A

Appendix A NOA study matrix

Assumption/Condition		Comments
Generation and Demand Scenarios	Leading the Way	Technical and economic assessment of the reinforcement options; sensitivity studies where appropriate
	Consumer Transformation	Economic assessment of the reinforcement options and technical assessment as required; sensitivity studies where appropriate
	Systen Transformation	Economic assessment of the reinforcement options and technical assessment as required; sensitivity studies where appropriate
	Steady Progression	Economic assessment of the reinforcement options and technical assessment as required; sensitivity studies where appropriate
Seasonal Boundary Capability	Winter Peak	Technical and economic assessment of the reinforcement options
	Spring/Autumn	Technical and economic assessment of the reinforcement options. Technical assessment of boundary capabilities can be calculated based on agreed scaling factors from winter peak capabilities which are validated against benchmarked results. Benchmarking is subject to availability of the model and agreement on generation despatch
	Summer	Technical and economic assessment of the reinforcement options. Technical assessment of boundary capabilities can be calculated based on agreed scaling factors from winter peak capabilities which are validated against benchmarked results. Benchmarking is subject to availability of the model and agreement on generation despatch
Boundary Capability Study Type	Voltage Compliance	
	Thermal	
Contingencies	N-1-1	
	N-1	
	N-D	
Network Reinforcements	Build reinforcements	
	Reduced-build reinforcements	Assessment of reduced-build reinforcement options

Assumption/Condition		Comments
	Operational reinforcements	Assessment of operational options
Study Years	Year 1	Assessment of alternative reinforcement options subject to availability
	Year 2	Assessment of alternative reinforcement options subject to availability
	Year 3	Assessment of alternative reinforcement options subject to availability
	Year 4	Assessment of build and alternative reinforcements options excluding those are subject to Ofgem agreement
	Year 5	Assessment of build and alternative reinforcements options excluding those are subject to Ofgem agreement
	Year 7	Assessment of build and alternative reinforcements options excluding those are subject to Ofgem agreement
	Year 10	Assessment of build and alternative reinforcements options excluding those are subject to Ofgem agreement

B

Appendix B System requirements form

We have changed the System Requirements Form template to an electronic form for parts B, C, E and F using a dedicated data room. The table below gives an overview of the SRF parts and a summary of the data content.

SRF Part	SOFI Content?	Description	Data content
Part A – Boundary requirement and Capability	Yes	ESO sends out a requirement level for each boundary which triggers the TO's response in providing options to meet the capability requirement level for that boundary. The form includes the BID3 unconstrained boundary transfers. Each boundary will have its own Part A.	The requirements listed are the transfer capabilities for each energy scenario for each of economy and security in tabulated and chart form. An example is later in this appendix.
Part B – TO Proposed Options	Yes	TO responds with an option that may partially or wholly meet the requirements set out by Part A. Each option will have its own Part B	Technical description of the option including: • physical works. • diagram. • what requirement the option solves and how. • earliest in-service date. • any environmental impacts • other reference information including option name, status, reference number.
Part C – Outage Requirements	Yes	TO responds with outage requirements for that option. Each option will have its own row in Part C.	Outage requirements to deliver the option: • Reference number to match option described in Part B. • Year of outage which says if the outages span more than one year. • Circuits required out of service and duration. • Restriction on sequence of works.
Part D – Studied Option combinations	Yes	TO and ESO supply how the options' capabilities have been studied to ensure that the ESO accurately and faithfully reproduces the options' order and capabilities in the economic analysis. Part D is a separate online form.	Boundary benefit data is captured in the handover tool: • The option code that has been agreed with the ESO. • The absolute boundary benefit in MW that the option gives. • Whether the option depends on other reinforcements to give its benefit. • The order of the reinforcements in the sequence.

SRF Part	SOFI Content?	Description	Data content
Part E – Options' Costs	Yes	TOs supply asset and cost information to allow the ESO to proceed with 'cost reasonableness' (See Appendix C). Each option will have its own Part E, but only if it has featured in Part D.	The data recorded includes: • WACC used. • A limited break down of costs. • The cost profile for the option. • Delay, remobilisation costs.
Part F – Publication Information	No	TOs supply names and descriptions of options for publication use. Each option will have its own row in Part E but only if it has featured in Part D.	The information includes: • The NOA code agreed with the ESO. • The option name to appear in the NOA report. • The description of the option to appear in the NOA report.

SOFI stands for System Operator Functions Information.

SRF Part A: Boundary Requirement and Capability

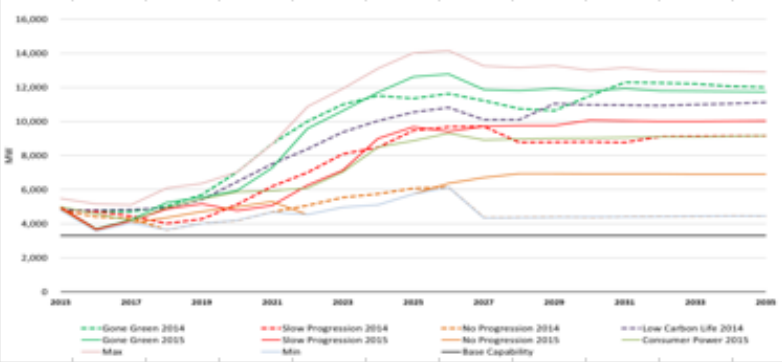
Part A: SO Requirement

For more information please see the information provided separately by the boundary studies.

Requirement preparer:	*ESO to fill in the SQSS Study this boundary*
Passed Tef Date:	*ESO to fill in the TO engineer whom this was passed to and when*
Boundary under Analysis:	*ESO to fill in which boundary this relates to*

Winter Peak Boundary Required Transfer Summary:

Year 1 Winter Peak Base Capability (from previous year):	*Year 1 winter peak base capability for this boundary as evidence for the TO*



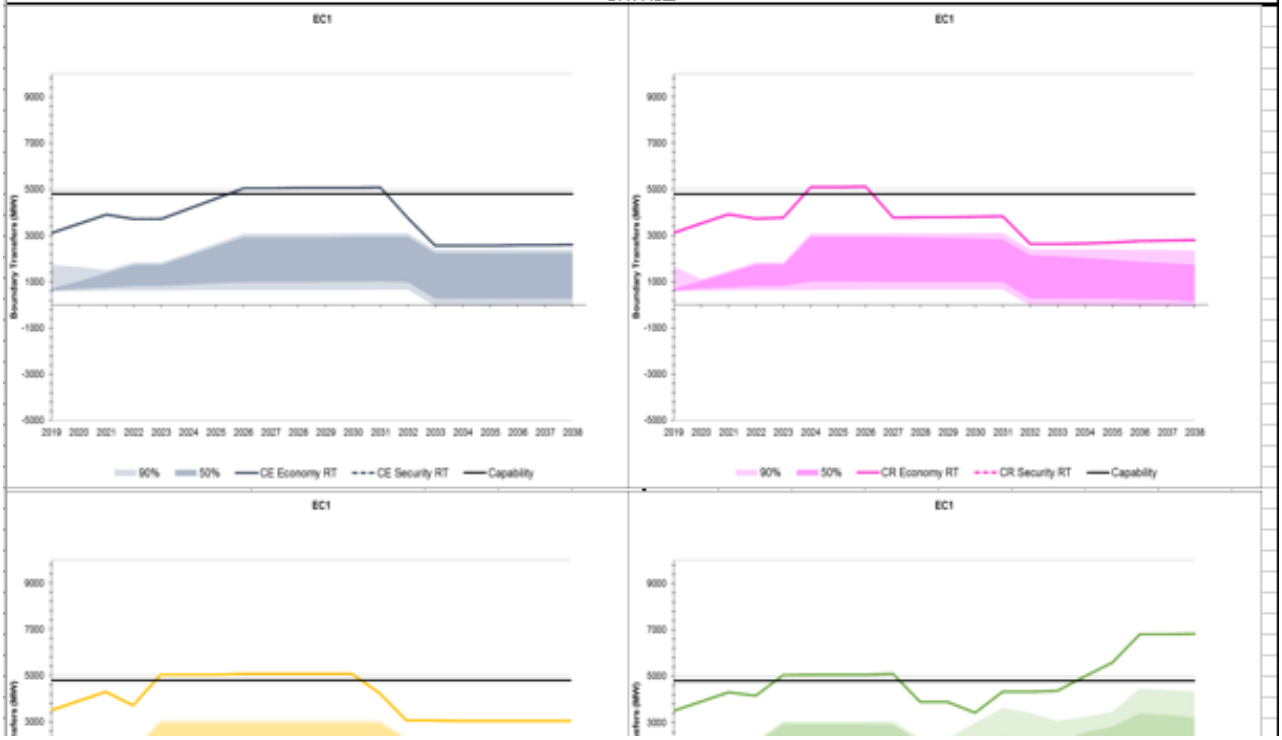
	Economy	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Winter Peak Required Transfers in accordance with NETS SQSS Chapter 4 Economy Background (in MW)	Two Degrees	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
	Community Renewables	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
	Consumer Evolution	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
	Steady Progression	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW

	Security	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Winter Peak Required Transfers in accordance with NETS SQSS Chapter 4 Security Background (in MW)	Two Degrees	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
	Community Renewables	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
	Consumer Evolution	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
	Steady Progression	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW

Unconstrained Boundary Flow

The section below details the unconstrained flow across the boundary. The 90th percentile and 50th percentile ranges have been highlighted for each scenario and this has been compared to the required transfer in accordance with the SQSS. The top four charts illustrate the FES18 unconstrained flow and the four charts below thereafter this year's FES19 unconstrained flow.

2018 Flow



Seasonal scaling factors can be submitted using the following template. Otherwise, default ones mentioned in Section 2 will be used or actual seasonal boundary capabilities can also be submitted separately.

Boundary Name	Seasonal Scaling Factor				Number of circuits crossing boundary	Number of outage days
	Winter	Spring/Autumn	Summer	Summer Outage		
Example	100%	85%	70%	50%	4	
B0						
B1						
B2						
B4						
B5						
B6						
B7						
B8						
B9						
B13						
EC5						
SC1						
SC1rev						
NW1						

Please enter data into column H OR column I. The number of outage days will be calculated based on the number of circuits crossing the boundary unless the number of outage days is specified.

Lock/unlock

Use this page to enter seasonal scaling factors for boundaries studied.

C

Appendix C Process for checking NOA option cost reasonableness

This appendix describes the process that the ESO uses to assess the NOA option cost data that the TOs provide as an input to the NOA economic process.

Figure E1 shows the process map for the cost reasonableness checking process.

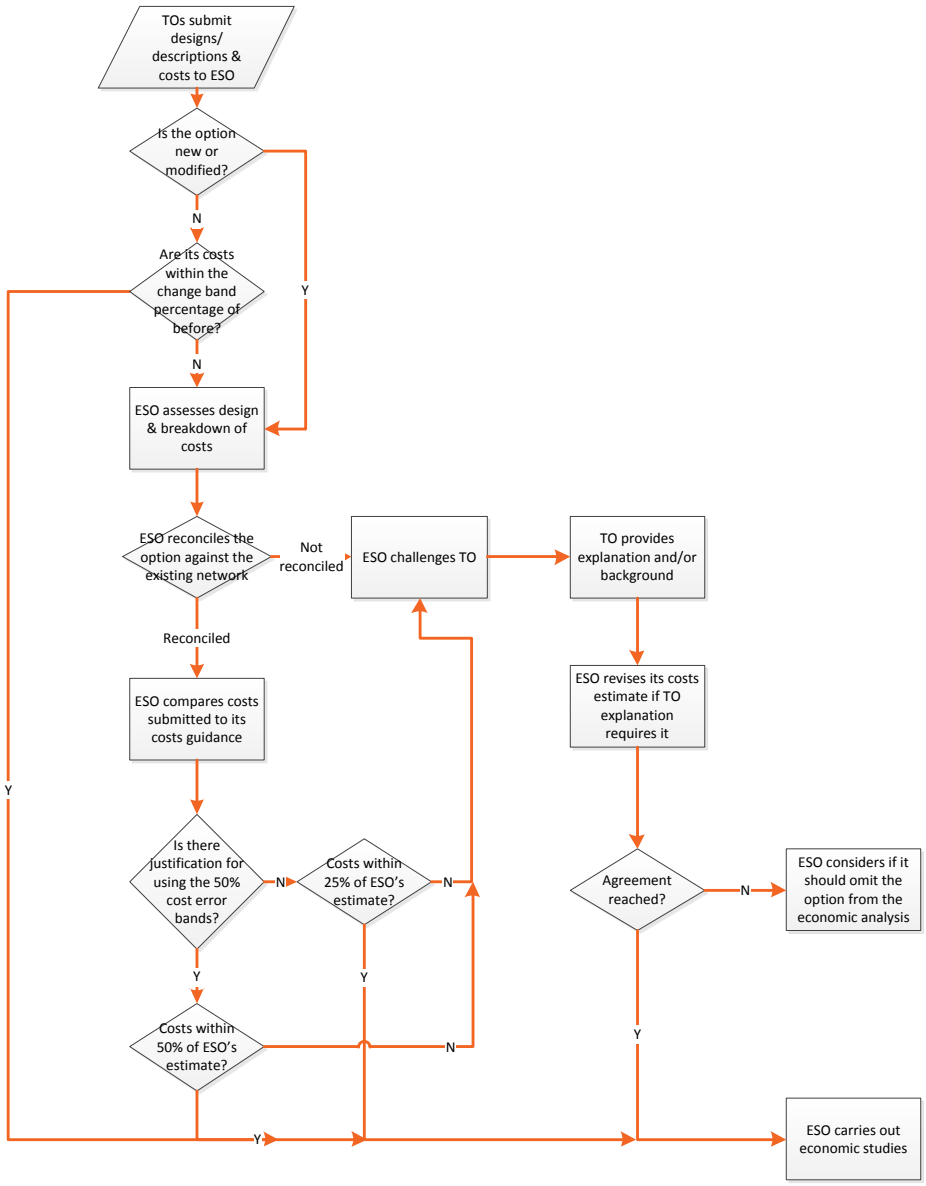


Figure E1: cost reasonableness checking process map

The input to the process is the costs that the TOs submit for their NOA options. The output of the process is the TOs' cost submissions to be deemed valid and act as an input into the NOA economic process. The TOs may modify their costs following discussions with the ESO as part of this process. If following discussions, the ESO still believes that the costs are outside of their expected range and will consequently unduly affect the economic analysis, the ESO may omit the option from the economic analysis.

The ESO maintains independent cost guidelines which are derived from RIIO unit costs and external public domain market intelligence. The ESO compares the costs of different options from a TO against previous years (allowing for inflation) and against its cost guidelines.

The headings below match the stages in the process map.

TOs submit designs/descriptions & costs to ESO

Having received the cost information from the TOs via the SRFs, the ESO gathers the information together. The ESO needs the following data, which it captures from the SRF:

Detailed technical breakdown of the reinforcement option

Cost data for the option.

Is the option new or modified?

Are its costs within the change band percentage of before?

The first step is for the ESO to identify which options should proceed through the cost reasonableness process. New or modified options always proceed through the cost reasonableness process. Options where the designs are unmodified from previous years' submissions may be exempt from the remainder of the cost reasonable process as they will have had their costs approved through previous years' ESO cost checks, provided any increase in costs falls within an expected range. If the costs submitted for the current year are within the change band of +/- 5% of previous submissions, then the cost checking process for such an option ends here. Options where the costs have changed outside this range, or options which have modified or new designs, proceed through the process as normal.

ESO assesses design & breakdown of costs

The aim of this step is for the ESO to understand the option, how it is intended to deliver the benefit, the component parts of the option and its benefit. The ESO takes the technical breakdown descriptions of the option and builds up its understanding of the reinforcement option:

The ESO checks the descriptive text with any diagrams that the TO has provided Note that some options will not need diagrams, for instance if they are about thermal upgrades or other overhead line work.

The ESO checks that equipment requirements are consistent and complete. For instance, where a new circuit is proposed, does the SRF explain how it will connect to the existing transmission system – are new bays proposed and how many, or will it reuse existing bays? Is equipment already installed mentioned separately from equipment that will be installed in the future?

The ESO checks environmental factors. For example, whether the option needs consents and whether the option is in a mainly urban or rural setting.

It is expected that the level of disaggregation of options included in the SRF and the cost accuracy will vary with the level of maturity of the option, with those options which have been developed over a few years being broken down into more detailed aggregate components with more accurately estimated costs than those in the initial stages of conception where design and costs are more approximate.

The ESO reconciles the option against the existing network

Having built up its understanding of the option, the ESO checks the existing part of the network that the option affects. This is to identify any parts of the option that might have been omitted and which may affect the cost estimate. The ESO notes any omissions or discrepancies in the SRF and seeks clarification from the TO. An example might be that the SRF describes using a spare bay so the ESO checks the latest system diagram to check for the bay's details. For an explanation of the remainder of the process, go to the **ESO challenges TO** stage on the process map.

ESO compares costs submitted to range of costs in its guidelines

The ESO performs two tests for each option at this stage as applicable.

1) Having developed its understanding of the option, the ESO compares the option's costs against the ESO's cost guidelines.
2) The ESO identifies similar options within a TO's portfolio and checks the cost consistency between them. For instance, where two options replace the conductors of circuits of the same voltage level, the ESO calculates the unit costs based on the TO's submission and checks how similar they are.

Is there justification for using the 50% cost error bands?

Some aspects of options add a lot of uncertainty to the forecast cost of a project and so are allowed a larger cost error. For this reason, the ESO measures against a 50% cost error band for any option affected by the following:

consents

new technology with high uncertainty.

Costs within 25% of ESO's estimate?

This step applies to options that involve **no** added justification for the wider cost error bands.

The first stage is for the ESO to compare the TO's submission with its own estimate of costs. If the costs are within 25%, the ESO progresses to the second stage.

The second stage is to check that a TO's costs are consistent with other options' costs across its portfolio. If this is the case, then the ESO sets the option costs as 'agreed' and the costs are used in the economic process.

If the costs are outside of the 25% band and/or the costs are not consistent, the ESO asks the TO for justification. For an explanation of the remainder of the process, go to **ESO challenges TO** stage on the process map.

Costs within 50% of ESO's estimate?

This step applies **only** to options where there is justification for wider cost error bands and is a similar two stage approach.

Firstly, the ESO takes the TO's submission and compares it with its own estimate of costs. If the costs are within the 50%, the ESO progresses to the cost consistency check across a TO portfolio.

If the costs are consistent with other options' costs in the TO portfolio, then the ESO sets the option costs as 'agreed' and the costs are used in the economic process.

If the costs are outside of the 50% band and/or the costs are not consistent, the ESO asks the TO for justification. For an explanation of the remainder of the process, go to the **ESO challenges TO** stage on the process map.

ESO challenges TO

If the ESO finds that an option's costs lie outside of the range that it estimates, it approaches the TO for a more detailed understanding.

TO provides explanation and/or background

In response to the ESO's challenge, the TO provides more information to solve the query. This information might be:

adding information, for instance including the details of cable section lengths

correcting assumptions about assets, for instance the amount of plant involved in work on a substation bay

amending a cost submission due to an error

the TO challenges the ESO's understanding of costs or option scope.

This is part of an iterative stage.

If the TO provides more information to the ESO, the ESO will revise its cost estimation accordingly to check if the costs are within the 25% bracket or 50% bracket as applicable. If 'yes', then the ESO sets the option costs as 'agreed' and the TO's costs are used in the economic process.

If the TO's response means that the ESO's concerns remain, the ESO reviews its concern, clarifies it and refers it back to the TO.

If after several attempts, the ESO cannot agree to the costs and explanations that the TO is providing, the ESO engineer escalates the matter within ESO management. The ESO management decides whether to include the costs for the option in question at this stage or to omit it from the economic analysis.

ESO revises its costs estimate if TO explanation requires it

The discussion between the ESO and the TO might mean that the ESO has to recalculate its estimate of the costs. The ESO notes the revised costs.

Agreement reached?

The ESO engineer conducting the process passes the 'agreed' TO costs for use in the NOA economic process.

General points

The ESO keeps the cost information for all options submitted by each TO and uses them to do consistency checks of options that the same TO submits in future years.

In general, the ESO assumes that the TO cost submissions include the development costs. There might be occasions on which the submissions do not include the development costs in which case the TO and ESO will discuss this further and decide how to proceed with the option for its economic analysis.

D

Appendix D Form of report

The Electricity System Operator (ESO) will produce the main NOA report which will be public and produce appendices where there is confidential information. The confidential appendices will contain full cost details of options and will have very limited circulation that will include Ofgem. Extracts of this report will go to the relevant Transmission Owners (TO). The main NOA report will omit commercially confidential information. We will provide Ofgem with justification for the redactions. This appendix describes the contents and chapters of the report. The ESO reserves the right to add or change chapters to better represent the NOA information.

Foreword

Contents Page

Executive Summary

The executive summary will include headline information on options listing those that meet SWW criteria.

Chapter 1: Introduction and Aim of the Report

This chapter will describe the aim of the NOA report, provide the reader with clear guidance on its relationship with the Electricity Ten Year Statement (ETYS) and give guidance on how to navigate the NOA report.

Chapter 2: Methodology description and variations

This chapter will describe the assessment methodology used at a high level and refer the reader to the NOA report Methodology statement published on National Grid ESO's public website.

The chapter will also include the definition of and commentary on Major National Electricity Transmission System Reinforcement options. We will include a description of how the ESO treats Strategic Wider Works (SWW).

We expect options to improve boundary capabilities will fall broadly into three categories:

SWW that have Ofgem approval. The NOA report will refer to these options which will be included in the baseline while presenting no analysis. The Report will justify why these options are treated as such.

Options that have SWW analysis underway. This analysis and available results will be used in the NOA report.

Options analysed using the Single Year Regret cost-benefit analysis. This analysis will appear in the NOA report.

Should any options fall outside of these three categories, the chapter will list them with an explanation as to how and why they are treated differently.

Chapter 3: Proposed Options

This chapter is to give an overview of the options that the ESO has assessed. The overview will group options by study region and by their technical type including whether it is build or reduced build. More detailed information on each option that will include status will be listed in an appendix. The chapter will include OWW options or record a nil return if there are none. It will also include a commentary on reduced-build or non-transmission ones, where applicable. The chapter will also include a short summary of the boundaries that make up the GB electricity network.

Chapter 4: Investment Recommendations

This chapter will cover the economic benefits of each option. The data will be tabulated and to support the comparison include earliest in service (EISD) and optimum delivery dates. An explanation of the regrets for the options and combinations of options where the options are critical will be included as an appendix of the report, i.e. those that need a decision to proceed (or otherwise) imminently. Chapter 4 will detail the ESO recommendation whether to proceed with each option. In some instances, there might be a recommendation to proceed with more than one option. Such an instance could be at an early stage when two options are closely ranked but there is uncertainty about key factors for example deliverability.

The chapter will indicate options that are likely to meet the competition criteria. As the competition framework is uncertain due to the necessary legislation not being passed, the chapter will highlight this. The chapter will explain how options meet competition criteria.

The chapter will finish with a summary of the options for the boundary. It will provide:

Any differences in preferred options between annual NOA reports where the ESO has carried out similar analysis in the past.

How the scenarios have different requirements and how they affect the options.

A comparative view of each option's deliverability and how it affects the choice of the preferred options.

Chapter 4 will meet the ESO obligation to produce the recommendations for the Network Development Policy for Incremental Wider Works.

Certain details will be in the appendices and that will include the cost bands for options as appropriate.

Chapter 5: NOA for Interconnectors

This section of the report will introduce the method of analysing GB's potential for interconnectors to other markets and publish the analysis.

Chapter 6: Stakeholder engagement and feedback

To help our understanding of stakeholder views, through the document we will include feedback questions. We will use this feedback to refine the NOA report process and methodology for the next report.

We have used our seminars to continue to talk with stakeholders and have received some interest. Onshore TOs have engaged with us and assisted in developing this NOA report methodology. We want to extend our engagement further and will use our NOA email circulation lists.

Glossary

E

Appendix E Summary of stakeholder feedback

This appendix summarises the views the ESO has on the comments we've received. We would like to thank the organisations for their feedback and contribution.

Area of feedback	Feedback	ESO response
This is to be filled in after the public consultation.		