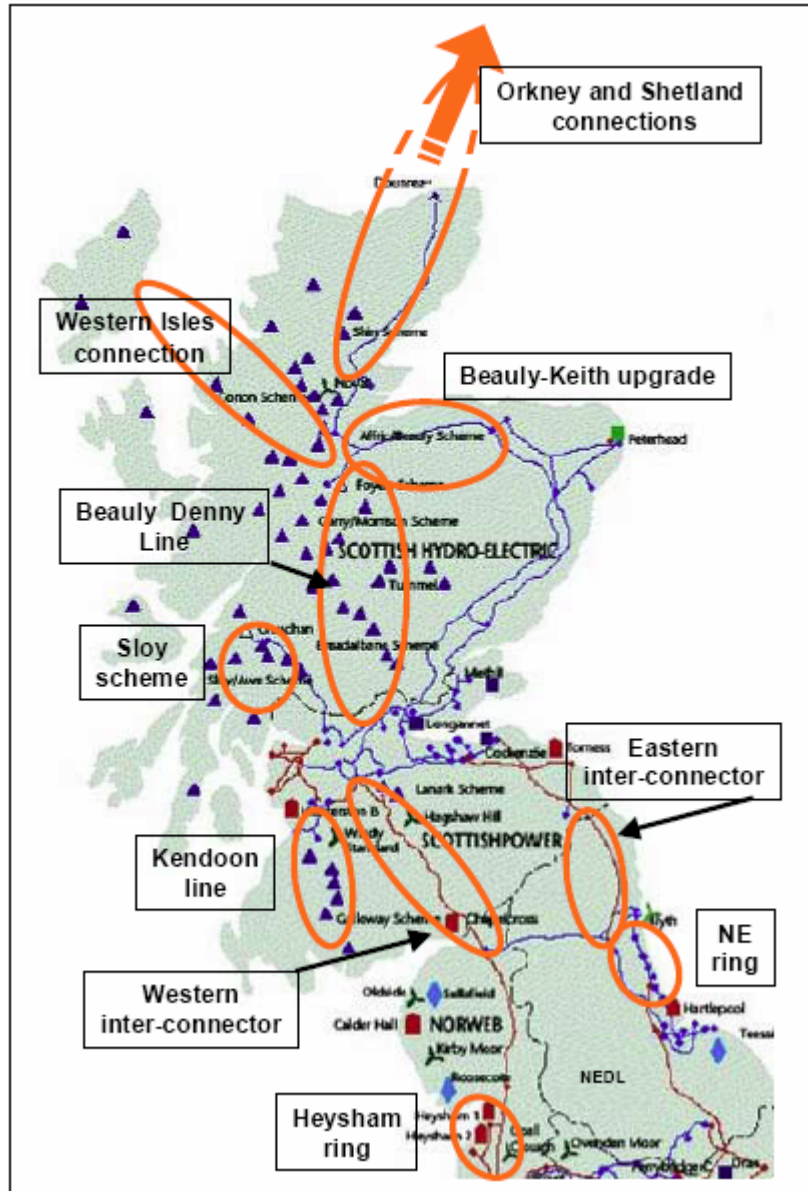
3.17. The reduction in transmission losses where network investment upgrades are undertaken is valued at the market-based price for replacement energy (£25-30/MWh).

Impact on investment proposals

3.18. In May 2004 the transmission licensees brought forward eight investment projects to reinforce the transmission network across Scotland and the North of England (see Figure 3). SKM reviewed the engineering design, cost, impact on constraint costs and transmission losses of each investment project. Their draft report is available on Ofgem's website⁵.

⁵ Technical Evaluation of Transmission Network Reinforcement Expenditure Proposals by Licensees in Great Britain – Draft report, Sinclair Knight Merz, August 2004.
http://www.ofgem.gov.uk/temp/ofgem/cache/cmsattach/8259_19604_tirg_skmreport.pdf
Transmission investment for renewable generation - final proposals
Office of Gas and Electricity Markets

Figure 3: Transmission licensees' investment proposals (Source: SKM report 2004).



3.19. This section summarises and updates SKM's work for each investment proposal.

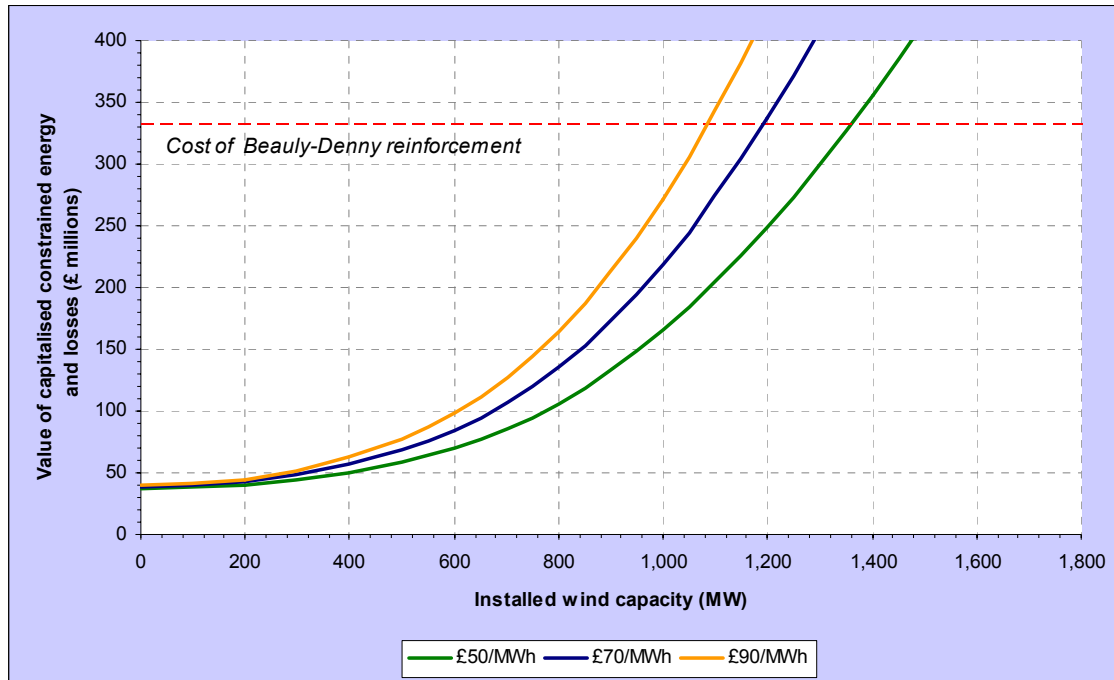
Beauly-Denny

3.20. SHETL and SPTL proposed reinforcing the transmission system in Scotland using a 400 kV construction between Beauly and Denny (near Bonnybridge) along a similar route to the existing 132 kV tower line. Over 1900 MW of quotes for wind generation connection have been issued in the area north of Beauly. SKM has estimated that a significant proportion of the connection offers will be accepted and

the associated generation will connect to the transmission system. The estimated project costs are £332 million.

- 3.21. Figure 4 shows the savings in constraint costs and transmission losses, and, compares these with the costs of the Beaulieu-Denny reinforcement. The appropriate constraint costs are relatively high because only renewable generation can be constrained off north of Beaulieu. SKM's central estimate is that around 1.5 GW of new generation will connect in this area. As this project becomes cost effective with around 1.2 GW of wind generation it is proposed to classify this project as baseline investment.
- 3.22. Constraint costs associated with the Beaulieu-Denny reinforcement could be affected by the operation of the existing pump storage station at Foyers. Constraints on wind generators could be reduced by the use of pump storage. Nevertheless, some of the capacity at Foyers is presently used to provide important system support services and the capacity of the upper reservoir is limited. SKM's updated analysis has indicated that Foyers could be expected to make a difference of only around 100 MW to the level of wind generation shown in Figure 3 as being needed to justify the Beaulieu-Denny reinforcement.

Figure 4: Comparison of capitalised saving in constraint and investment costs for the Beauly - Denny project for constrained energy costs between £50-90/MWh.



Scotland-England interconnector

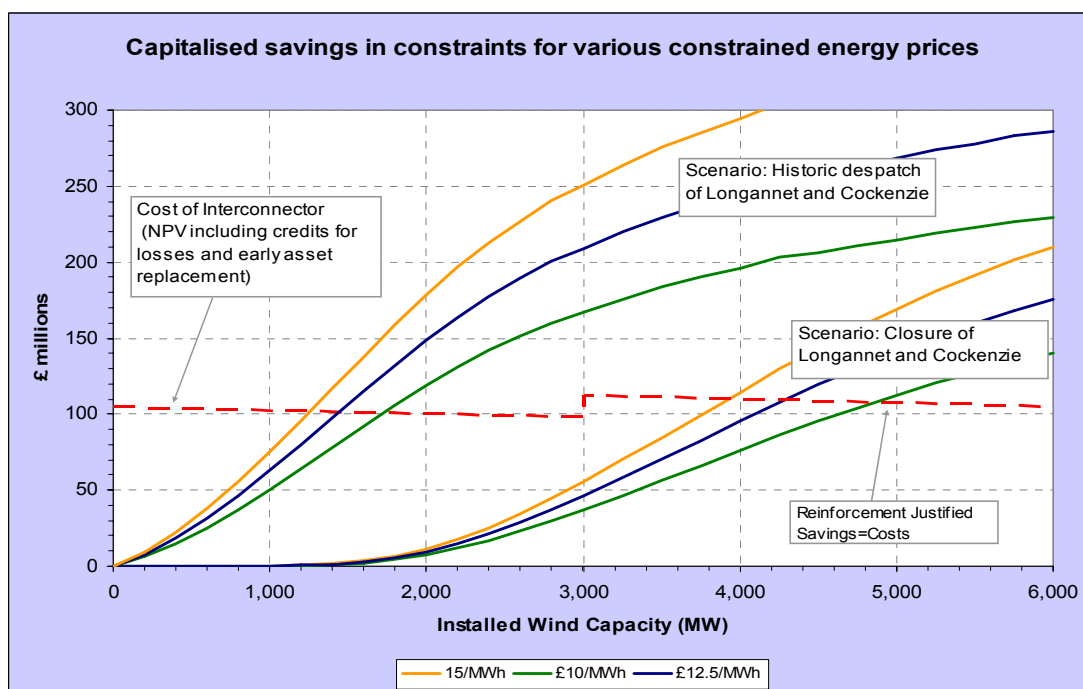
3.23. The Scotland-England interconnector involves reinforcing the transmission circuits in the west and east of Great Britain that link together the electricity transmission systems in Scotland and the north of England. The original project put forward by licensees bundled this work together with the North East ring project. SKM concluded that there was merit in considering these projects separately. The cost of the interconnector reinforcement was estimated by licensees at £152 million. SKM's assessment was that this was a reasonable forecast of the likely costs. Current project cost estimates are between £158 million and £168 million as a result of additional requirements to undertake an extensible development at Elvanfoot to accommodate rail infrastructure, representing an increase of £16.million above the original estimates.

3.24. For the interconnector, the analysis of the likely savings in constraint costs is particularly sensitive to the assumptions about how the existing conventional power stations in Scotland will be operated. Figure 5 compares project and constraint costs assuming that the two main conventional power stations, Longannet and Cockenzie, either close (or operate only when wind generation is

idle) or continue to operate according to their historical pattern of outputs. Any long-term decommissioning plans for nuclear plant at Hunterston, Torness or Chapelcross would be likely to produce similar results to closing conventional capacity, i.e. a reduction in flows across the interconnector and a reduction in constraint costs.

3.25. The scenarios shown in Figure 5 represent plausible low and high cases for constraint costs. In the historical despatch scenario constraint costs are high and interconnector reinforcement is clearly justified. In the other scenario, with no output coming from Longannet and Cockszie, the interconnector reinforcement would only be cost effective with about 4 GW to 5 GW of wind generation in Scotland. This is broadly consistent with SKM's estimates and so it is proposed to classify this project as baseline investment.

Figure 5: Comparison of capitalised saving in constraint and investment costs for the interconnector project⁶



3.26. An important assumption with respect to the interconnector project is its dependence on the Beauldy-Denny project (which might be delayed in the planning process). The increasing energy flows that would be provided for by

⁶ For constrained energy costs between £10-15/MWh. Two scenarios are presented: historical despatch or closure of the conventional power station Longannet and Cockszie.
Transmission investment for renewable generation - final proposals
Office of Gas and Electricity Markets 24 December 2004

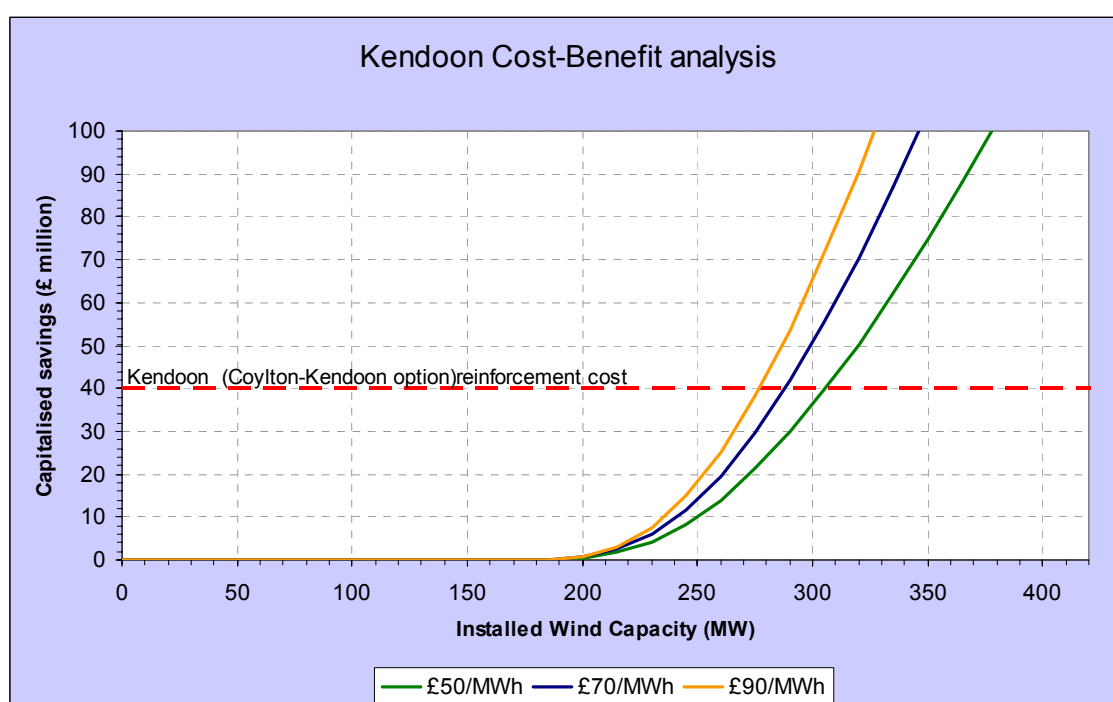
the Beaully-Denny project contribute toward the constraint costs associated with the interconnector. If Beaully-Denny were not to get planning consent then the economics of the interconnector reinforcement could be undermined. On this basis it would be prudent only to make funding available for the interconnector if the Beaully-Denny reinforcement receives planning consent or if requests for transmission connections in the West of Scotland trigger the need for substantial work on the western circuit of the interconnector.

Kendoon reinforcements

- 3.27. SPTL's initial proposal set out plans to construct a 400 kV line from Kilmarnock South to Kendoon to provide infrastructure for wind developments in south west Scotland and as infrastructure support for the provision of a third interconnector between Scotland and England via Galloway.
- 3.28. In its draft report SKM recommended that the Kendoon reinforcement project as specified by SPTL could be ahead of need and could result in stranded assets. Following this, SPTL submitted an alternative investment proposal for reinforcement work, highlighting existing system constraints on wind farm output on the Coylton-Maybole-Kendoon 132kV circuit, together with revised applications or interest from developers for connections in this part of south western Scotland.
- 3.29. SPTL's updated information shows that:
- ◆ a further 142MW of offers have either been issued or are in preparation and that three further wind developments are in prospect, taking total connections to around 519 MW. SKM originally estimated that 350 MW of new connections would be required as a break even point for the investment to be cost effective
 - ◆ a scaled down upgrade proposal would only develop new network infrastructure between Coylton and Kendoon but would deliver an additional 240 MVA of firm and 480 MVA of non firm capacity, and
 - ◆ there would be potential to connect up to 1320 MVA of additional capacity in incremental stages in the future.

3.30. As a result, the Kendoon project was scaled down from £90 million to £40 million. Figure 6 shows the savings in capitalised constraint costs (these are relatively expensive as only renewable generators would be subject to these constraints) compared to the cost of the investment. SKM estimated that there could be 300 MW of new wind generation connections in this area, compared to an updated break even point of approximately 280 MW, based on updated information from SPTL. On this basis the project has been classified as baseline investment.

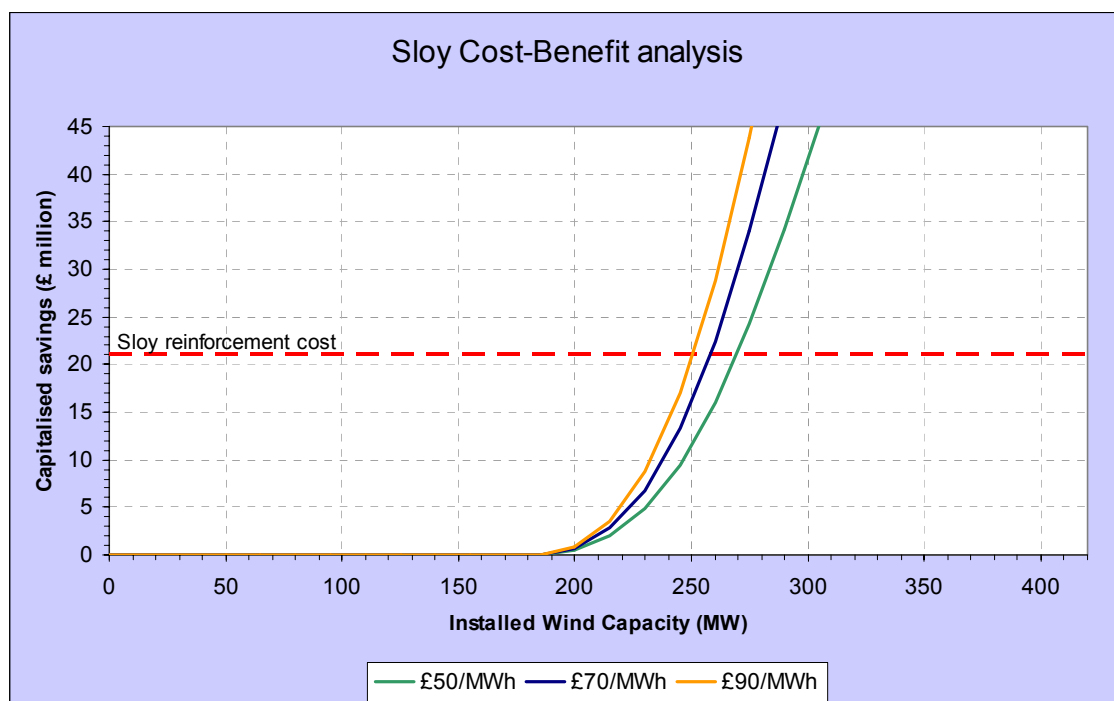
Figure 6: Comparison of capitalised saving in constraint and investment costs for the Kendoon project, assuming constrained energy costs between £50-90/MWh.



Sloy

3.31. Figure 7 analyses the Sloy project. SKM estimate that an additional 310 MW would connect, and as break even is around 260 MW, this project also fits in the baseline investment category. The cost of the investment is estimated at approximately £21 million.

Figure 7: Comparison of capitalised saving in constraint and investment costs for the Sloy project, assuming constrained energy costs between £50-90/MWh.



Other investment projects

- 3.32. The other investment projects are Beauly to Keith, Beauly to the Scottish Islands, North East ring and Heysham reinforcements. The North East ring project continues to be classified as incremental, while Beauly to Keith and Beauly to the Scottish Islands are considered to be additional investment projects.
- 3.33. These schemes were all considered in SKM's draft report and the initial proposals. In general the schemes were either thought to be ahead of need (requiring 5 GW of wind generation or more) or required that the development of large scale wind farms on the Scottish Islands.
- 3.34. A number of respondents have suggested that wind generation on the Scottish Islands would be economically viable and that funding should either be provided for pre-construction costs or for all the investment required to connect the Scottish Islands to the GB transmission network.
- 3.35. It is clear from the relatively large number of wind generation projects either operating or under construction that wind generation is economic (given the

present level of ROCs) at suitable onshore locations in mainland Scotland. The situation on the Scottish Islands is more uncertain, with desk top studies of the economics showing a range of results. While some respondents to the initial proposals said their projections indicated that investment would be economic other respondents expressed concern that transmission investment for renewable generation would lead to additional costs for consumers. The best approach to resolving these uncertainties appears to require potential developers of wind generation to make a financial commitment to pay future transmission charges. This should help ensure that only projects that have proper financial backing and are economic would proceed, which would in turn reduce the probability of stranded transmission assets and extra costs for consumers. The detail of these arrangements is discussed in chapter 4. If appropriate these matters could be reconsidered at the next main transmission price control reviews (in 2005 and 2006).

- 3.36. In the light of these considerations none of the above projects have been included as baseline investment.

Final proposals

- 3.37. Ofgem has assessed each investment proposal to identify which projects are clearly justified to allow transmission companies to meet the needs of their customers in the most efficient manner practicable and to protect consumers from the costs of any stranded assets. Those projects which appear to be cost effective have been categorised as baseline, those projects where there is some uncertainty as to whether they are cost effective have been categorised as incremental and those projects where there is significant uncertainty as to whether they would be economically viable have been categorised as additional. The main changes from the initial proposals relate to the reinforcement projects for the interconnector and at Kendoon. The assumption of higher constraint costs for conventional generators makes the interconnector project baseline rather than incremental and the assumption of lower capital costs for Kendoon makes it baseline rather than additional.
- 3.38. The initial proposals indicated that about £350 million of investment would be classified as baseline. The final proposals allow for about £560 million of baseline investment, subject to planning consents and licensees delivering

outputs (as discussed further in chapter 4). Table 1 summarises the classification of all project proposals and compares these to the initial allocation as part of initial proposals.

Table 1: Summary of the classification of projects in the initial and final proposals

Transmission company	Project	Initial proposals	Final proposals	Latest estimate of costs
SPTL/SHETL	Beauly-Denny	Baseline	Baseline	£332 million
NGC/SPTL	Interconnector	Incremental	Baseline	£168 million
NGC	NE Ring	Incremental	Incremental	£140 million
NGC	Heysham Ring	Additional	Additional	£65 million
SPTL	Kendoon	Additional	Baseline	£40 million
SHETL	Sloy	Baseline	Baseline	£21 million
SHETL	Beauly to Keith	Additional	Additional	N/A
SHETL	Beauly to islands	Additional	Additional	N/A

4. Price control adjustment mechanisms

- 4.1. Chapter 3 analysed the costs and benefits of the various transmission reinforcement schemes put forward by the licensees in response to actual and prospective increases in renewable electricity generation in Scotland. This chapter sets out final proposals for an adjustment mechanism to the present price controls designed to finance and incentivise efficient investment.
- 4.2. The August 2004 initial proposals document suggested categorising the transmission reinforcement schemes as either:
- ◆ baseline investment
 - ◆ incremental investment, or
 - ◆ additional investment.
- 4.3. Respondents broadly supported this approach, but a number of respondents suggested that certain projects should be allocated to different categories. These matters were dealt with in chapter 3. This chapter focuses on the incentive mechanisms that should be associated with each of the three investment categories.

Baseline investment

Initial proposals

- 4.4. Baseline investment would include those projects where analysis showed, with a reasonable degree of certainty that the savings in projected generator constraint costs would be such as to make the project cost effective. In these circumstances the following funding and incentive arrangements were suggested:
- ◆ funding for an estimate of pre-construction costs
 - ◆ funding for the costs of any public inquiry that might be associated with the planning process

- ◆ funding for financing costs during construction, on the basis of a fixed construction period and efficient budgeted costs (to incentivise efficient construction)
- ◆ once construction is completed and assuming the licensee is able to deliver the appropriate outputs for the project (for example in terms of network capacity) then it would receive an allowance for depreciation and return based on the budget costs, and
- ◆ after a fixed period these allowances would be calculated on the basis of actual rather than budget costs, sharing efficiency gains and the risks of cost overruns between the licensee and consumers.

Respondents' views

4.5. Most of the comments on these incentive and financing arrangements came from transmission licensees. In particular:

- ◆ the revenue allowance during construction should be based on the overall cost of capital rather than on the cost of debt
- ◆ higher allowances should be made for depreciation and returns
- ◆ actual costs should be used to calculate depreciation and returns after 5 years rather than 10 years, and
- ◆ output measures should be associated with the project parameters in terms of its key design features, as these would be easier to measure than network capability.

Final proposals

4.6. To the extent that it is practicable there may be advantages in streamlining the arrangements set out in the August 2004 initial proposals. For instance it should be possible to treat budgeted pre-construction costs and public inquiry costs and in a similar way to other construction costs. This would suggest the following process:

- ◆ establish whether a project should be treated as baseline

- ◆ if any public inquiry were to impose significant extra costs on the project (over and above any contingencies in the licensees' estimates of project costs) then its economic viability would be retested and a decision taken on whether it should be retained as a baseline project
- ◆ funding for the financing costs of budgeted pre-construction work, any public inquiry (over and above any contingencies in the licensees' estimates of project costs) and budgeted construction, on the basis of a fixed construction period (to incentivise efficient construction)
- ◆ once construction is completed and assuming the licensee is able to deliver the appropriate outputs then it would receive an allowance for depreciation and return based on the budgeted costs, and
- ◆ after five years these allowances would be calculated on the basis of actual rather than budgeted costs, (provided there was no clear evidence of inefficiency or wasteful expenditure) sharing efficiency gains and the risks of cost overruns between the licensee and consumers.

Financing costs

- 4.7. It is proposed to base the financing costs of these projects (including interest during construction) on a cost of capital broadly equivalent to that used in recent price control reviews. For the four projects presently assigned to the baseline category, the cost of capital will be a real pre-tax cost of capital of 8.8 per cent, equal to the average allowance used in extending the Scottish transmission price controls.
- 4.8. The return allowances to be established after construction and the delivery of outputs will be based on the cost of capital used in future transmission price control reviews. It is expected that this will be broadly consistent with the 4.8 per cent real post-tax cost of capital allowed in the recent distribution price control review, with an adjustment for expected corporation tax.
- 4.9. Transmission price controls have been set assuming a 40 year life for transmission assets for the purposes of setting allowances for the recovery of regulatory depreciation. Some of the licensees have suggested that this should

be set at 20 years for baseline investment, to reflect the strain on cash flows and the risks associated with these projects.

- 4.10. There is no compelling evidence that transmission reinforcement for renewables is at a higher risk of stranding than other transmission investment. Issues concerning cash flow and the financing of investment are better considered at a main price control review. In the light of these considerations it is intended to retain the assumption of a 40 year life for the purposes of calculating regulatory depreciation, but reconsider this at the next main price control reviews.

Output measures

- 4.11. Output measures will be set before construction commences so each licensee is clear as to what it will be required to deliver if it is to receive full allowances for returns and depreciation. These output measures should assist in incentivising each licensee to invest appropriately.
- 4.12. Transmission licensees suggested that output measures should be based on the installation of assets to an agreed specification. While being easy to measure, such outputs would not focus on what is important to system users – the capacity and reliability of the transmission network.
- 4.13. Ofgem proposes to implement the following process to assess performance and output measures:

Stage 1 - assess the additional level of capacity to be delivered by each project, based on the investment plans, including:

- ◆ MVA capability for each line (for defined ambient temperature/season)
- ◆ line resistance, and
- ◆ line reactivity.

Stage 2 - the transmission licensees would notify Ofgem when commissioning each investment project and would provide a commissioning report explaining how each of the pre-agreed output measures had been satisfied.

Stage 3 – in due course the transmission licensee would provide Ofgem with a new asset reliability report for each network investment covering the initial five years post commissioning, with information about how the line had performed (fault rate and unavailability including planned outages) and confirming that its capability had not suffered any derating.

Under delivery of output measures

- 4.14. Any under delivery of outputs will be investigated and unless the licensee is clearly not at fault, then future allowances for depreciation and returns will be scaled back to ensure the interests of network users are appropriately protected.

Over delivery of output measures

- 4.15. If a transmission licensee has delivered additional outputs that benefit network users then it will be for consideration as to whether it should earn higher returns (assuming it has spent less than the original cost projections) or whether an extra allowance should be made for these costs (if it has spent more than the original cost projections).

Incremental investment

Initial proposals

- 4.16. The incremental investment category would accommodate those investment projects where there is greater uncertainty as to whether constraint costs would be larger than the investment required to relieve the constraints or where it may be more efficient to delay the project. However, there may be advantages in carrying out pre-construction work to minimise delays in the event that the project was reclassified as baseline capacity. If appropriate pre-construction costs would be financed by adjusting the price control revenue allowance.

Respondents' views

- 4.17. Some respondents suggested that projects categorised as additional should be treated in a similar way to incremental investment projects. These issues are dealt with in the section on additional investment.

- 4.18. One transmission licensee indicated that pre-construction costs should be added to its regulatory asset value to ensure consistency with the main price controls.

Final proposals

- 4.19. Where there are significant advantages for consumers in a licensee incurring pre-construction costs before it is clear that a project is fully justified then licensees should be able to recover these costs, perhaps by allowing them to be added to the regulatory asset values that underlie the transmission price controls. This will be considered on a case by case basis, if and when these particular circumstances arise.

Additional Investment

Initial proposals

- 4.20. Additional investment projects were originally categorised as those projects where the estimates of constraint costs were less than 50 per cent of the estimates of the investment costs and/or where there were significant risks of stranded assets. The initial proposals suggested that these could be funded by three possible mechanisms:
- ◆ further information could emerge that could lead to these projects being reclassified as incremental or baseline
 - ◆ if the licensee were convinced its forecasts of generation were accurate then a revenue driver could be established that would protect consumers from the risk of stranded assets but allow higher returns for the licensee if the asset were fully utilised, and
 - ◆ the developers of generation projects requiring network extensions could commit to funding the necessary investment, perhaps by longer-term charging arrangements.

Respondents' views

- 4.21. Some of the transmission licensees considered that development expenditure should be allowed for additional investment projects to enable the transmission

licensees to offer connection terms. Other respondents also considered that a number of the projects classified as additional investment would need significant development to allow participants to consider them as viable options.

- 4.22. Transmission licensees considered that a revenue driver based on the number of generation connections would allocate risks to the transmission licensees that they could not control. None of the licensees expressed an interest in proceeding on this basis.
- 4.23. Some respondents considered that long term charging arrangements would, in effect re-introduce deep connection charges. It was also suggested that the requirement for some developers to commit to long-term arrangements to ensure the delivery of certain investment project and not others could potentially be discriminatory. One respondent suggested that small generators might have insufficient credit to underwrite investment and such charging arrangements could form a barrier to entry.
- 4.24. Other respondents said that it would be inappropriate to incentivise the provision of additional transmission investment if the economic case for this investment had not been proven.
- 4.25. Respondents representing the Scottish Islands said there would be advantages in providing additional funding to allow the exploitation of the considerable wind resources available in these locations.

Final proposals

- 4.26. It is essential that these proposals protect the interests of consumers by providing for efficient and timely investment and minimising the scope for stranded costs and inefficiencies. On this basis it remains valid to retain the additional investment category. If the developers of new power stations (both conventional and renewable) want to be able to connect to the transmission system then they should be prepared to fund any detailed development studies required, so that NGC can offer terms.
- 4.27. In light of the transmission licensees' lack of interest in an approach involving the development of revenue drivers, this section focuses on the scope for developing longer-term financial commitments or charging arrangements.

4.28. The final proposals for additional investment are intended to be a guide for developers that wish to progress generation schemes that depend on additional investment, but it is for these participants to develop appropriate commercial arrangements or to raise necessary industry code modifications to allow for the development of long term access arrangements.

Long term commercial arrangements

4.29. Under long term commercial arrangements the transmission licensee would seek some commitment from the developer to contribute to the costs of undertaking the investment, for example by committing to paying transmission network use of system (TNUoS) charging over the long term.

4.30. Transmission licensees, developers and generators would need to consider the merits of entering bilateral agreements which would offer guaranteed payment of TNUoS charges for an agreed number of years. Arrangements in the gas industry for entry capacity require shippers to commit to meet 50 per cent of incremental costs of a new entry capacity through a present value test. This test requires a commitment to pay fees of a present value over a 15 year period equal or greater than the present value of the incremental investment costs.

4.31. It seems sensible to also use these gas arrangements as a benchmark for electricity transmission, suggesting developers would need to commit to paying cost reflective TNUoS charges equal to at least 50 per cent of investment costs on a present value basis over 15 years.

4.32. Under the current arrangements, new sites wishing to connect to NGC's electricity transmission system are required to:

- ◆ complete a connection application
- ◆ sign a bilateral connection agreement (construction agreement) setting out their specific requirements
- ◆ meet NGC's credit rating criteria and provide security to cover pre-connection work as detailed below, and
- ◆ become a CUSC party (through an accession agreement).

- 4.33. NGC makes a connection offer to fulfil the connection agreement and sets out itemised costs for two types of bilateral construction agreements:
- ◆ work specific to a generator's requirements (H1 work), and
 - ◆ general transmission work which NGC had already planned to undertake, but which must be completed before the generator can connect (H2 work).
- 4.34. The new connectee is liable for any local and specific infrastructure work (H1 work) that NGC has undertaken if it does not turn up to connect. If the new connectee turns up, then the costs of H1 (and H2) construction agreements are collected from the generator through TNUoS charges. These arrangements could be further developed to accommodate the need to commit to pay long term for additional investment requirements. Generators would need to make substantial financial commitments probably secured on a similar basis to existing CUSC provisions (these include cash collateral, an investment grade credit rating, performance bonds, guaranteed bonds or letters of credit to underwrite the sums involved). If a generator did not build, or prematurely closed its capacity, it would be required to meet any outstanding obligations arising from the bilateral agreement.
- 4.35. If agreement is reached on the form of a longer term product, the transmission licensee would submit its proposal to Ofgem setting out the investment costs and the proportion of costs which had been underwritten by developers. Ofgem would assess the proposal against the 50 per cent test described above. If the project passed this test it would be treated as baseline capacity.
- 4.36. Bilateral arrangements would need flexibility to enable them to develop alongside any longer-term transmission access and charging arrangements. There are currently limited charging arrangements to allow generators and developers to signal their need for network capacity. These matters will be considered as part of the next main transmission price control reviews in 2005/6.

Independently owned transmission assets

- 4.37. Ofgem has also considered the possibility of participants undertaking transmission network extensions independently of the transmission licensee. Independent developers could consider such an approach, which would allow developers to control the scope and delivery of infrastructure and own and operate the network extension.
- 4.38. In order to undertake independent transmission investment it seems likely that a developer would need to hold a transmission licence authorising participation in transmission asset owner (TO) activities, and comply fully with all the relevant licence obligations. A new transmission licence would probably require the existing TO transmission licence(s) to be modified to carve out the authorised area needed for the independent developer's transmission licence. This would be more straightforward with the consent of the relevant transmission licensee(s).
- 4.39. Any transmission licence granted to an independent developer would also need to be compliant with EU third party access requirements of EU Directive 2003/54/EC concerning common rules for the Internal Market in Electricity (IMED). Of relevance are the provisions of the IMED which require third party access to be offered with respect to all transmission systems where the necessary capacity is available.

Conclusion

- 4.40. The three proposed investment project categories - baseline, incremental and additional are to be retained with refinements to the incentive arrangements as described in this chapter. Ofgem intends to consult on the necessary licence modifications to implement the associated adjustment mechanisms in early 2005. Final proposals to modify the transmission licences will follow between February and April 2005 in conjunction with the licence consultations being undertaken for the BETTA go live with a view that the price control adjustment be effective from 1 April 2005.

Appendix 1 Impact assessment

Introduction

- 1.1 Ofgem is required to carry out an Impact Assessment (IA) under section 5A of the Utilities Act 2000 (as amended by the Sustainable Energy Act 2003). The August 2004 initial proposals document included a draft IA for the suggested incentive and funding arrangements for transmission investment. This appendix updates the draft IA.

Initial Proposals

- 1.2 The draft IA suggested that implementing an adjustment mechanism to the transmission price controls would address the risk that transmission licensees may not invest in response to growing demand for transmission capacity from renewable generators. It illustrated the initial proposals to develop and implement an adjustment mechanism against a base case scenario (ie do nothing) and noted the following:
- ◆ implementing an adjustment mechanism to fund transmission investment should lead to environmental benefits and should not have any adverse implications for security of supply or competition
 - ◆ no significant adverse distributional implications of the initial proposals were identified
 - ◆ the compliance costs of the initial proposals should be modest given the relatively small number of transmission schemes under consideration, and
 - ◆ the categorisation of projects should provide incentives designed to promote: (a) the cost effective management of constraint costs (b) timely and efficient investment (c) the interests of consumers by protecting them from the costs of stranded assets.
- 1.3 No respondents commented directly on the content or conclusions of the draft IA. Given the broad similarities between the initial and final proposals the conclusions of the draft IA remain valid. The remainder of this IA updates the

analysis set out in the draft IA for the refinements to the assumptions that have been made (to project and constraint costs) between the initial and final proposals.

Constraint Costs

Ofgem has given further consideration to the method for assessing constraint costs. These matters are discussed further in chapter 3. Revised estimates of constraint costs are set out in Appendix table 1.

Appendix table 1: Range of constraint costs

Generation type	Constraint cost estimate	Constraint cost estimates post 2027
Conventional	£ 10 – 15 MWh	£ 10-15 MWh
Renewable (including ROCs)	£ 65 - 75 MWh	£ 32-37 MWh
Renewable (non-ROCs)	£ 25-33 MWh	£ 32-37 MWh
Renewable (hydro) plant pre 1990 less than 20 MW	£ 65 - 75 MWh	£ 32-37 MWh

Transmission Reinforcement Projects

- 1.4 As noted in chapter 3 the estimate of the cost of transmission reinforcement in the Kendoon area has fallen from about £90 million to about £40 million.

Classification of projects

- 1.5 The changes to the estimates of constraint costs have led to the reclassification of the interconnector reinforcement from incremental to baseline and the reclassification of Kendoon from additional to baseline. The classification of projects is summarised in Appendix table 2.

Appendix table 2: Costs and Benefits of the Investment Proposals

Proposal	Capitalized investment costs (£ million)	Generation capacity required to justify project	SKM estimate of new generation by 2010	Constrained energy volume GWh	Capitalized savings in constraints based upon constrained energy volumes (£ million)*
1- Beaully-Denny	332	R and N: 1200 MW	1500 MW	890	R: 436 N: 180
2 - Sloy area reinforcements	21	R: 275 MW	310 MW	66	R: 68
3 - Kendoon area connection infrastructure	40	R: 350 MW	400 MW	68	R: 70
4 -Scotland-England Interconnector upgrade.	168	R: 2400 MW C 2600MW	4000 MW	1645	C: 302
5 - North East Ring upgrade.	140	R: 3100 MW C: 1900 MW	4000 MW	666	R: 457 C: 41
6 - Heysham area reinforcements	65	Not quantifiable with available information, however significantly greater than 4 above	4000 MW	Significant uncertainty	N/A
7 - Beaully to islands (Shetland/Orkney/ W.Isles)	-	Not quantifiable	1921 MW	Significant uncertainty	N/A
8 - Beaully / Keith reinforcement	-	Circa 5000 MW north of Beaully	1500 MW	Significant uncertainty	N/A

(*) R: £70 MWh - renewable generation (including ROCs)
 C: £12.5 MWh - conventional generation
 N: £ 27.5 MWh - non ROC renewable generation.

Environmental Impact

- 1.6 Under the base case scenario (ie do nothing) transmission licensees would have significantly weaker incentives to invest in transmission reinforcement. This would lead to greater network constraints and possibly fewer renewable generators connecting to the network. The final proposals provide incentive and funding mechanisms designed to promote efficient investment.

- 1.7 Constraining renewable plant has consequences for emissions if the plant generating in its place is conventional fossil-fuel generation. For instance in the case of the Beaulieu-Denny line the constrained energy volumes given existing generation are forecast to be about 890 GWh. Network logistics mean that hydro or wind generation is most likely to be constrained. Appendix table 3 shows that depending on the alternative generation used, an increase in CO₂ emissions of between 320 kt and 850 kt could result. The Government expects 9.2 million tonnes of CO₂ savings to be delivered by the Renewables Obligation⁷.

⁷ DETR (2000) Climate change the UK programme
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Office of Gas and Electricity Markets

Appendix table 3: CO₂ emissions avoided by removing network constraints

Investment Proposal	Likely wind energy to be constrained	Substituted by current grid average	Substituted by CCGT	Substituted by coal	Social cost of carbon
	<i>GWh</i>	<i>Kilotonnes of carbon dioxide</i>			<i>£m</i>
Beaully-Denny	890	380	320	850	3.7
Sloy area	66	30	20	60	0.3
Kendoon area	68	30	20	70	0.3
Scotland-England interconnector	n/a	n/a	n/a	n/a	n/a

NB For the Scotland-England interconnector, energy to be constrained is expected to be conventional generation.

- 1.8 The last column of the table shows an estimate of the social cost of the additional carbon dioxide emissions. This estimate is based on an illustrative value £35/tC for the social cost of carbon. This is the lower bound of the range currently recommended by Defra and has been agreed as the value that will be consistently used in analysis of Ofgem’s policy proposals. Social cost of carbon estimates are highly uncertain and the social cost could vary widely depending on the assumption made about the social cost of carbon.
- 1.9 Constraining renewable plant can affect air quality if the plant generating in its place is conventional fossil-fuel generation. An increase in output from conventional generation will lead to an increase in emissions of sulphur dioxide and oxides of nitrogen which will impact on air quality.
- 1.10 However, the final proposals to introduce an adjustment mechanism to fund transmission investment for renewable generation may also have environmental impacts. Specifically, environmental impacts may result from an expanded or upgraded high voltage transmission system, such as:
- ◆ the visual and other impacts of new transmission towers and lines. For the proposed investment projects, visual impact would differ according to the project. Building a new 400kV line (e.g. Kendoon) or upgrading a 132kV line to 400kV (e.g. Beaully-Denny) will result in the construction of larger towers which could have a detrimental effect on the visual amenity of the area. It could also have significant impacts on surrounding areas during the construction phase e.g. disturbance of habitats. However, in the case of a project where circuits would be

reconducted, such as the interconnector upgrades, the impacts on visual amenity are likely to be much less

- ◆ impact of new generating stations. Increasing the capacity of lines to accommodate renewables will encourage the development of new generating stations which will have an environmental impact in their own right, for example impacts from the construction of new plant on visual amenity, and
- ◆ issues relating to visual impact can be considered as part of the planning and consents process for new overhead lines, which are matters for local and national Government.

Appendix 2 Related issues

- 2.1 This appendix considers the additional issues requiring consideration alongside the assessment of efficient investment and the development of an appropriate adjustment mechanism to the current price controls. In particular the chapter considers:
- ◆ areas of double counting between the price controls and the transmission adjustment arising from increased renewable generation
 - ◆ security and planning standards
 - ◆ the effect of increased investment on transmission charges, and
 - ◆ distribution connected generators.

Double counting

- 2.2 The present transmission price controls for SHETL and SPTL are intended to last until 31 March 2005. It is proposed to extend these price controls for two years to 31 March 2007 to align the price control review dates with those for other transmission licensees in both electricity and gas, enabling all transmission issues to be considered together at the next main reviews.
- 2.3 NGC's TO price control is due for renewal from 1 April 2006 and its current SO incentive scheme (except for the internal cost incentive) was set to be reviewed from 1 April 2004. Ofgem has consulted on extending NGC's price control until 31 March 2007 and will publish its final proposals on the scope of this proposed extension shortly.
- 2.4 Ofgem has reviewed information provided by each of the transmission licensees to try to ensure no double counting of expenditure between the present price controls, price control extensions and the incentive mechanisms for transmission investment for renewable generation.
- 2.5 Appendix table 4 summarises the areas Ofgem reviewed where there was potential for double counting of capital expenditure between these proposals and the last main price control, or the price control extensions the two Scottish

transmission licensees. Ofgem is satisfied that the investment undertaken as part of the price controls is different to the proposed investment for renewable generation.

- 2.6 Analysis has suggested that NGC could undertake £1.5 million of investment in 2005/06 on the interconnector that has been funded via adjustments made to price controls as part of the BETTA project. This will now be deducted from any funding allowed for the Scotland-England interconnector upgrade.
- 2.7 Ofgem will review NGC's capital expenditure for the price control extension for 2006/7 and the next main price control for all three transmission licensees commencing 2007, to ensure that there is no additional double counting of investment associated with the transmission investment for renewables project.

Appendix table 4: Potential areas of doubling counting considered by Ofgem

	TIRG project	Area of potential double counting	Price control investment	Price control investment delivery	TIRG investment	Double counting
SPTL	Beauly-Denny	Clyde's Mill	Refurbishment of overhead line on Clydes Mill - Dalmarnock route	2004/5	Switch gear and connections change at the sub station	No
SHETL	Beauly-Denny	Errochy	Funding for phase shift transformers at Errochy	2005/6	Funding of substation at Errochy	No
SHETL	Beauly-Denny	Braco	Funding for additional transformers at Braco	2006/7	Funding of substation at Braco	No
NGC	Scotland-England Interconnector	Stella West	Additional transformer in Stella West – Eccles No. 1 circuit, replacement of circuit breaker at Stella West, installation of two transformers in Stella West - Eccles No 2 circuit, uprate of cable at Stella West to accommodate higher rating. This investment was made by NGC Interconnections Business and is not part of the Transmission price control prior to BETTA.	2000/1	Re-conductoring the Stella West – Eccles overhead line route to enable it to carry a higher rating	No
NGC	Scotland-England Interconnector	Eccles-Stella West	Replacement of conductor and fittings on Eccles-Stella West 2 circuit with modern equivalent rated asset. This funding has been given to NGC as part of BETTA.	2005/6	The replacement of conductor and fittings will be superseded by the TIRG related investment. £1.5m will be deducted from the TIRG related work to avoid double counting.	Yes

Security planning standards

- 2.8 The transmission licensees are required to operate and develop their networks to certain security standards. These standards were not developed to deal with large scale wind generation and so may need to be reconsidered in the future. SKM considered that in the longer term security standards could influence the need for investment upgrades and suggested how security standards might be developed in the future.

- 2.9 In light of increases in the level of new generation NGC will need to review its security standards.

Transmission charges

- 2.10 NGC has consulted on the transmission charging arrangements to apply on a GB basis following the introduction of BETTA. Following consideration of responses to its consultation on these charging arrangements, Ofgem decided that these charging arrangements should be further developed by NGC to better facilitate achievement of the applicable charging method objectives. NGC is consequently in the process of developing an alternative set of charges. These proposed charges will be submitted to the Authority for approval in due course.
- 2.11 Under clause 185 of the Energy Act, the Secretary of State has the power to amend transmission charges in areas with high renewable generation potential if the level of charges is likely to hinder the development of renewable generation in a material respect. The Secretary of State has yet to decide whether to exercise these powers.

Distribution connected generation

- 2.12 It will be important in future to consider and develop charging arrangements for all network users that contribute to flows on the transmission system (including distributed embedded generators) such that these users are required to make an appropriate contribution towards costs they impose on the transmission system. This might result in the development of the existing transmission charging arrangements for distributed connected generators.

Appendix 3 Baseline investment – case studies

3.1 This appendix sets out case studies illustrating how the revenue allowance would be calculated for each of the four baseline transmission investment proposals. The case studies are based on Ofgem’s final proposals for the adjustment mechanism as set out in chapter 4 and should be read in conjunction with these proposals.

Phase 1- construction

- 3.2 As the case studies set out in Appendix figures 1 - 4 indicate each baseline investment has three phases. Phase one relates to construction⁸. The construction periods were proposed by the transmission licensees and reviewed by engineering consultants SKM. The case studies show *budgeted project capex* which is the estimated build costs for each construction year.
- 3.3 During the construction phase transmission licensees will earn a cost of capital allowance based on the cumulative forecast construction costs in each year. This is shown in the case studies as *interest during construction*. In the case studies the *rolling RAV (budgeted capex)* shows the costs incurred if the transmission licensee’s construction costs were the equal to forecast construction costs while the *shadow RAV (actual capex)* shows the savings a licensee could make if it made a ten per cent efficiency gain in construction costs.
- 3.4 The construction phase is fixed and so if the transmission licensee takes an additional year to complete construction it would be unable to earn cost of capital on the investment for the additional year. The transmission licensee has an additional incentive to complete construction earlier as it would be able to earn depreciation on the investment once construction had been completed, subject to the full provision of the associated outputs.

⁸ This period is different for each of the baseline investment proposals i.e. for Beaully-Denny it is five years,

Phase 2 - incentives

- 3.5 At the end of the construction period Ofgem will assess the investment against pre-agreed output measures. If Ofgem is satisfied that the investment has met these output measures the investment will roll into phase 2, which is a fixed five year period for all the baseline investment proposals.
- 3.6 In this phase the transmission licensee is able to earn allowances for cost of capital and depreciation on the budgeted investment costs. The *income (proposed)* row of the case studies shows the total revenue that a transmission licensee would make. The *income (efficient)* row shows the hypothetical revenue that a transmission licensee would have earned if it had made a ten per cent efficiency saving. The *incentive payment* row shows the revenue above its normal costs and return that the transmission licensee would earn if it were to make a ten per cent efficiency saving.

Phase 3 - actual investment costs

- 3.7 At the end of the five year incentive period Ofgem will reassess the investment against the pre agreed output measures to check that there have been no major faults arising from the investment. The investment then rolls into phase 3 and the transmission licensee would earn total revenue (cost of capital and depreciation) based on the actual cost of the investment (provided there was no evidence of wasteful or inefficient expenditure) until the end of its depreciated life.

for the Scotland-England interconnector it is six years, for Sloy area it is three years and for Kendoon area it is four years.

Appendix figure 1: Beaulieu-Denny adjustment mechanism case study

Capex assumptions															
Asset life (yrs)						40									
PC Allowance						331,929									
Actual Capital Expenditure						298,736									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rolling RAV (Proposed)	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Budgeted capex	7,435	100,722	127,957	82,933	12,882										
Cumulative budgeted capex	7,435	108,157	236,114	319,047	331,929										
Opening RAV budgeted capex)						331,929	323,631	315,333	307,034	298,736					
Interest during construction	327	5,086	15,148	24,427	28,643										
Total interest during construction					73,631										
Depreciation						-8,298	-8,298	-8,298	-8,298	-8,298					
Closing Rolling RAV						323,631	315,333	307,034	298,736	290,438					
Shadow RAV (Actual capex)	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Capital Expenditure in Year	6,692	90,650	115,161	74,640	11,594										
Cumulative Capital Expenditure	6,692	97,341	212,503	287,142	298,736										
Opening Shadow RAV						298,736	291,268	283,799	276,331	268,862	261,394	253,926	246,457	238,989	231,520
Interest during construction	294	4,577	13,633	21,984	25,779										
Total interest during construction					66,268										
Depreciation						-7,468	-7,468	-7,468	-7,468	-7,468	-7,468	-7,468	-7,468	-7,468	-7,468
Closing shadow RAV						291,268	283,799	276,331	268,862	261,394	253,926	246,457	238,989	231,520	224,052
Calculation of Allowed Income (Proposed)															
Rate of return	8.8%					8.8%									
Allowed Depreciation						8,298	8,298	8,298	8,298	8,298	7,468	7,468	7,468	7,468	7,468
Allowed Return	327	5,086	15,148	24,427	28,643	28,845	28,114	27,384	26,654	25,924	22,674	22,017	21,360	20,702	20,045
Total Income						37,143	36,413	35,682	34,952	34,222	30,142	29,485	28,828	28,171	27,514
Calculation of Shadow Income															
Rate of return	8.8%					8.8%									
Allowed Depreciation						7,468	7,468	7,468	7,468	7,468	7,468	7,468	7,468	7,468	7,468
Allowed Return	294	4,577	13,633	21,984	25,779	25,960	25,303	24,646	23,989	23,331	22,674	22,017	21,360	20,702	20,045
Total Income						33,429	32,771	32,114	31,457	30,800	30,142	29,485	28,828	28,171	27,514
Income (Proposed)	327	5,086	15,148	24,427	28,643	37,143	36,413	35,682	34,952	34,222	30,142	29,485	28,828	28,171	27,514
Income (Efficient)	294	4,577	13,633	21,984	25,779	33,429	32,771	32,114	31,457	30,800	30,142	29,485	28,828	28,171	27,514
INCENTIVE PAYMENT	33	509	1,515	2,443	2,864	3,714	3,641	3,568	3,495	3,422	0	0	0	0	0
PV	31	445	1,240	1,871	2,052	2,489	2,282	2,092	1,917	1,756	0	0	0	0	0
Total PV	16,175														

Appendix figure 2: Scotland - England interconnector adjustment mechanism case study

Capex assumptions																
Asset life (yrs)							40									
PC Allowance							167,987									
Actual Capital Expenditure							151,188									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rolling RAV (Proposed)	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Budgeted capex	14,510	42,461	42,087	37,022	25,551	6,356										
Cumulative budgeted capex	14,510	56,971	99,058	136,080	161,631	167,987										
Opening RAV budgeted capex)							167,987	163,787	159,588	155,388	151,188					
Interest during construction	638	3,145	6,865	10,346	13,099	14,503										
Total interest during construction						48,597										
Depreciation							-4,200	-4,200	-4,200	-4,200	-4,200					
Closing Rolling RAV							163,787	159,588	155,388	151,188	146,989					
Shadow RAV (Actual capex)	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Capital Expenditure in Year	13,059	38,215	37,878	33,320	22,996	5,720	0	0	0	0	0	0	0	0	0	0
Cumulative Capital Expenditure	13,059	51,274	89,152	122,472	145,468	151,188										
Opening Shadow RAV							151,188	147,409	143,629	139,849	136,069	132,290	128,510	124,730	120,951	117,171
Interest during construction	575	2,831	6,179	9,311	11,789	13,053										
Total interest during construction						43,738										
Depreciation							-3,780	-3,780	-3,780	-3,780	-3,780	-3,780	-3,780	-3,780	-3,780	-3,780
Closing shadow RAV							147,409	143,629	139,849	136,069	132,290	128,510	124,730	120,951	117,171	113,391
Calculation of Allowed Income (Proposed)																
Rate of return	8.8%						8.8%									
Allowed Depreciation							4,200	4,200	4,200	4,200	4,200	3,780	3,780	3,780	3,780	3,780
Allowed Return	638	3,145	6,865	10,346	13,099	14,503	14,598	14,228	13,859	13,489	13,120	11,475	11,143	10,810	10,477	10,145
Total Income							18,798	18,428	18,059	17,689	17,319	15,255	14,922	14,590	14,257	13,924
Calculation of Shadow Income																
Rate of return	8.8%						8.8%									
Allowed Depreciation							3,780	3,780	3,780	3,780	3,780	3,780	3,780	3,780	3,780	3,780
Allowed Return	575	2,831	6,179	9,311	11,789	13,053	13,138	12,806	12,473	12,140	11,808	11,475	11,143	10,810	10,477	10,145
Total Income							16,918	16,585	16,253	15,920	15,588	15,255	14,922	14,590	14,257	13,924
Income (Proposed)	638	3,145	6,865	10,346	13,099	14,503	18,798	18,428	18,059	17,689	17,319	15,255	14,922	14,590	14,257	13,924
Income (Efficient)	575	2,831	6,179	9,311	11,789	13,053	16,918	16,585	16,253	15,920	15,588	15,255	14,922	14,590	14,257	13,924
INCENTIVE PAYMENT	64	315	687	1,035	1,310	1,450	1,880	1,843	1,806	1,769	1,732	0	0	0	0	0
PV	60	275	562	792	938	972	1,178	1,081	991	908	831	0	0	0	0	0
Total PV	8,588															

Appendix figure 3: Sloy area adjustment mechanism case study

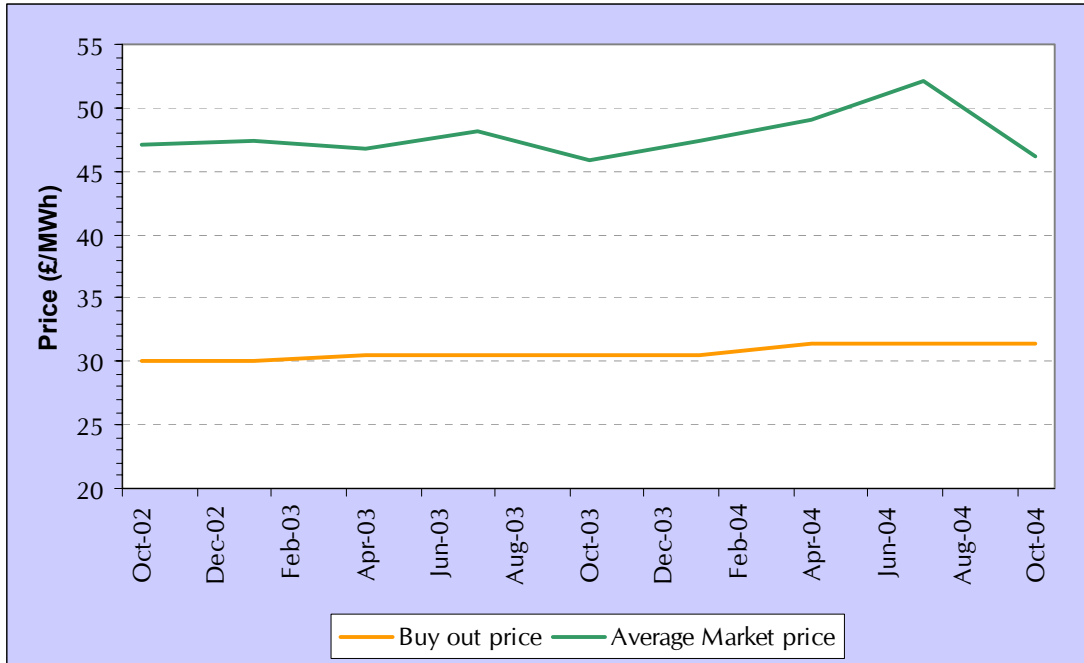
Capex assumptions													
Asset life (yrs)				40									
PC Allowance				20,693									
Actual Capital Expenditure				18,624									
	1	2	3	4	5	6	7	8	9	10	11	12	13
Rolling RAV (Proposed)	2004/05	2005/06	2006/07	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Budgeted capex	100	11,342	9,251										
Cumulative budgeted capex	100	11,442	20,693										
Opening RAV (budgeted capex)				20,693	20,176	19,658	19,141	18,624					
Interest during construction	4	508	1,414										
Total interest during construction			1,926										
Depreciation				-517	-517	-517	-517	-517					
Closing Rolling RAV				20,176	19,658	19,141	18,624	18,106					
Shadow RAV (Actual capex)	2004/05	2005/06	2006/07	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Capital Expenditure in Year	90	10,208	8,326										
Cumulative Capital Expenditure	90	10,298	18,624										
Opening Shadow RAV				18,624	18,158	17,693	17,227	16,761	16,296	15,830	15,365	14,899	14,433
Interest during construction	3.96	457	1,273										
Total interest during construction			1,734										
Depreciation				-466	-466	-466	-466	-466	-466	-466	-466	-466	-466
Closing shadow RAV				18,158	17,693	17,227	16,761	16,296	15,830	15,365	14,899	14,433	13,968
Calculation of Allowed Income (Proposed)													
Rate of return	8.8%			8.8%									
Allowed Depreciation				517	517	517	517	517	466	466	466	466	466
Allowed Return	4	508	1,414	1,798	1,753	1,707	1,662	1,616	1,414	1,373	1,332	1,291	1,250
Total Income				2,316	2,270	2,224	2,179	2,133	1,879	1,838	1,797	1,756	1,715
Calculation of Shadow Income													
Rate of return	8.8%			8.8%									
Allowed Depreciation				466	466	466	466	466	466	466	466	466	466
Allowed Return	3.96	457	1,273	1,618	1,577	1,536	1,495	1,455	1,414	1,373	1,332	1,291	1,250
Total Income				2,084	2,043	2,002	1,961	1,920	1,879	1,838	1,797	1,756	1,715
Income (Proposed)	4.40	508	1,414	2,316	2,270	2,224	2,179	2,133	1,879	1,838	1,797	1,756	1,715
Income (Efficient)	3.96	457	1,273	2,084	2,043	2,002	1,961	1,920	1,879	1,838	1,797	1,756	1,715
INCENTIVE PAYMENT	0	51	141	232	227	222	218	213	0	0	0	0	0
PV	0	44	116	177	163	149	137	125	0	0	0	0	0
Total PV	911												

Appendix figure 4: Kendoon adjustment mechanism case study

Capex assumptions														
Asset life (yrs)	40													
PC Allowance	40,000													
Actual Capital Expenditure	36,000													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Rolling RAV (Proposed)	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Budgeted capex	300	2,700	21,600	15,400										
Cumulative budgeted capex	300	3,000	24,600	40,000										
Opening RAV budgeted capex)					40,000	39,000	38,000	37,000	36,000					
Interest during construction	13	145	1,214	2,842										
Total interest during construction				4,215										
Depreciation					-1,000	-1,000	-1,000	-1,000	-1,000					
Closing Rolling RAV					39,000	38,000	37,000	36,000	35,000					
Shadow RAV (Actual capex)	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Capital Expenditure in Year	270	2,430	19,440	13,860										
Cumulative Capital Expenditure	270	2,700	22,140	36,000										
Opening Shadow RAV					36,000	35,100	34,200	33,300	32,400	31,500	30,600	29,700	28,800	27,900
Interest during construction	12	131	1,093	2,558										
Total interest during construction				3,794										
Depreciation					-900	-900	-900	-900	-900	-900	-900	-900	-900	-900
Closing shadow RAV					35,100	34,200	33,300	32,400	31,500	30,600	29,700	28,800	27,900	27,000
Calculation of Allowed Income (Proposed)														
Rate of return	8.8%				8.8%									
Allowed Depreciation					1,000	1,000	1,000	1,000	1,000	900	900	900	900	900
Allowed Return	13	145	1,214	2,842	3,476	3,388	3,300	3,212	3,124	2,732	2,653	2,574	2,495	2,416
Total Income					4,476	4,388	4,300	4,212	4,124	3,632	3,553	3,474	3,395	3,316
Calculation of Shadow Income														
Rate of return	8.8%				8.8%									
Allowed Depreciation					900	900	900	900	900	900	900	900	900	900
Allowed Return	12	131	1,093	2,558	3,128	3,049	2,970	2,891	2,812	2,732	2,653	2,574	2,495	2,416
Total Income					4,028	3,949	3,870	3,791	3,712	3,632	3,553	3,474	3,395	3,316
Income (Proposed)	13	145	1,214	2,842	4,476	4,388	4,300	4,212	4,124	3,632	3,553	3,474	3,395	3,316
Income (Efficient)	12	131	1,093	2,558	4,028	3,949	3,870	3,791	3,712	3,632	3,553	3,474	3,395	3,316
INCENTIVE PAYMENT	1	15	121	284	448	439	430	421	412	0	0	0	0	0
PV	1	13	99	218	321	294	270	247	226	0	0	0	0	0
Total PV	1,688													

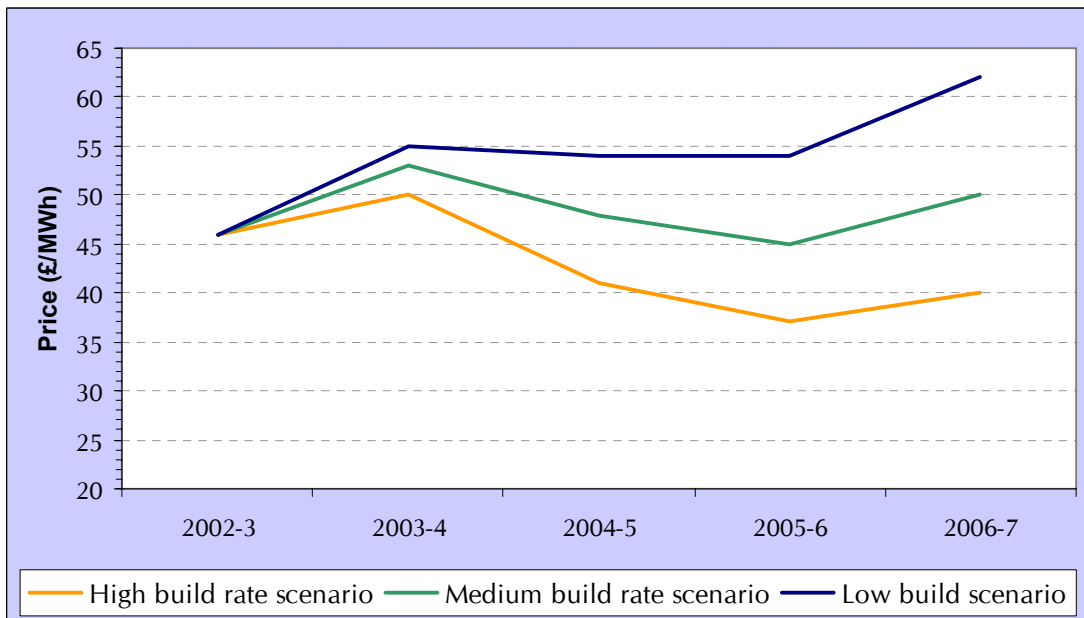
Appendix 4 – ROC prices

Appendix Figure 5: ROC market price per quarter



Source: www.nfpa.co.uk (Non-Fossil Purchasing Agency)

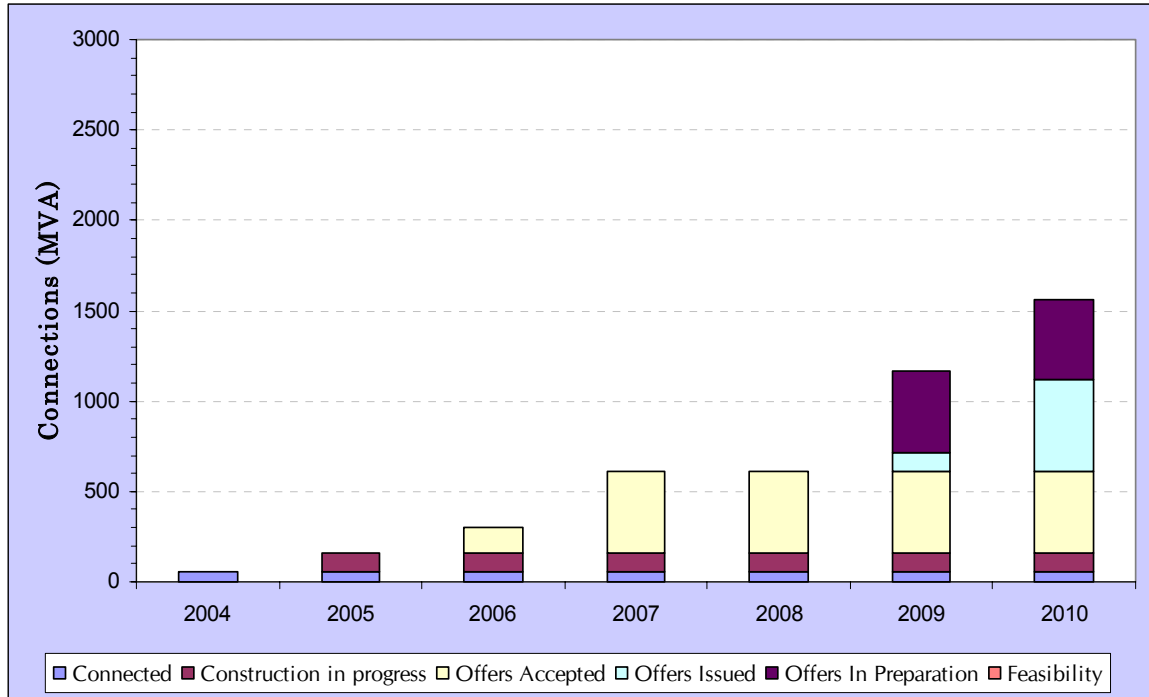
Appendix figure 6: Platt's projections of ROC prices



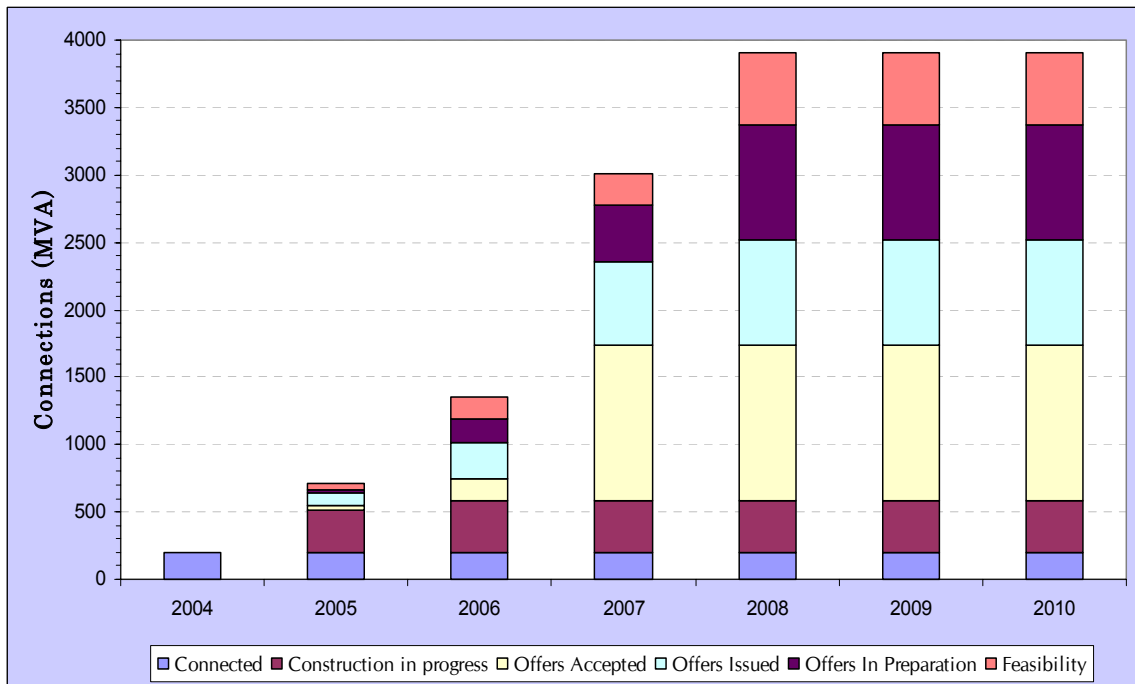
Source: Power UK / Europe Economics Report

Appendix 5 Licensees' forecasts of connections

Appendix figure 7: Connection activity – NGC North



Appendix figure 8: Connection activity - SP



Appendix figure 9: Connection activity - SSE

